The Effect of Shoe Heels on the Human Body

FIRST DRAFT

PREFACE

If you just follow the evidence wherever it goes, you can end up in a completely unexpected place. Sometimes what at first seems inconsequential leads to unimaginably important results.

So it is here. This started as an informal investigation into a single rather odd effect of the common shoe heel, a seemingly innocuous structural afterthought.

Over the years, however, the initial investigation gradually developed into a surprising story about solving an unexpected mystery. And the unexpected solution has highly unlikely consequences. It leads directly to a basic rethinking our understanding of the very structure of the human body.

If that sounds barely believable -- if not impossible -- the available evidence all points clearly in that direction. The evidence is all solid science, including hundreds of peer-reviewed articles from well-regarded medical and scientific journals.

Like any good mystery, this one begins with an important clue. Or, in this particular case, a set of two clues.

Many classic mysteries involve fresh footprints at the crime scene, but it is just plain coincidence that in this case too the first clues are footprints. However these are not fresh footprints. They have been buried since 1939 in a long forgotten medical journal report.

The report is from a Clifford James at the Melanesian Mission Hospital in the island of Malaita, next to Guadalcanal in the British Solomon Islands in the South Pacific. Although that is an unusually old and obscure source, at least the medical journal is the prestigious British journal, the *Lancet*.

Despite their age, the footprints turn out to provide both unique evidence and a specific direction in which to go to solve the mystery. The mystery itself, unlike most popular mysteries, is not about solving a crime like murder. Nor is it fiction.

It does, however, involve life and death, because it is a medical mystery, one that involves many real lives and many real deaths. So many in fact, it probably also involves you, and your own life and death. How that can possibly be will become all too apparent as the mystery is unraveled.

Starting with just the few footprint clues, solving the mystery step by step slowly uncovers a surprising medical discovery about major human anatomical deformities that somehow have remained completely hidden for centuries, until now.

So, to start, take a look at the clues. The footprints of barefeet offer a key to unlocking the mystery.

FIRST CLUE SECOND CLUE

FIGURE A **Identical** **FIGURE B** **Different** (Normal Shoe-Using **European** in yellow)

(**European** in Solid Lines, Barefoot **Native** In Dashed Lines)

THE FIRST CLUE: Different Races Have Identical Footprints

In the **first set of footprints**, **FIGURE A** **on the left below**, two separate bare footprints are superimposed on each other, the first of a barefoot Solomon Islands native[1] and the second of a European.[1] **Both had never worn shoes** (which of course makes the European a very rare laboratory specimen). The footprints are essentially identical.

FIGURE A provides extraordinarily unique evidence that race is definitely not a factor in determining the natural, inherent shape of the human foot. Both racially different feet were the same, and both never wore shoes.

Those identical footprints indicate that all human feet have the same basic shape if left to develop bare, without the influence of footwear. Foot shape is fundamentally the same for both Caucasians and Polynesians.

THE SECOND CLUE: Normal Shoe Use Creates A Different Footprint

In the **second set**, **FIGURE B** **on the right above**, another two bare footprints are superimposed on each other. Again, the first of a barefoot island native and the second of a European, but this time a different European (in yellow) who normally wore shoes. The bare footprints are very different.

FIGURE B provides what proves to be the most crucial clue. It shows starkly what will turn out to be the most important change to feet made by shoes.

That change is that the normally shoe-wearing European's bare (yellow) footprint is rolled unnaturally to the outside relative to the natural barefoot footprint. Technically, this rolled outward foot position is called **supination** (in contrast to rolling inward, which is called pronation).

FIGURE B provides strong evidence that shoes must be the cause of this difference in foot shape between races, since shoe usage is the only difference between the two footprints.

If you are a bit too inherently skeptical to accept these clues from the old **James** reference as good enough evidence to continue reading, before quitting please consider this unpublished data recently provided by Dr. Steffen **Willwacher** from his 2015 award-winning running biomechanics study.[1]

His data is that the static reference angle of ankles is **4** degrees of inversion (virtually identical to supination) for 129 males and **5** degrees of inversion for 93 females -- all middle-aged runners measured while standing in their own shoes.

So Willwacher's results generally confirm those of James regarding modern foot supination. So now let's get back to James.

The old footprints in the **James** study provided the first really definitive evidence ever found that shoes alone change the shape of the modern human foot, whereas racial differences do not.[2] (Although some earlier research does take significant steps in that direction.)

It is important to note that this overlooked simple but direct evidence from James contradicts the widespread general belief that human anatomical differences are race-based, unalterably determined by genes.

However, an even more important question remains: how do shoes change the feet? Many studies before and since have implicated shoes as the prime suspect underlying the many well-known problems of the modern foot. But none of them show how shoes do it.

So how do shoes change feet? What mechanism is involved? The footprint clues provide us with a key line of questioning to begin our investigation in earnest.

Why & How Does the Modern Foot Roll to the Outside?

We will forcus specifically on the following question: why and how exactly do shoes cause the foot to roll to the outside, to supinate. That is the critical question.

Answering it gradually leads step by step directly to unforeseen and astonishing conclusions about other significant changes in the structure and function of other parts of the human body that are caused by shoes.

The uneven trail of often fragmentary and frequently misleading evidence we must follow in solving this mystery is longer and more complicated than anything by Agatha Christie, with at least as many surprises and even more human mayhem.

When we are done, we will find ourselves mostly in uncharted territory with regard to human anatomy, oddly lost in a familiar landscape, but without the guideposts upon which we once thought that we could rely.

There really is no way to describe the uncomfortable situation that we as shoe-wearers are all now in except to say that all of us are Guinea Pigs. At least for now, we are all inadvertently trapped, involuntarily enrolled in a huge, unguided experiment that began when we took our first enfant steps in baby shoes and continues through today. This book is an attempt to find a way to escape from our trap.

Remember the Clues, Especially FIGURE B

Always keep in mind during this journey the simple evidence you have seen in **FIGURE B** above, that **shoes cause feet to roll unnaturally to the outside;** that is, to **supinate** abnormally. That clue is the primary key to unlocking the deepest parts of the mystery that is uncovered in the book that follows.

The book provides the first glimpse of the true natural shape of the human body, and a first step in grasping the full extent of its current state of unnatural deformity - caused by the most improbable of everyday objects, the common shoe.

1 INTRODUCTION

By way of introduction, I am a runner. Or more accurately, and most sadly, little more than a former runner, like most longtime runners. Relatively early on in my running career, which really began as a young adult, I began to have an assortment of overuse injuries. That set me searching for cures.

Initially I was just looking for solutions for my own persistent problems. Eventually, out of the frustration of not finding any existing running shoes or orthotics that worked for me, I ended up pioneering the first research into barefoot-based shoe sole designs.

I had discovered back in 1988 that the human barefoot has much better lateral or side-to-side stability than conventional shoe soles. My goal then was therefore to invent a new shoe sole structural design that retained that much better stability of the barefoot. The barefoot designs I developed then preserve the wider, rounded shape and flexibility of the natural human foot sole in order to prevent ankle sprains, the most common sports injury (as well as the most common cause of Emergency Room visits).

Within about three years I was awarded my first U. S. patent, and many more patents followed, including foreign patents, for new shoe sole inventions based on the barefoot. All of my now more than fifty footwear and related U. S. patents are listed on my website: www.anatomicresearch.com.

A Patent License With Adidas For Barefoot-Based Shoe Sole Technology

After three more years, in 1994 I was able to license that patented technology to Adidas, which initially called it barefootwear and almost immediately made it their core technology in all categories of footwear, except for classics, which are old models with continuing popularity. See **FIGURE 1.1.**

FIGURE 1.1 Adidas "*Feet You Wear"* shoe advertisement

Adidas began marketing the shoe sole technology as "*Feet You Wear*" using their star athlete endorsers like Kobe Bryant (before Nike) and their largest ad campaign to date. Steffi Graff used the first *Feet You Wear* tennis shoe to win the U.S. Tennis Open in 1996. See **FIGURE 1.2**.

FIGURE 1.2 Unsolicted Article on My License With Adidas and "*Feet You Wear"*

By 2003, Adidas had marketed about a hundred different models of *Feet You Wear* and similar shoes, many models in every category. However, the patent license was terminated then, at the end of several years of litigation over its terms.

Over 100 More U. S. Patents For Footwear and For Computer Architecture

Since then, I have continued to develop and patent even better barefoot-based footwear sole designs. To date I have been awarded over 100 U.S. patents, the majority in footwear sole design. These include patents for shoe soles with support structures that can be actively configured by smartphone control and by the cloud, as well as in other fields, including designs for helmets that prevent concussions and electronic medical device implants for the human body.

I have also patented a basic new computer architecture with unique internal hardware-based defenses to provide absolutely reliable cybersecurity and privacy for personal computers, smartphones, or any other computer. In contrast, all existing internal computer cyber defenses are software-based and are inherently vulnerable to Internet hacking, so the huge and ever-growing cybersecurity problem can never be fixed using them.

Reviewing Research On the Differences Between Running Barefoot and In Modern Shoes

More to the point here, I have devoted an increasing portion of my time in recent years to doing what can best be characterized as an extensive survey of academic research into the biomechanical differences between footwear and bare feet, particularly during locomotion, and especially when running.

I have focused specifically in the fields of footwear biomechanics and human anatomy, both structural and functional, as well as related medical fields like orthopedics and podiatry, covering both injury and disease, and physical anthropology, and even a little of the chiropractic science, as well as some other wellness approaches, like Pilates, Rolfing, and yoga.

Over the years I have sorted through thousands of academic research papers from as far back as the late 19th Century up to the latest research of today. I have selected over a thousand research papers of particular relevance to my project and have completed the laborious process of analyzing them in depth. I have also gone through over a hundred textbooks and other reference books in the above noted fields, and even resorted occasionally to Wikipedia.

Most of these research papers and books were based on formal laboratory testing or field studies, which are generally difficult and time-consuming to complete rigorously. Personally, I do not have a laboratory with the necessary specialized equipment or lab expertise or staff. Other than some informal real world testing and some rather unique tests involving photographic analysis, both on myself and a few others, some of which yielded significant results, I did not conduct any formal laboratory or field research.

Instead, I have worked for years to connect the dots among many research results that had already been created in an almost totally uncoordinated and unsynthesized way in many different specialized fields over the past 150 years. In a general way, I have been struggling with a giant jigsaw puzzle with thousands of pieces, none of which came conveniently together in a box with a picture of the finished puzzle. Unfortunately, I had no such finished picture and most of the pieces I had to sort through did not fit into the puzzle. In modern research terms, what I was doing included a kind of metadata approach.

Surprising Research Results Develop Into Surprising Conclusions

I don't mean to make that would sound like it might have been a nearly impossible task, because at the very start I found some great clues, including the footprints in the Preface, with some surprising evidence that provided both important guidance and strong incentive to proceed. That evidence indicated rather strongly that common, everyday shoe soles, which must generally be considered to be pretty innocuous, have actually altered the structure of important parts of the human anatomy in ways that were heretofore unknown.

As I got much very deeply into the research in the past several years, I gradually became much more deeply surprised at what I was finding by just following the available evidence wherever it led. Astonished might be more accurate.

Background on Injuries and the Basic Design of Existing Running Shoes

At the same time that I was working on personally designing the first barefoot-based shoe sole inventions in 1988, I was also looking for whatever related formal research I could find. I happened to come across a very interesting column on his early experience running barefoot and in minimalist racing shoes by the then Editor of ***Runners World***, Joe Henderson In it he referenced a study by a Canadian researcher and physician, Dr. Steven Robbins. Dr. Robbins and a colleague had published a study that surveyed the available literature on the injury history of primitive, barefoot populations[1].

What Dr. Robbins found was that those barefoot populations representing many different racial groupings had far fewer overuse injuries than were typical of modern shoe-wearing populations. Even more attention-grabbing was that this was far fewer injuries despite far higher activity levels on a routine basis, often including what would be called back-breaking work in the modern world.

A little later, in 1989 I came across an injury study by Dr. Bernard Marti, a Swiss physician, who had conducted a survey of over 4,000 runners[2]. Runners typically have many injury problems. It is a big problem. Up to as many as 70% a year get injured from running.

Dr. Marti could find only one variable that correlated with injury, a highly embarassing one: the price of the running shoes. The more expensive the shoe, the greater was the probability of injury. In other words, the more technology the footwear industry had put into their shoes, the more likely they would cause injuries.

It was hard not to conclude from these studies that the designers of modern shoe sole must not have a very good idea of what they are doing. Overall, the fundamental structural design of most modern athletic shoes is roughly the same, and essentially not much changed today from the 1980's. With minor variations, the shoe designers just use the same existing basic design. Then they add whatever new material or neat new cushioning or structural "improvement" that the designers can think up and use it on the convenient theory, I guess, that it has to be good since it is new and different.

Unfortunately, it is difficult not to conclude that most of the "improvements" are just artificial gimmicks that all too often backfire by causing unnecessary and unforeseen problems because their only real use anyway is for marketing, not actual performance. (And of course a substantial portion of their profits come from selling classic shoes from the past, without change or presumed improvement.)

Generally, that seems to be what Dr. Marti found in 1989. In 2015, Jens Jacob Andersen, founder of a Danish Web site called Runrepeat.com, compiled nearly 135,000 consumer reviews and found a similar result: in general, the more expensive the running shoe, the lower the consumer rating.

It stands to reason that if there were any firm rational basis for what they do, the major shoe companies would not be marketing several completely different sole cushioning technologies at the same time within the same company, as most of them now currently do. Presumably, if they actually knew what they were doing, they would just market the best technology they had (and tell you why, with scientific proof to back it up).

And I'm just talking about the shoe designers who are actually trying to improve cushioning performance or some other functional feature of the shoe. The actual products seem to suggest that the primary focus is just trying to come up with a cool overall design look, as well as neat color and pattern combinations. The reality is that virtually all shoe designers come out of an art school background, not science or engineering. Their only real expertise is in making shoes look attractive enough that customers will buy them.

Modern Shoe Designs Have Absolutely No Scientifically Proven Benefit

Both of the earlier studies reinforced the conclusion that I had already reached in 1988: that my barefoot-based shoe sole designs was definitely a new and better approach because they are scientifically based on the natural structure and function of the bare human foot sole.

Further reinforcement came in 2004, shortly after my patent license with Adidas ended. Professors Dennis Bramble and Daniel Lieberman published a widely reported study in the prestigious scientific journal ***Nature*** that evolution had created a human body that was fundamentally designed to run[3].

They presented compelling evidence that humans were the best endurance runners in the animal kingdom. Humans excel at "persistence hunting" in which they successfully run down far faster antelopes and other game in long hunts over relatively great distances. Such persistent hunters succeeded by being efficient runners that did not overheat like their prey did. And those hunters clearly did not evolve to do this over hundreds of thousands of years while wearing modern running shoes with elevated heels.

In addition, Dr. Craig Richards authored in 2008 what I think is the most important formal research paper ever published on the design of modern running shoes[4]. Simply put, his paper makes unequivocally clear that there is no existing scientific evidence whatsoever supporting any of the supposed benefits for using modern running shoes and their many technologies. He even challenged major footwear companies to provide supporting evidence. They have not, apparently because there is none. Nor has any such evidence been published independently.

"*Born To Run*" Book Popularizes Barefoot Running and Minimalist Shoe Design

In 2009, Christopher McDougall's blockbuster, best-selling book, ***Born to Run***, was published. A brilliant book, you should read it if you have not done so already. It publicized the work of the researchers mentioned above[5] and much more. It radically changed the landscape for runners and for running shoe design. Almost overnight, many runners became barefoot runners.

In addition, many "barefoot" and "minimalist" shoes became available soon thereafter[6]. For example, the Vibram Five Fingers, a previously existing super-minimalist shoe that was originally designed for water sports. It was drafted for use by new barefoot runners who wanted some immediate protection from asphalt, but the least possible. Many different designs followed, but with no definition of what exactly constituted a "barefoot" or "minimalist" shoe.[7]

The impact of the barefoot running revolution, which was sort of a popular uprising against conventional footwear, stirred a reaction in the footwear science community that had been growing for over a decade. One of its leaders and pioneers, Benno Nigg, observed that they had been barking up the wrong tree for the last 30 or so years[8]. Groupthink had resulted too readily in too easily accepted dogma that produced increasing complex but similar footwear without proven benefit.

By 2011 another leader and pioneer, E.C. Frederick, the Editor-In-Chief of ***Footwear Science***, concluded in an Editorial titled "Starting Over" that

> The fact that we can't answer many really fundamental questions about the functional benefits of shoes, not to mention their potential detrimental properties, ought to be humbling if not humiliating. Instead of responding with emotionally charged polemics … it's an opportunity, if not a clarion call, to start over.[9]

But despite this, just a few years later the barefoot running revolution that had started in 2009 definitely stalled out. Lots of barefoot runners have had injury problems and sales of barefoot-like and minimalist running shoes are way down from their peak a few years ago.[10 & 11]

It could even be said that a counter revolution has begun in the form of maximalist running shoes by Hoka One One and their many copycats. Most of the major shoe companies never really changed their basic running shoe design, although most added some minimalist and maximalist designs, probably just to meet that particular customer demand.

Unfortunately, the only thing that is evident now is that we are at an impasse as to where to go in shoe design. Why isn't running barefoot a simple and reliable way to avoid overuse injuries? Why don't barefoot-like or minimalist running shoes work either?

Why Don't Barefoot-like Shoes or Minimalist Running Shoes Solve the Injury Problem?

The second question is the easiest to answer. None of the barefoot-like or minimalist running shoes currently available that I am aware of are based on a firm scientific understanding of the anatomy and barefoot function of the human foot. More specifically, none are structurally configured so that they interact with the ground in the same way as does a barefoot sole during walking or running or playing in sports.

All of them change the natural biomechanical function of the human foot in fundamental ways. None are structurally or functionally neutral. All interfere with nature. The elevated shoe heel mentioned earlier is just one example of an unnatural feature, the most important one, but there are other ones of significance as well.

Frankly, I am very sure at this point that I am the only shoe sole designer who has approached the problem of creating a “barefoot” shoe rigorously based on the best science available to me. Also, I have rigorously and humbly put nature first, above all other considerations, to let nature be in fact the ultimate designer without unnatural interference.

In that regard I should point out at this time that I never had any shoe design role whatsoever in my license with Adidas. My license with Adidas was strictly limited to patents only.

As is customary, when my litigation with Adidas was settled in 2003, the proceedings were made confidential, so I cannot disclose what went on relative to our relationship. I can say however that personally I was not at all satisfied with the “Feet You Wear” models that Adidas designed and marketed.

Why Doesn’t Simply Running Barefoot Solve the Problem?

The more difficult of the two questions initially posed above is, why isn't simply running barefoot a solution to problem caused by existing conventional running shoes? The answer to that is not good. Nearly all of this book will deal in considerable detail with what that answer is and specifically why it is not good.

For starters, as previously noted in the Preface, your body has already been structurally altered by the shoes with elevated heels that you most likely have worn most of your life. Simply put, the structure of your feet, ankles, legs, and the rest of your body are no longer designed to run barefoot. Your bones and the joints that link them together no longer have their correct natural shape. The range of modern individual variation in bone and joint variation is abnormally substantial, so your own particular body might personally be in a pretty good, natural shape or in pretty bad, unnatural shape compared to that of others.

But the answer is even worse than that. There are substantial grounds for concluding that the transition (especially any abrupt transition) between barefoot and shod running is an important basic injury mechanism for many or perhaps most runners. Even running at different times with shoes having significantly different heel heights may produce approximately the same basic injury mechanism, one that you have probably already inadvertently triggered countless times in your life before now without being aware of it.

There Can Be No Real Solutions Until We Understand the Real Problem

So, we are currently at a major impasse. You don't really have the option of going barefoot since your body is no longer structurally adapted for that, nor are there any good footwear alternatives available in the footwear market now that solve the problems created by existing footwear.

At this stage, all any of us can do it to try to fully understand the exact cause of this problem and trace it as best we can to the specific anatomical and functional effects that we can identify. Then, using that information, we need to explore realistically what solutions are available to each of us. That is what this book attempts to do.

The Innocuous Shoe Sole Has Altered the Structure of the Human Body In Many Ways

My key finding is that the innocuous shoe sole has had what can only be called a widespread effect on the structure and function of the human body, altering many parts of it. That widespread effect is quite perverse in the sense that it is incredibly subtle, sufficiently so to have escaped notice before now.

I fully appreciate that it must be difficult to believe that at this point. However, you need to recognize a vastly under appreciated fact about shoe soles. The soles of shoes are the absolutely essential foundation upon which your body has been built over the course of your entire lifetime. And it is well known in architecture that any building is only as strong as its foundation.

A fundamental insight I have based my research on is that any feature of a shoe sole that is structurally unnatural is automatically suspect as potentially an important weakness in the critically important foundation that the shoe sole provides the body. Any unnatural structural feature therefore should be considered guilty until proven innocent.

While this is in itself an obvious research bias, I believe it is entirely appropriate in this case. That is because it is essential to counterbalance the historical bias of the footwear industry, which goes very far in the other direction. I believe it is fair to say that the footwear industry has always presumed that any shoe sole structural design it chooses to manufacture and market is okay unless proven defective in some pretty obvious way in simple standard testing. That fundamental bias is supported by the fact that the design of footwear products is largely unregulated in any practical sense.

The only consumer protection regulation that I am aware of is that, in the U. S., the Federal Trade Commission prohibits the general marketing of footwear with any claims that it is “corrective”. In the 1930's, there was extensive marketing abuse of that particular term leading to its ban. Other than not using the word “corrective” in advertising, pretty much anything else is allowed.

The Most Unnatural Feature of Modern Shoes: Elevated Shoe Heels

Anyway, as is obvious to anyone, including many of the researchers of the more recent studies I have reviewed, the common shoe sole has a “highly” significant structural feature that the human foot does not: an elevated heel on the shoe sole. The elevated heel can be either separate and distinct from the shoe sole, or integrated into the sole as a wedge, as is common in athletic shoes. If the typical shoe sole were as natural as the ground with which your bare foot sole normally interacts, the forefoot area of the shoe sole would be at the same level as the heel area.

That is to say, essentially flat. Otherwise, you would be, everyday and forever, standing, walking or running downhill. That is of course impossible to do barefoot. However, you do it everyday, all day long, in nearly all conventional footwear.

So we all know elevated heels are not natural. That much is fairly clearcut. But what specifically is their structural effect on your body? While a number of researchers have discovered adverse effects strongly correlated on a statistical basis with, for example, high heel shoes for women, no actual cause for the associated adverse effects has yet been identified and proven.

PART I - The Cause: The Unnatural Structure of Elevated Shoe Heels

2 ELEVATED SHOE HEELS AUTOMATICALLY TILT THE FOOT & ROTATE THE ANKLE JOINT - BOTH TO THE OUTSIDE

Prior to reading this chapter, please keep in mind the simple evidence you have seen in **FIGURE B** above, that **shoes cause feet to roll unnaturally to the outside;** that is, to **supinate** abnormally. That clue is the key to understanding everything that is revealed in this chapter.

The lower leg bone is the shinbone (the tibia). The shinbone is joined to the ankle bone (the talus) of the foot to form the ankle joint. The ankle joint is a fairly simple joint that works like a hinge. It has an easy to understand structure and function.

So too, putting an elevated shoe heel under a heel of a human who is standing upright and stationary causes a fairly simple and automatic direct reaction by that human. In order to maintain balance in the same upright stance, the leg is unconsciously and automatically straightened from the slightly bent knee position the higher heel causes. The shinbone automatically moves backwards in an amount equal to the amount by which the elevated shoe heel tilts the foot downward. (Otherwise, unbalanced, you fall forward onto your face.)

In other words, if the elevated shoe heel raises the foot heel and tilts the foot downward by 10 degrees, then the shin bone must move backwards on the ankle joint by 10 degrees. This adjustment maintains the same upright, straight leg standing position. It is a simple and automatic compensation. The ankle joint is then in what is called a plantarflexed position. See **FIGURE 2.1** below.

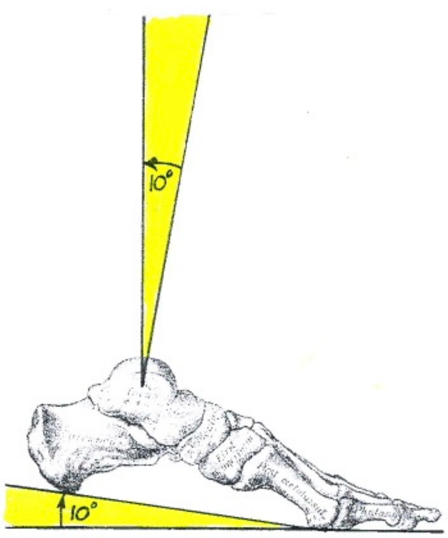


FIGURE 2.1

There is nothing complicated in this automatic, self-adjusting reaction to the elevated shoe heel taking place in the ankle joint. This is very well understood by anyone who has ever bothered to analyze this very simple and automatic joint compensation motion.

Nothing more appears to happen. And if that were in fact all that happened, we would be done now, end of story. But it turns out that much more is going on when the heel is raised, even though it is anything but obvious.

Shoe Heels Critically Affect the Subtalar Joint That Is Located Directly Under the Ankle Joint

That is because directly underneath the main ankle joint (shown highlighted in yellow in **FIGURE 2.2A**) is yet another ankle joint, the subtalar joint (shown highlighted in yellow in **FIGURE 2.2B**). It is located between the ankle bone and the heel bone (the calcaneus). As you can see by comparison, the subtalar joint has a much more complicated structure and function than the ankle joint.

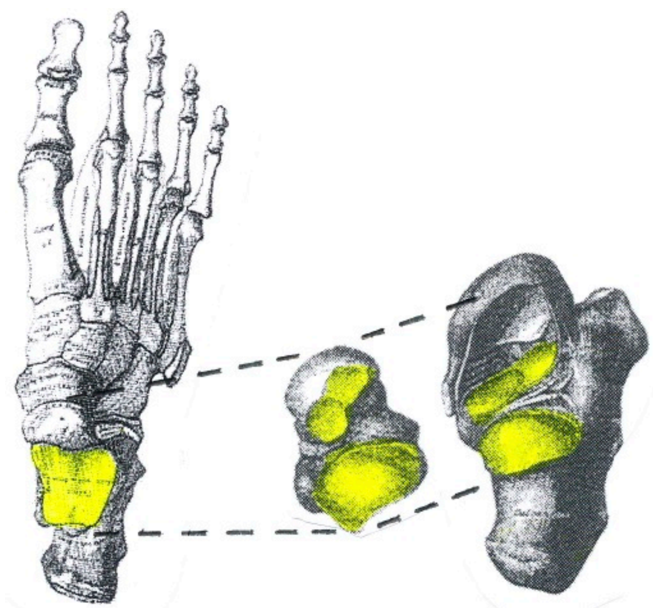


FIGURE 2.2A **Ankle Joint*** **FIGURE 2.2B** **Subtalar Joint** (Top of Heel Bone and Bottom of Ankle Bone) *Top of Ankle Bone (Joint Surfaces in Yellow)

The subtalar joint also is affected directly by the elevated shoe heel. However, it is affected in a much different way than the ankle joint because of its dissimilar structure and function. It doesn't need to be the like the ankle joint because the ankle joint already provides the basic hinge joint that is necessary to allow the shin bone to move forwards and backwards over the foot (back and forth motion in what is called the sagittal plane).

The principle function of the subtalar joint is to provide sideways, left to right motion of the foot on the ground (sideways motion in what is called the frontal plane). This side-to-side motion capability is essential so that the foot can adjust to irregularities in the ground surface during locomotion. Conceptually, that's pretty straightforward too.

But the subtalar joint is also an even more essential component of a locomotion system that controls the rigidity of the foot. This rigidity control is critical so that the foot is capable of fulfilling two essential but entirely different functions while walking or running.

The Subtalar Joint Enables the Foot to Be Either Rigid or Flexible As Needed

During the first half of the stance phase after landing, the foot must be flexible so as to absorb the shock of a ground reaction force produced by our full body weight when we land. During the second half of the stance phase, the foot must be rigid to function as a propulsive lever to push off the ground.

The subtalar joint performs this dual and contradictory role by enabling what is mostly a slight sideways rolling motion of the foot on the ground. The foot's sideways rolling motion is called pronation when rolling to the inside to absorb landing shock through greater flexibility. During pronation, the main longitudinal arch of the foot depresses toward the ground, and the heel bone tilts inward from a neutral, generally vertical position.

The foot's slight sideways rolling motion is called supination when rolling to the outside to create a more rigid propulsive lever in a plantarflexed position. During supination, the main arch is raised and the heel bone tilts outward from the neutral, vertical position as the heel is raised prior to the toe-off phase of propulsion.

This rigid propulsive lever is unique to the human foot. Our closest living non-human relatives, the chimpanzees, do not have it[1].

The Effect of Elevated Shoe Heels On the Subtalar Joint Has Not Been Well Understood Before Now

The subtalar joint's role in pronation and supination motion is well understood. But in stark contrast, the subtalar joint's reaction to the presence of an elevated shoe heel has been little noticed, much less its importance understood. What has somehow been overlooked almost entirely is that the elevated shoe heel also automatically causes the subtalar joint to roll the foot slightly to the outside in supination.

As a result of the shoe heel-induced supination motion, the heel bone is artificially tilted out and the foot becomes more rigid. This is an absolutely crucial change. When standing upright, the foot is no longer in a natural, neutral position.

If the height of the elevated shoe heel is moderate, then the associated supination is also moderate. If the elevated shoe heel is greater, then the amount of supination will also be greater.

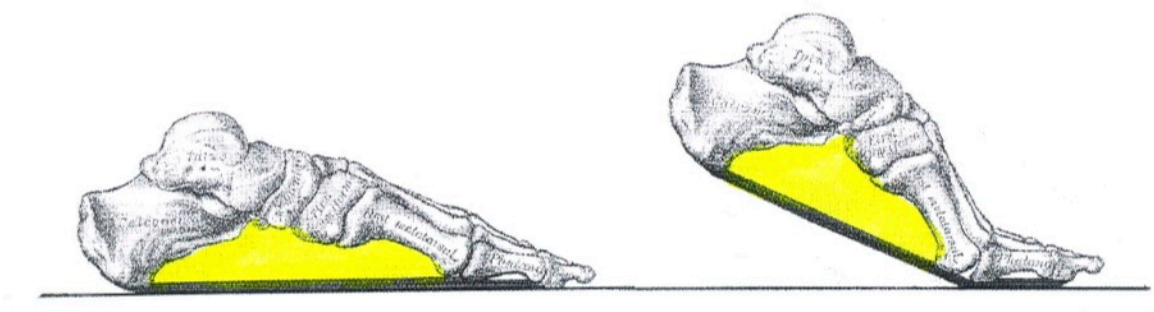
This supination adjustment of the foot to an elevated shoe heel is automatic, strictly a direct function of human foot anatomy and biomechanics. It occurs for two reasons primarily.

Elevated Shoe Heels Automatically Shift the Position of the Subtalar Joint

First, a powerful ligament called the plantar aponeurosis (located on the bottom of your foot sole) connects your heel bone to your toes. When the foot is level on the ground, the plantar aponeurosis is relatively loose, so the foot is flexible and most capable of conforming to any irregularities of the ground, in order to provide a stable base of support for the leg. See below **FIGURE 2.3 A**.

When the heel bone is raised during the propulsive phase of running or walking, it automatically bends your toes upward toward you. That mechanism automatically tightens the plantar aponeurosis so that it acts mechanically like a windlass that forces the foot into a supinated position with both a higher, more rigid arch and a tilted out the heel bone. This creates a rigid propulsive lever with which to push off. See below **FIGURE 2.3 B**.[2]

The elevated shoe heel artificially puts the foot into this position all the time, not just during the toe-off propulsive phase of running or walking.



FIGURES 2.3 A Supporting Foot Flexible **FIGURES 2.3 B** Propulsive Foot Rigid

Second, a midtarsal joint connects the heel and ankle bones with the middle part of the foot (called the midtarsal of the foot). The windlass action of the plantar aponeurosis acts as a locking mechanism for the midtarsal joint.

When the foot is automatically plantarflexed by the elevated shoe heel, the foot is supinated by the windlass action and the midtarsal joint is gradually locked into an ever more rigid supinated position, away from a pronated position. In this way, the human foot becomes a uniquely rigid propulsive lever.

FIGURE 2.4, which shows a front view of the ankle bone (the talus, in yellow) and heel bone (the calcaneus), which are joined together by the subtalar joint. **FIGURE 2.4** shows how the subtalar joint operates. The ankle bone rotates on top of the heel bone – tilted inward in pronation and tilted outward in SUPINATION.

FIGURE 2.4 PRONATED Rotated Inward SUPINATED Talus Rotated Outward

The windlass mechanism is the principal way the position of the subtalar joint is synchronized with the position of the ankle joint.

In the SUPINATED position on the right, the axis of each of the joints connecting the front of the ankle and heel bones to the rest of the foot are crossed, locking the joints to make the foot rigid for propulsion. In pronation, they are parallel, unlocking the subtalar joint. The windlass mechanism is the principal way the position of the subtalar joint is synchronized with the position of the ankle joint.

Both the windlass action of the plantar aponeurosis and the locking role of the midtarsal joint have been very well known in the associated fields of anatomy and biomechanics for many decades, as is their mutual interaction with the subtalar joint to form an effective part of the human locomotion system. It is definitively settled science and has not been challenged (although there is a "de-coupling" effect during running, which will be discussed in detail shortly).

What has escaped notice is the critical role that the elevated shoe heel plays in triggering their artificial activation as a system to automatically move the foot into an unnatural, supinated position, away from its natural neutral position. The profoundly unnatural effect of that change has gone virtually unnoticed.

This is an extremely subtle change, perversely so. It is so non-obvious that unless you already know to look for it, it is likely you will not see it. And if you don't know it is there, it is easy to miss the abnormal effects it causes, and therefore logically but incorrectly accept those effects as natural and normal.

But you already know those effects are unnatural from the simple evidence you saw at the beginning in **FIGURE B** above, that **shoes cause feet to roll unnaturally to the outside;** that is, to **supinate** abnormally. The James study cited in the **Preface** is the first study to make clear this abnormal rotation.

Research Studies Have Experimentally Confirmed the Twisting Effect of Elevated Shoe Heels on Ankle Joints and Foot

A relatively recent study in 2012 by Danielle **Barkema**, Timothy Derrick, and Philip Martin experimentally confirmed the existence of this artificial supination effect of shoe heels on the ankle joints and foot. Specifically, in an experiment with 15 women, they found that

> **As heel height increased** for both fixed and preferred [walking] speeds, rearfoot angle became more positive throughout stance, i.e. the center of the ankle joint shifted laterally relative to the heel point of contact, which contributes to **an inversion-biased ankle orientation** (Fig. 4)[4].

Another walking study, also in 2012, by Alicia **Foster**, Mark Blanchette, Yi-Chen Chou, and Christopher Powers indicated an increase from low heels (1.3 cm or ½ inch) to high heels (9.5 cm or 3½ inches) coincides with a peak ankle inversion angle increase from 3 degrees to 9 degrees.[5] The high heels take the foot to near maximum supination, since less than 8 degrees has been reported to be about the maximum passive range of motion for inversion.

In an earlier study with 37 women in 2000, Makiko **Kouchi** and Emiko Tsutsumi also found that as the height of a shoe heel increases, the foot supinates, as did a study with 13 women in the same year by Darren **Stefanyshyn** and others.[6]

In addition, a study in 2002 by Timothy **Derrick**, Darrin Dereu, and Scott McLean indicated that foot becomes more inverted at impact at the end of an exhaustive run in conventional running shoes, demonstrating a direct cause and increasing effect, even in a relatively short period of time.[7]

As shown previously on the right in **FIGURE 2.4**, the supinated position of the foot caused by an elevated shoe heel causes the ankle bone to rotate externally to the outside (and typically the foot too, as discussed later), which is also shown in a top view in **FIGURE 2.5B,** below on the right.

This is a critically significant and abnormal change, because the upper surface (the trochlear) of the ankle joint shown in **FIGURE 2.5B** is no longer pointed straight ahead, in the direction of forward locomotion in walking or running like the foot. The natural position of the foot and ankle without shoe heel is shown below on the left in **FIGURE 2.5A**.

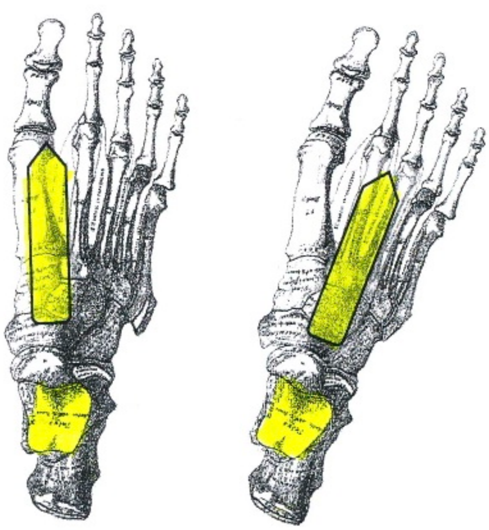


FIGURE 2.5A Flat FIGURE 2.5B SUPINATION: Twisted Out Ankle Joint (& Foot)

Instead, because the ankle joint is rotated externally, it guides the leg unnaturally to the outside, not in the direction of forward locomotion.

This is a basic structural alignment problem in the literal sense at the lowest, most fundamental level. There is only a single way to compensate for the alignment problem. That way is to realign the leg in a more correctly forward direction by rotating inward the subtalar joint in pronation, everting the ankle. That is, rotating inward, away from the shoe-heel induced outward rotation of supination and ankle inversion.

Negative Heels Have the Opposite Effect, Tilting the Foot Inwardly &

Rotating the Ankle Joint to the Inside

Like the classic "Earth Shoe" of the 1960's and 70's, there are some "negative heel" shoe soles that have the opposite effect from that of elevated shoe soles. Instead of tilting the foot outward, negative heel shoe soles tilt the foot inward, in a manner that is roughly the reciprocal of the tilting out mechanism discussed above. Similarly, walking or running uphill or up an inclined treadmill has the same effect, the opposite of elevated shoe heels.[8]

With An Outwardly Twisted Subtalar Joint, the Stage is Set for Real Trouble During Running

Elevated shoe heels artificially force the subtalar ankle joint into an unnatural, outwardly twisted position. This causes a major structural problem for the human body when running, as we shall see in the next chapter when we analyze the effect of elevated shoe heels on the lower leg and knee during running. The **Willwacher** Nike Award-winning study includes firm data that provides additional conclusive proof of this unnatural foot supination caused by shoe heels.

Note: for more information on the key windlass mechanism of the foot see this **YouTube** video: https://www.youtube.com/watch annotation_id=annotation_832449729&feature=iv&src_vid=L3s7z8DXVwo&v=vzTdSXgTCsY, which is titled "What is The Windlass Mechanism of The Foot? [Ep9]" by James Dunne.

In addition, for more information on the ankle joint see this **YouTube** video: https://www.youtube.com/watch?v=4hCS1O2LP_c&index=7&list=PLdFi-NEDU0HcJLwxK7Jn4kbvx-BUEDwPb, which is titled "Ankle Anatomy Animated Tutorial" by Randale Sechrest, MD

PART II - The Abnormal Effects on the Modern Human Body

3 SHOE HEELS ALSO TILT AND ROTATE THE LOWER LEG OUTWARD, ABNORMALLY RESHAPING THE KNEE

The reality is that the human body, even at rest, is hugely complicated and infinitely variable. Therefore, it is extraordinarily difficult and time consuming to measure and analyze it accurately. It is much more difficult still to measure and analyze it when in locomotion, even when walking. And it is far more difficult to do when running.

So much more difficult that almost all studies of the human body in motion have been when walking. Only since the 1970's have any rigorous biomechanical studies of running been completed (other than photographic studies).

Many more have been completed in recent decades as the technology has improved enough to lessen the degree of difficulty from nearly impossible (and very limited) to very hard and time-consuming but more comprehensive.

However, the basic reality is that the human body in motion is unbelievably complex. Super slow motion video of even a single part of the human body in motion makes this point emphatically. This inherent massive biological complexity has created diabolically effective camouflage for the single most substantial and direct effect caused by elevated shoe heels.

That is because the adverse effect of shoe heels is maximized when you run.

The key effect is that the shoe heel induced supination rotates the front of the ankle bone or talus to the outside, as already shown in **FIGURE 2.4** above. Supination motion by itself is an inherent feature of the subtalar joint and has been known for a long time, exclusive of its interaction with shoe heels.

Any supination motion like that caused by the elevated shoe heel automatically rotates the lower leg (or tibia) to the outside, as demonstrated in a classic study by Gustav **Rubin**[1]. This automatic motion is shown in **FIGURE 3.1A** from his classic study.

FIGURE 3.1A Supination of Foot Rotates Tibia to Outside

Elevated Shoe Heels Artificially Shift the Subtalar Joint Laterally, Rotating the Ankle Joint to the Outside

The fact that elevated shoe heels unnaturally cause that supination has been known to a few researchers who noticed the linkage but not its implications, as noted in the last chapter. That abnormal supination means the upper ankle joint surface (the talar trochlea) of the ankle bone, which articulates with the bottom of the shin bone (tibia), is pointed in a direction that unnaturally veers off to the outside, not straight ahead.

If the ankle bone (tibia) were in its normal, neutral position, your knee would move directly forward over the talar trochlea, as shown below on the left in **FIGURE 3.1B**. This is sort of like over railroad train tracks pointed straight ahead, when you flexed your knee to absorb the force of your full body weight when walking or running.

Instead, when shoe heels artificially point your ankle bone abnormally to the outside, your talar trochlea unnaturally redirects your knee, twisting it to the outside, as shown below on the right in **FIGURE 3.1B**.

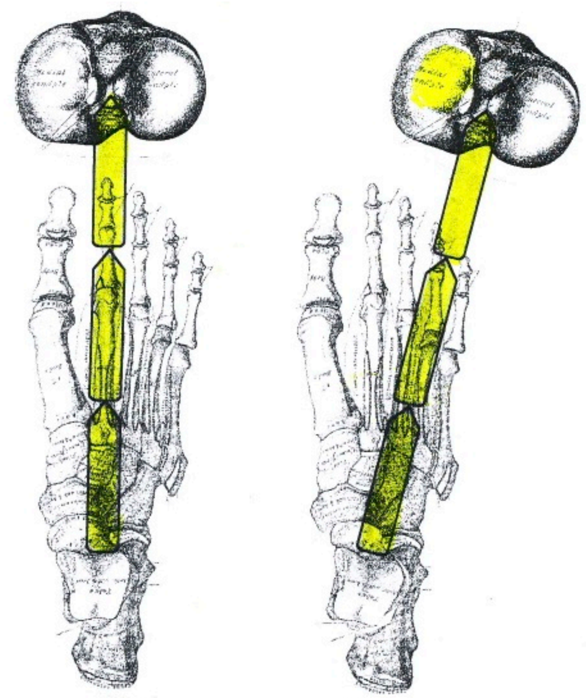


FIGURE 3.1A No Heel **FIGURE 3.1B** Shoe Heel: Knee Tilted Out By Supinated Foot

Fully Flexed Knee is Automatically Tilted-Out Into an Artificially Bow-Legged Position When You Run In Modern Shoes With Elevated Heels

The result of this shoe heel-induced redirection of your knees is that they are tilted outward (canted out), from straight-legged into a bow-legged position when you run, as shown in **FIGURE 3.1C**. The more you flex your knees in the loadbearing stance phase of running, the farther to the outside your knee is also bent unnaturally to the outside.

Runners' legs are forced into an inherently unstable, tilted-out position. **FIGURE 3.1C** below shows a front prospective view of a tilted out runner's leg of **FIGURES 3.1B** above, with the resulting 2-3 times body weight of the runner being angled from vertical, following the support structure provided by the lower leg bone. Whereas the leg otherwise would be stable if substantially vertical, it is unavoidably unstable in the tilted out position.

In the terms of simple classical physics, this angled vector of body weight resolves into a vertical component vector and a horizontal component vector, as shown below in **FIGURE 3.1D**. The horizontal component is the key factor, since it unnaturally forces the subtalar joint inward, causing the foot to pronate.

FIGURE 3.1C FIGURE 3.1D

A natural, vertical leg is inherently in equilibrium, with the downward body weight force balanced by a matching upward ground reaction force. In contrast, the unnatural shoe heel sets up a fundamental structural instability shown above in **FIGURE 3.1C&D**.

Summing up, as shown above in FIGURES 3.1 B&C, the shoe heel forces the knee to tilt unnaturally outward in the frontal plane and rotate externally in the horizontal plane.

Simultaneously the ankle is unnaturally forced inward by the unstable force vectors resulting from the tilted lower leg, as shown in FIGURE 3.1C, resulting in unnatural pronation. This dual interaction is strictly mechanical. It is automatic and unavoidable.

Shoe Heels Artificially De-Couple Natural Joint Motions

A few months ago I sent a copy of the first draft of the full book version of this article to E. C. "Ned" Frederick, Ph.D., for a preliminary review. Dr. Frederick has for many decades been one of the best-known scientists in the field of footwear biomechanics and is the former head (actually the first) of R&D at **Nike** and currently the Editor (also the first) of **Footwear Science**. He also played a significant role in helping to license my barefoot-based shoe sole technology to **Adidas** in the 1990's, where it became **Adidas'** core footwear technology for many years (See www.AnatomicResearch.com.)

Ned was kind enough to quickly put together a brief analysis of my relatively long and complex book (which includes over 50 pages of Endnotes). I believe the most significant concern he raised in it is as follows. Although the static lower leg bio-mechanisms described above in **FIGURES 2.3A&B, 2.4, & 3.1B&C** are settled science, many studies in recent years indicate clearly that the static mechanisms are "**de-coupled**" when running.

That is to say, joint linkages measured when stationary may be assumed to be rigid but become flexible under dynamic conditions. That could be interpreted as generally meaning that the known static bio-mechanisms have less effect in a dynamic situation, sometimes much less.

If so, then all the effects of shoe heels that I was describing in this article were also de-coupled when running, and perhaps were therefore less or much less significant. So that is potentially a big issue, given the central importance of running to my analysis.

I was already aware of many of these studies, but had not specifically addressed the issue in my draft book. However, in the course of my research I had interpreted the known running de-coupling effect to support the opposite conclusion, but had not formally presented my position. My personal thanks to Ned for taking the time to raise this important but unresolved issue so it can be directly addressed in a focused way.

My opposing conclusion is that, during running, the shoe heel itself -- as the automatic bio-mechanism described above in **FIGURES 3.1B&C** -- actually causes the observed **de-coupling** of the lower leg bio-mechanisms. Simply put, shoes heels cause the abnormal de-coupling, thereby disrupting the otherwise natural direct joint linkages.

Those bio-mechanisms include the normal, well-proven internal/external rotation motion of the tibia in the horizontal plane and eversion/inversion of the foot in the frontal plane that would otherwise be expected from stationary testing, as shown above by Rubin.

So, in reaction to the issue constructively raised by Ned, I set out to find more compelling research support for my opposite conclusion. Fortunately, I found it almost immediately in the latest issue of ***Footwear Science***.

Specifically, I found it in data from a study by Steffen **Willwacher**, Irena Goetze, Katina Mira Fischer and Gert-Peter Bruggemann. The study is titled "The free moment in running and its relation to joint loading and injury risk," in ***Footwear Science*** (2016), Vol. 8, No. 1, pages 1-11 particularly pages **4-9** and **Figures 4-6**.

The study is outstanding, the winner of the **Nike Award for Athletic Footwear Research**, the highest award presented at the **XIIth Footwear Biomechanics Symposium** in Liverpool, UK 2015**.**

What I found was that with some formal analysis the actual existence of the artificial de-coupling physically caused by shoe heel bio-mechanism can be proven mathematically using the unusually large data set from the **Willwacher** study**.** The proof is surprisingly solid.

Simple Mathematical Proof that Shoe Heel-Induced Foot Supination Causes Joint De-Coupling

The **Rubin** study[1] shown above in FIGURE 3.1A found in static testing that for every 1 degree of supination, the tibia is rotated outward (or externally) by about 1.7 degrees, a ratio of **1:1.7**. This is an inherent, automatic linkage that happens strictly by the mechanical interaction of biological parts, principally the shin bone, the ankle bone, and the heel bone, as well as the main foot sole ligament (technically, the tibia, talus, and calcaneus, as well as plantar aponeurosis).

More precisely, this **direct coupling** between shoe heel-induced subtalar joint supination and tibial outward rotation is strictly bio-mechanical. It is therefore just as inevitable as if it were a direct mechanical interaction of non-biological gears. It is automatic!

It is in fact the closest biological equivalent of a strictly mechanical interaction between parts. But, like the automatic mechanical interaction of a large multitude of relatively simple geometric parts of a clock, this is an automatic interaction of a much more limited number of human bone parts, all with far more complex, non-geometric anthropomorphic shapes.

The Ankle Angle Frontal Plane graph of Figure 6 of the **Willwacher** award-winning study shows ankle eversion (effectively identical to supination) of about **11** degrees for the average of all **222** runners under a maximum body weight load at midstance while wearing their own mostly conventional running shoes.

According to the Rubin study ratio of **1:1.7**, the **11** degrees of inward rotating **ankle** eversion should be directly coupled with fully **18** degrees of internal rotation of the tibia (and knee joint). Instead, in the Knee Angle Transverse Plane graph of Figure 6 of the Willwacher award winning-study, there is only **8** degrees of internal rotation of the **tibia (and knee joint)**, fully **10** degrees less that should be there according to Rubin's ratio.

The Mysterious Missing 10 degrees of Inward Tibial Rotation

This is an important mystery. Why is the 10 degrees missing? Less than half as much inward tibial rotation occurs in Willwacher's testing when running in shoes compared to Rubin's static testing of barefeet.

The only available explanation is the outward rotation of unnatural supination caused by shoe heels! Unnatural shoe heels must cause the abnormal joint motion de-coupling.

FIGURE 3.1E 11ºAnkle Angle Eversion & Only 8º Knee Angle Internal Rotation

This **10** degree discrepancy indicates clear evidence of a very substantial **de-coupling** during running in shoes of the directly parallel linkage between ankle and tibia rotation found in Rubin's stationary study of barefeet.

In fact, the substantial de-coupling shown in the Willwacher study provides clear proof of the direct mechanical effect of shoe heel-induced supination on knee motion in the transverse plane. The inescapable conclusion is that the shoe heel-induced unnatural supination actually causes the abnormal decoupling, which is otherwise inexplicable, as it has remained until now!

The math could not be more simple. The missing **10** degrees of inward tibial rotation is a result of **10** degrees of outward rotation that must be caused by about **6** degrees of shoe heel-induced supination, using Rubin's ratio of 1:1.7.

The equal rotations of **10** degrees in opposite directions cancel each other out, leaving the observed inward rotation of only **8** degrees when running in shoes.

That final result neatly proves mathematically the existence of a direct bio-mechanical de-coupling effect of shoe heel-induced ankle joint supination and its directly resulting tibial external rotation, based on the **Willwacher** prize-winning study, which is particularly authoritative because of its exceptionally large and therefore statistically valid sample size (222 runners)!

Another major mystery solved by just following the lead provided by our original footprint clues. You might rightly ask if there is some other, competing scientific explanation for the decoupling effect. The answer is no. The existing official explanation is that it just happens.

An Unusually Large Sample Size, But Highly Selected Instead of Random

By the way, the **Willwacher** study sample size is much larger than a typical biomechanics study, and includes both men and women. However, unfortunately it must also be pointed out that the runners studied are middle-aged, so on a de facto basis they are highly selected biomechanically, since they apparently have remained runners after surviving many years of annual injury rates as high as 70%.

Moreover, the study's runners were also limited to those runners who had been injury-free for at least the past 6 months, which makes them very unique indeed, again given the typical 70% annual injury rates.

Therefore, the test subjects were not at all randomly selected and do not at all reflect the overall population, even of their age group. Rather, they are highly filtered, elite winners who have triumphed in a lifelong "survival of the fittest" race in an age group in which nearly all other runners are former runners.

So a truly random study of subjects in this age group would likely including only a small number of active runners to be studied, which of course is why the study and all other running studies are not randomized and therefore do not at all represent the overall population.

This is an extremely serious problem, since it means that there are no existing biomechanical studies on running that examine the effect of shoe heels on the general population. It is expected that in general such effect is far more adverse, with much greater abnormal distortion of joint motion and skeletal structure.

On the positive side, the unique older runners in the Willwacher study above provide a rational guide to interpreting the study results. It is reasonable to conclude that the middle aged runners' relatively straight-to-slightly-valgus legs enabled them to avoid injury and continue running far longer that typical.

Also, Strong Evidence of Shoe Heel-Induced Knee Tilting & Rotation Provided By Data from the Willwacher Study

As seen in the Knee Moment **Frontal** Plane graph of Figure 4 of the same study by Steffen **Willwacher** and others[2], awarded the largest prize in footwear biomechanics, there is strong evidence of a powerful **external knee adduction moment (or torque).** This external torque forces the knee to tilt out into a bow-legged position in the frontal plane. See below **FIGURE 3.1F.**

There is also a similarly powerful **external rotation torque** in the Knee Moment **Transverse (or horizontal)** Plane graph of Willwacher's Figure 4. This external torque forces the knee out into a twisted-out position in the horizontal plane.

As expected, both torques peak at midstance when the knee is maximally flexed and under peak body weight load.

FIGURE 3.1F External Knee Torque in Both Frontal & Horizontal Planes

So, the dual torques shown above in FIGURE 3.1F act powerfully together to both tilt out and externally rotate the knee toward an artificial varus or bow-legged (or adducted) position shown above in FIGURE 3.1G&H, as is predicted by the preceding discussion of the biomechanical effect of conventional shoe heels.

While the Willwacher Nike Award-winning study is the most recent and comprehensive, a multitude of other well-regarded studies by renowned biomechanics researchers indicate essentially the same results[3].

Unfortunately, evalulation of those studies is difficult even for an expert because they were done in a manner that hardly could be more confusing. The studies wholly lack a reasonable consistency in what should be a relatively simple definitional issue concerning the critical terms, "**ab**duction" and **ad**duction" as they applied to knee angular motion and torques. A discussion of the problem is included in some detail in Endnote[3] of this chapter.

(Beyond terminology, it is all the more confusing because the unnatural **FIGURE 3.1C** position is inherently unstable and tends to collapse inward in compensating pronation into a valgus or knock-kneed position. This important issue will be discussed in more detail below.)

FIGURE 3.1 G&H Increased Knee Abduction & Adduction Moments (Torques)

Foot Supination/Tibial Outward Rotation Induced By Shoe Heel is

Evidence-Based Fact

Based on settled science as best we know (which is the gold standard, many peer reviewed studies), the shoe heel-induced supination of the foot is a closed-system bio-mechanism that automatically happens in a simple mechanical way.

And, again mechanically, the abnormal tilted out position of the supinated heel bone is also a closed-system biomechanism that automatically forces the shin bone to rotate to the outside, artificially bowing out the knee to the outside unnaturally when you run.

In summary, the elevated shoe heel causes external tibial rotation when you run that is a bio-mechanism as automatic as a clockwork mechanism.

The Unusal Sample of Elite Runners Explains Slight Valgus Knee Position

The Nike Award-winning study by Willwacher et al. previously cited[2] indicates in Figure 6 of the study **about 2 degrees of valgus or abducted or inward-tilt of the knee in the frontal plane;** see again **FIGURE 2.6A**. This is instead of a bow-legged or varus or outward knee tilt because of the induced pronation in compensation to elevated shoe heels when running.

As far as I have been able to tell from video studies of super-elite competitions like the Olympics, the best runners have either vertical or slightly valgus knee positions in the frontal plane at the maximally loaded midstance position. Therefore, these knee positions would seem to be the optimal compensations for running with shoe heels at the highest competition levels, with the least injuries.

The video studies include USA Olympic Distance Running Champions Galen Rupp (2012 & 2016) and Evan Jager (2016), well as a number of similarly elite African runners, and are referenced at the end of this chapter and are available on the website, www.anatomicresearch.com.

Extraordinarily Wide Variation in Knee Tilt in the Frontal Plane

Data from the Willwacher study (graph on Knee Angles in Frontal Plane – shown above) also provides clear evidence of the extraordinarily high individual range of variation of knee abduction/adduction motion between the 222 runners, as expected given each individual's specific genetic adaptation to their own particular, highly variable shoe heel use.

The frontal plane knee motion shown is also the most erratically variable of all the lower limb joint motions measured in the Willwacher study, suggestive of wide individual variation in compensating for the excessive lateral instability in the modern knee joint due to the unnatural effect of shoe heels.

It is especially important to note in the same Willwacher graph the **extremely wide standard deviation,** from 4 degrees of varus to 6 degrees of valgus, which indicates extraordinarily wide variation in individual knee adaptations to shoe heels. The very broad range means that some individuals become more bow-legged, while others pronate more in compensation to the inherently unstable varus position and end up in a more knock-kneed (also called valgus or abducted) position.

The standard deviation shown in this knee frontal plane graph is far greater than in the other Willwacher graphs, indicating strongly that the knee is the joint most affected by shoe heels. The individual compensations at the knee joint are therefore the most widely varying, with the result that the structure of the tibial plateau or head of the tibia is well-known as one of the most widely varying parts of the human skeleton.[3A]

The Impact of Abnormal Shoe Heel-Induced Supination Is Greatly Magnified By Running

When you run, your body is subjected to the maximum force (the vertical ground reaction force) that it experiences in a routine and regular way millions of times during your lifetime, about 2-3 times your full body weight.

Making matters worse, you are subjected to this highly repetitive maximum force when your knee is maximally flexed to about 45 degrees[4] during the midstance phase of running, and therefore when your knee is maximally bent abnormally to the outside. See **FIGURE 3.2** and **VIDEO 3.1**.

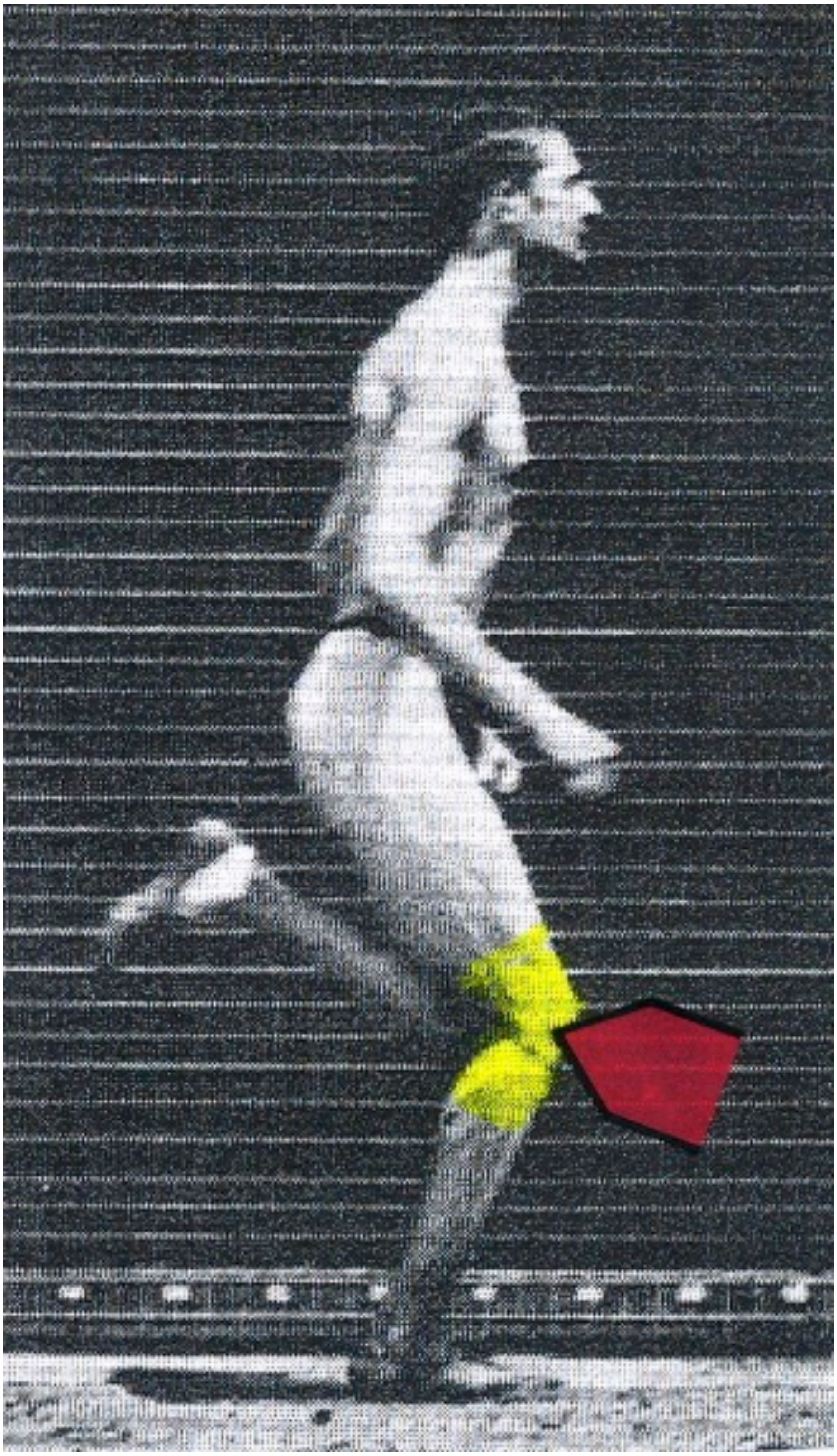


FIGURE 3.2 Running Midstance: Maximally Flexed & Maximally Loaded

So the effect of the elevated shoe heel/tibial outward rotation mechanism is maximized when you run or jog, when your knee is at the same time both the most maximally flexed and the most maximally loaded as regularly occurs routinely in the human body.

You were born to run, and therefore your body is shaped for running. Your body also is shaped by running and therefore, in the final analysis, also abnormally shaped by elevated shoe heels worn while running, as we shall see.

The footprints clue cited in the James report in the Preface (**FIGURES A & B**) is all the more powerful as evidence since the footprints were taken with knee bent forward, supported on that single leg alone, so it was taken in roughly the typical midstance running position shown in **FIGURE 3.2** above (although at only 1 full body weight, rather than 2-3).

Your Body Was Shaped By Shoe Heels When You Were Young and Running Everywhere

If you think you are protected now by the fact that the last time you actually ran was so long ago you cannot remember even to the nearest decade, guess again. You still have a big problem that you cannot avoid.

That is because the basic structure of your body was formed by about age 8. The die was cast then, even if you only walk now. Experts agree that both boys and girls up to that age run almost constantly[5]. Their activity levels remains very high through puberty.

After that, activity levels become lower, especially for women, at least historically, before the running revolution that began in the 1970's. (However, today, by at least one count, there are slightly more female runners than male, but I have not found any information as to whether that is primarily a result of Title IX in school or of women taking up running later in life - or of both.)

As a result of running with shoe heels, the structure of the foot becomes more supinated in early childhood. The calcaneus or heel bone tilts upward into a more upwardly inclined supinated position through age six (from about 14º to about 21º). During the same time period, the talus or ankle bone tilts downward, declining into a more supinated position also (from about 30º to about 23º).

From age 6 to age 18 there is little change and, surprising, there is negligible difference between sexes, although these results from age 6-18 are from an old 1968 study predating the running revolution and Title IX.[6]

So back to your own personal problem, which virtually all of you share with all the rest of us in the modern world, particularly the developed countries of the West. If your knee joint has been habitually subjected to maximal forces when tilted to the outside throughout your life, or at least the early, formative portion of it, what would happen to your knee? Would it change and if so, how would it change?

Biomechanically speaking, the issue is pretty simple. The abnormal tilted out position of your knee would increase the portion of your body weight load that was carried on the inside (the medial) portion of the knee, offset by a matching decrease on the outside (the lateral) portion of the knee, as shown below on right in an exaggerated example in **FIGURE 3.3A**.

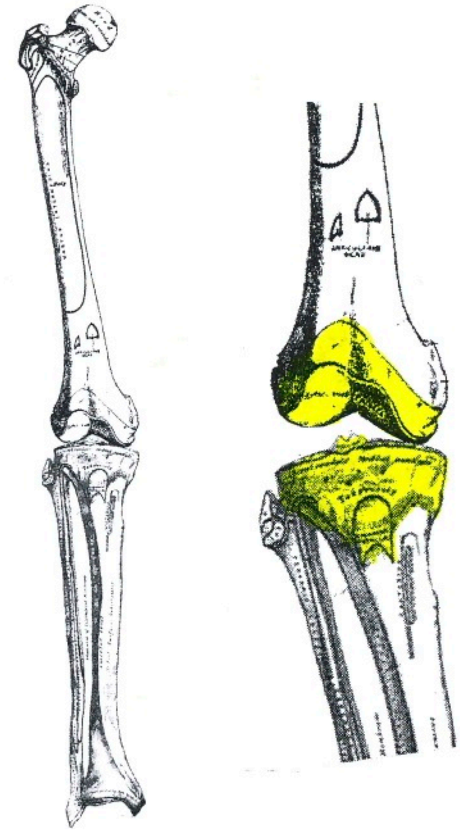


FIGURE 3.3A Tilted-Out Knee Focuses Pressure on Medial Side of the Joint

The result is a varus-aligned knee and the generation of an unnatural internal knee abduction moment, as shown below in this comparison between neutally aligned (natural or barefoot) and varus aligned (shoe heel-induced) knees.

Strong Anatomical Evidence of the Abnormal Tilted-Out Knee Position on Internal Bone Structure

A cross-section showing the internal bone trabecular structure of the knee shows the same clear evidence, with a much denser network of bone on the inside or medial portion of the knee.
See **FIGURES 3.3 B&C**.

FIGURES 3.3 B&C Knee Medial Side Bone Growth

More importantly, numerous authoritative studies agree that from slightly over 70% to just under 90% of the load is typically carried on the inside (medial) portion of the knee[7]. This excessive overloading is so great it can result in a "**varus thrust**" of the knee, pushing the knee to the outside when running or even when walking, so that the bowing out increases. See **VIDEO 3.2**.

The Mystery of the Knee Screw Home Mechanism

To that point, in my research I came across an old but extensive written description comparing the knees of an African population with modern Western knees. It described the basic shape of the African knee as smaller and rounder[8].

The African study also made what I think is a truly startling observation. The African knees displayed little or no rotary motion in a horizontal plane, in marked contrast to the obvious rotary motion evidenced in the Western knees studied in Africa (and everywhere else).

This is an extremely significant finding. The modern Western knee joint has a well-known horizontal rotary motion called the "screw home mechanism". It occurs in the last 15 or 20 degrees of leg extension motion, as the leg is fully straightened, which locks it into a "close-packed" position.

Vigorous debate over the screw home mechanism has occurred over many decades and in many different anatomic, orthopedic, and physical anthropology studies. No clear consensus has emerged concerning its exact enabling structure or its function. It has remained a deeply controversial and unsolved mystery to this day.

The Robust Barefoot Knee is a Simple Hinge, But the Fragile Modern Knee Also Automatically Rotates

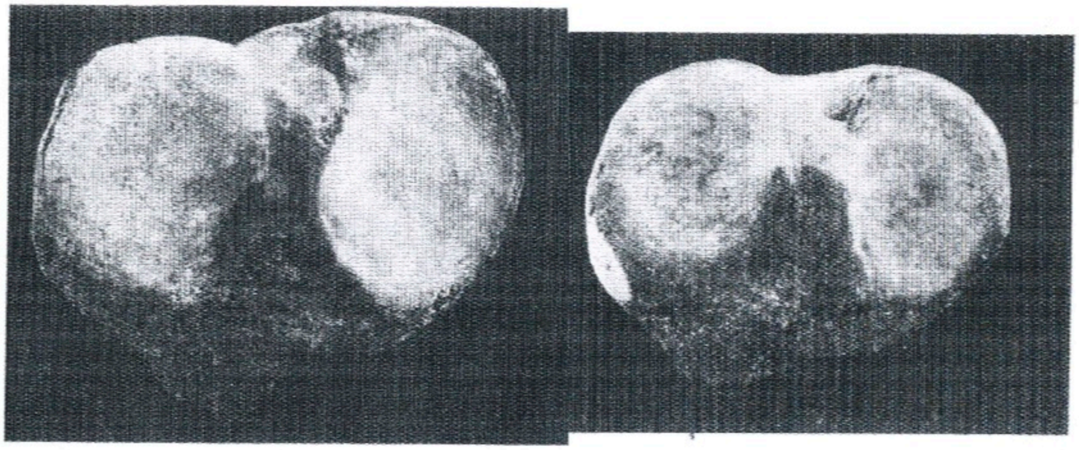
So it is quite interesting that the African study also noted that the modern Western knees were subject to widespread meniscus problems (i.e. torn cartilage), which are generally associated with rotary motion in a horizontal plane. Such problems were almost entirely absent in the vast number of African knees studied and in which the African menisci were more firmly attached in the knee joint.

Also, the barefoot African knees had much straighter cruciate ligaments, unlike the obliquely oriented cruciate ligaments of the modern Western knees. The cruciate ligaments are a well-known source of knee injury in modern populations and their twisted position in the knee also suggests the strong possibility of unnatural rotary motion.

The Rotary Shape of the Tibial Plateau of the Modern Knee Joint Is Direct, Smoking Gun Evidence of Major Abnormality

The conclusion that this horizontal rotary motion is unique and unnatural is strongly reinforced by comparing samples of our modern knees and those of some other "primitive" barefoot populations.

The lower joint surface (the tibial plateau or upper surface of the shin bone) of the modern knee shown in the upper photo clearly shows the swiveling, rotary effect built into the surface of the actual bone structure. Just as clearly, the primitive knee shown in the lower photo does not show any such unnatural rotary motion. In the lower example, the primitive knee sample is from an Australian aborigine[9]. See below **FIGURE 3.4**.



The proximal aspects of a European and an Australian tibia of approximately the same length. The greater breadth and more massive character of the European epiphysis are clearly demonstrated. The two bones were photographed at the same distance from the camera.

FIGURE 3.4 Shoe-Wearing European and Barefoot Aborigine (Lower Surface of Knee Joint)

In **FIGURE 3.4**, the primitive knee joint has basically a simple round shape. The modern knee is proportionately larger and has a more complex oval shape. This has the distinct look of evidence in the conspicuous form of a smoking gun that seems to prove a major structural and functional difference between barefoot primitive knees and those subjected to modern shoe heels. And there are more examples.

Similar samples from barefoot India populations show the same simple, non-rotary structure as the Australian[10]. This is true despite being distinct racial branches representing entirely different major genus homo migrations out of Africa. In fact, Indians are considered Caucasian, racially very closely related to Western Europeans. See **FIGURE 3.5**.

FIGURE 3.5 India Barefoot Knees (Lower Surface of Knee Joint)

In addition, an ancient Roman sample also shows the same simple, non-rotary structure as the barefoot Australian and Indian[11]. Although it is probably native Italian, its exact racial source is not known and could theoretically have come potentially from anywhere in the racially diverse Roman Empire. See **FIGURE 3.6** (Lower Surface of Knee Joint).

FIGURE 3.6 Ancient Roman Knee (Lower Surface of Knee Joint)

The forgoing discussion strongly suggests that the rotary motion of the screw home mechanism is an artificial and abnormal feature of the modern knee that is caused by elevated shoe heels. It is not a racial difference at all, as we shall see in more detail in a later chapter.

The Modern Knee's Motion When Tilted Out By Shoe Heels

In fact, the unnatural, abnormal horizontal rotary motion of the modern knee is a byproduct of its structure being literally re-formed by shoe heel-induced knee cant when running.

When we run with elevated shoe heels that both rotate and tilt our shinbones to the outside under a maximal 3 times body weight peak vertical load with knee flexed at about 45 degrees, the following joint mechanisms must occur biomechanically:

First, the initial tilting of the tibia to the outside causes the medial (inside) surfaces of the knee to be pressed very tightly together. Therefore, the medial collateral ligament of the knee becomes very loose, allowing the medial (inside) condyle of the thigh (femur) bone to slide forward on the medial tibial plateau; that is, the femur rotates externally to the tibia.

Again, as seen in the transverse plane of Figure 6 of the Willwacher Nike Award-winning study, the 8 degrees of internal rotation of the tibia (and knee joint) provides clear proof of this abnormal internal sliding rotary motion (relative to the femur). See again **FIGURE 2.6A**.

The tibia tilting puts the medial portion of the knee joint under disproportionately great pressure during this forward sliding motion. The forward motion of the relatively loose medial femural condyle forces the medial meniscus forward and substantially erodes the forward (anterior) portion of the medial meniscus over time.

Second, in contrast to the medial side surfaces, the knee's lateral (outside) surfaces are pulled apart by the outward tilting of the tibia. Therefore, the lateral collateral ligament becomes very tight and anchors lateral condyle on the lateral tibial plateau, locating the center of rotation there, in a slightly posterior location. The lack of motion of the lateral condyle allows the lateral meniscus to remain firmly in its natural position and also remain relatively intact.

Third, the outwarded tilted and rotated shinbone pulls with a powerful vertical force 2 to 3 times body weight through the patellar tendon through the patella (knee cap) on the thigh bone (femur) in an unnaturally oblique direction between the two bones in this misaligned position (ie. with the tibia rotated to the inside relative to the femur)

If you just look at the lower surface of the modern knee joint (the tibial plateau) in the upper portion of **FIGURE 3.7** (shown below) you can see obvious evidence on the surface of the bone of exactly the horizontal rotary motion of the first and second actions described above occurring, without the need of any specialized anatomical training. The medial side meniscus cartilage (on the left side) is obviously pushed up completely out of a centered position, unlike the roughly centered position on the lateral side, as shown highlighted in yellow.

In contrast, the lower portion of the **FIGURE 3.7** shows a “primitive” tibial plateau and, separately to the right, the twin right and left menisci, which are highly symmetical mirror images of each other.

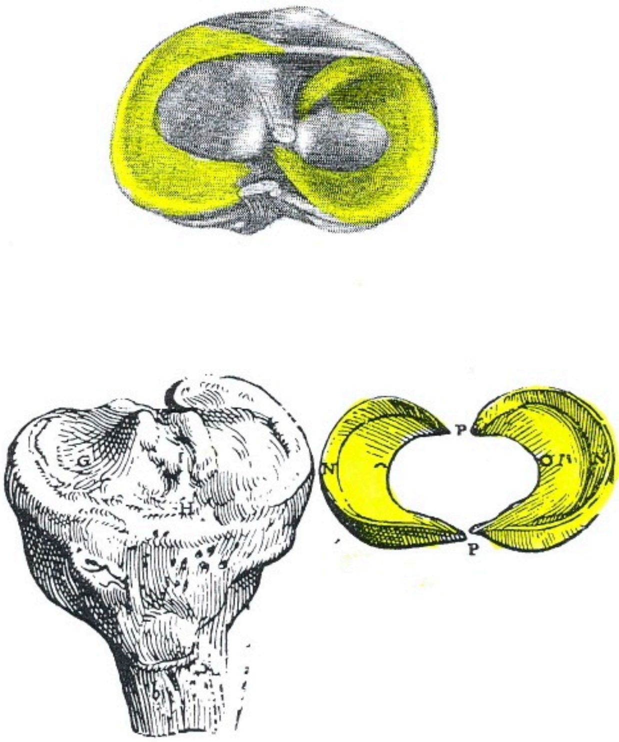


FIGURE 3.7 Modern Knee Surface with menisci above – Primitive Knee with menisci below

As we shall see later on in Chapter 17, the right and left knee joints of any given individual may have the same or very different amounts of unnatural rotary motion as evidenced in their tibial plateaus, due to a right/left asymmetry in the body caused by shoe heels.

Elevated Shoe Heels Overload the Medial Portion of the Knee, Causing Knee Osteoarthritis

If that massively disproportionate load distribution is “normal”, then why is there a well-proven direct correlation between the much greater load on the knee's medial portion and knee osteoarthritis. And why is knee osteoarthritis usually located specifically on that medial portion[12].

And if that massively disproportionate load distribution is “natural”, then why have numerous authoritative studies shown a direct connection between an increasing height of shoe heels with an increasing portion of the load on the knee's medial portion[13].

So the answer to the above questions, as I am sure you can guess by now, is that our modern knees are unfortunately neither natural nor normal. They have been deformed and made much less durable by elevated shoe heels.

The abnormal rotary motion under extreme load is literally the force that alters the natural structure of the modern human knee, as shown in **FIGURES 3.4 & 3.7**. This is all according to Wolff's Law, which essentially says that structure of bone re-forms itself in reaction to the forces placed on it, with the greatest forces having the greatest effect on the re-forming process.

Unfortunately, the re-formed structure of the modern knee is actually a deformed structure that leads directly to osteoarthritis. Osteoarthritus is the most common type of arthritis and it most often attacks the human knee on the unnaturally overloaded medial side. The weak point is obviously the inner or medial portion, which is both extremely overloaded and the principal site of the unnatural horizontal rotary motion discussed above. The effect on the knee is exactly like a millstone grinding. A virtually countless number of studies support this conclusion.[12]

This is a very serious heath care problem. Nearly 60 million people are affected by arthritis in the U.S. alone, including more than half the population over age 65. Virtually all of these 60 million arthritis sufferers were non-stop runners at least in their early lives. The cost economically and in terms of the loss in quality of life is enormous. Neither cure nor prevention has been possible because the underlying cause has not heretofore been known.

Prior Studies on the Connection Between Running and Knee Arthritis Are Wrong and Misleading

A highly important fact to note: a deeply misleading and plainly incorrect conclusion has been reached in some recent studies that running (with shoes) does not cause knee osteoarthritis, since most older runners do not develop arthritis.

In fact, a far different conclusion is much more likely. Most older runners do not develop knee arthritis only because they are a tiny and highly selected population of the very few biomechanically fittest runners that can continue as active runners into middle or old age. By chance and genetics, they are the select few who developed the most favorable, least damaging biomechanical adjustments to shoe heels, and should be carefully studied in the future for that reason.

However, as noted earlier, the harsh reality is that nearly all older runners are former runners who already have been forced to quit much earlier in life because of the annual 70% running injury rate! Or they never even took up recreational running after childhood due to shoe heel-induced injuries occurring very early in life. So none of these former runners are included in the studies of older runners, making their conclusions worthless and misleading relative to the key issue of the principal cause of osteoarthritis.

Although there are some studies of old runners that indicate that they do not typically have arthritic symptoms, that is obviously must be because those few old and active runners typically have nearly vertical legs when running, which is the most optimal compensation to shoe heels.

Otherwise they would be former runners, like everyone else in their age group. The Willwacher study Figure 6 graph on the knee in the frontal plane discussed above makes this point clearly. It is not "wear and tear", it is shoe heels.

The Screw Home Mechanism Is Just an Abnormal Artifact of the Unnatural Outward Knee Tilting

The screw home mechanism is just an artifact of this abnormal structure that is formed under maximum stress when the knee is flexed, principally around 40 to 45 degrees flexion. When the knee joint is no longer flexed but rather in the last 15 degrees of extension, the collateral ligaments of the knee both gradually return to a relatively normal, balanced state of tension, instead of too tight on one side and too loose on the other.

That allows the medial condyle of the thighbone (femur) to return from its abnormal forward position to its initial, more centered position by rotating internally and backwards. But that position is no longer entirely natural, since the medial collateral ligament was very loose under load in the flexed position described above. So the fit is now unnaturally tighter with a gradually shortened medial collateral ligament, causing an unnatural "close-packed" or locked position when the screw home mechanism is completed in full knee extension when the leg is straight.

For the First Time: A Clear Understanding of the Mysterious Knee Screw Home Mechanism

The screw home mechanism consists of the shinbone or tibia rotating to the outside relative to the thighbone (or femur) during the last 15-20 degrees of extension and locking the knee in a completely straight, unflexed, unbent position, shown on the right below. See **FIGURES 3.8 A&B**.

FIGURES 3.8 A&B Knee Screw Home Mechanism

In this straight and locked position the shinbone and thighbone are no longer lined up straight for loadbearing. Instead, they are oblique to each other, as indicated by the position of the kneecap (or patella) and the patellar tendon, with the tibia or shinbone rotated laterally (externally) to the outside relative to the femur or thighbone.

I think the confusion about the knee screw home mechanism is that it is typically measured in a seated, unloaded position. In contrast, the modern knee joint is actually formed in reaction to the routine maximum, 3 times bodyweight load when about 45 degrees flexed during running with shoe heels.

At that maximal load point in the stance phase, the knee joint is mechanically forced into the position shown in **FIGURE 3.8A** above, with the centers of the tibial tubercle and patella lining up with the midline shown. But, and this is critical, this alignment occurs with the unnatural tibial varus tilt and external rotation of the femur on the tibia caused by shoe heels, as discussed above.

Therefore, being an unnatural, malformed alignment, the femur reverses and moves backward and rotates internally (as the tibia untilts) when the knee straightens without the presense of the maximal 3 times bodyweight load, as shown in **FIGURE 3.8B** above.

In this light, the solution to the longstanding mystery of the screw home mechanism is fairly obvious. It is an abnormal, unnatural, and uselessly detrimental consequence of the abnormal modern knee structure and function created by elevated shoe heels. As a frequent source of injury and disease, it is a prime example of how such shoe heels have made our bodies far less durable. They also make our knees and legs much weaker, as we shall see in the next chapter.

In addition, the resulting abnormal misalignment and stress between the sides of the patella and femur condyle produce an unnatural patellofemoral pain (formerly called chondromalacia or “runner's knee”), which is the most common running injuring. Indeed, it is the most common overuse athletic injury, affecting about 25% of all those participating in sports and exercise.

Shoe Heels Cause a Structural Repositioning of the Ankle Joint, Rotated to the Outside

There is a strong indication of the effect of shoe heels in the changing structural long axis alignment of the tibia from birth through adulthood. During that period, the ankle joint is forced by shoe heels laterally to the outside from a neutral, aligned with the knee joint position to a 20º-25º outward rotation compared to the knee joint, as shown by the position of the top of the ankle joint (formed by the medial and lateral malleoli) relative to the knee joint, as shown in the horizontal plane in **FIGURE 3.9**~~12~~.

The entire length of the bone of the tibia is literally torqued to the outside by shoe heels permanently, so that over time the entire length is re-formed according to Wolff’s Law.

FIGURE 3.9 Birth to Adult: Ankle Joint Permanently Twisted Out By Shoe Heels

How the Shoe Heel-induced Misalignment is Baked Into Leg Bone Structure Over Time

Shoe heels cause knee cant to the outside into a varus or bow-legged position, overloading the medial side and underloading the lateral side. Therefore, under Heuter-Volkman's law, increased pressure on the epiphysis (growth plate) inhibits growth on the medial side of the knee, and under Delpech's law, decreased pressure stimulates growth on the lateral side.

The result is for the bone structure of the knee joint surfaces of the tibia and femur to reform themselves over time to bring the two surfaces back into alignment, albeit in a varus or bow-legged position, which is called Blount's Disease.

For many other individuals, as we shall see later, the varus position is so unstable that their legs collapse inward into a valgus or knock-kneed position. And just like the varus position, over time the valgus position becomes baked into the bone structure of the knee joint.

How Has The Central Role of Shoe Heels Been Missed Before Now?

Just like in chapter 2, all of these abnormal anomalies perversely appear unrelated and do not have an obvious connection to shoe heels. If you don't know to look for the connection, it is impossible not to miss it. And if you don't know it is there, it is easy to miss the abnormal effects shoe heels cause, and accept those effects as natural and normal because they are so universally widespread throughout the modern human population.

Moreover, where there has been made any connection at all between high heels and bow-leggedness in the past, such as between bow-legged cowboys and cowboy boots, an alternative explanation for the connection has been all too obvious, however incorrect. Nevertheless, it is not the horse but the boot heels that cause the bowlegs of cowboys. See **FIGURE 3.10**~~13~~.

FIGURE 3.10 Gary Larson's Cartoon: Bowlegged Cowboy and His Horse

Unfortunately, the true solution to a complicated problem of subtle cause and hidden effect usually become "obvious" only in hindsight. I can think of no better general example of this basic fact than a passage I first read in college:

> ...the supreme paradox of the scientific revolution is that things which we find easy to instill into children at school … - things which would strike us as the ordinary natural way of looking at the universe, the ***obvious*** way of regarding the behavior of falling bodies, for example – defeated the greatest intellects for centuries, defeated Leonardo da Vinci and at the marginal point even Galileo, when their minds were wrestling on the very frontiers of human thought with these very problems. ...It required their combined efforts to clear up certain simple things which we should now regard as **obvious** to any unprejudiced mind, and even easy for a child.[14]

The Varus Thrust Change in the Knee Caused by Running Is Retained During Walking in Shoes

The "**varus thrust**" of the knee change in the knee caused by running effectively becomes permanent and therefore carries over into walking locomotion, especially in high heels. **SEE VIDEO 3.3.** However, varus thrust is clearly absent in barefoot populations, whose tibias are upright, not tilted out. **SEE VIDEO 3.4**.

A Large and Growing VIDEO SAMPLE of Famous Modern Walkers From Politics, Movies, Business, and Sports, Most Showing Bow-Leggedness and Varus Knee Thrust, currently including:

Former President Obama, Tim Cook, Clint Eastwood, Larry David, Marilyn Monroe, Duke Coach K, Mitt Romney, David Beckham, Madonna, UNC Coach Williams, Coach Kevin McHale, Melinda and Bill Gates & Warren Buffet, Governor Christy, Dominique Wilkins, Steve Carell. and Rick Steves. Forrest Whitaker is the outlier, showing the opposite, a severe valgus or knock-kneed position.

A Contrasting Small But Growing VIDEO SAMPLE of Unknown Primitive Barefoot Walkers, None Showing Bow-Leggedness and Varus Knee Thrust, currently including:

Barefoot African Boy, Barefoot African, Barefoot Male in India, Barefoot Africans, Barefoot in Indonesia, and Barefoot Woman India.

A Small But Growing VIDEO SAMPLE of Famous & Other Modern Runners, Most Showing Bow-Leggedness and Varus Knee Thrust, currently including:

Liam Neeson, *The Walking Dead* Male Stars, a Woman Running in High Heels, and others.

In marked contrast, USA 2016 Olympic Distance Running Champions Galen Rupp & Evan Jager do not show varus thrust.

A Small But Growing VIDEO SAMPLE of Unknown African Runners in Shoes, Most Not Showing Bow-Leggedness and Varus Knee Thrust

A Small But Growing VIDEO SAMPLE of Unknown Boys & Girls Running in Shoes, Most Not Showing Bow-Leggedness and Varus Knee Thrust

Note: for more information on the anatomy of the knee, see this **YouTube** video: https://www.youtube.com/watch?v=_q-Jxj5sT0g, which is titled “Knee Anatomy Animated Tutorial” by Randale Sechrest, MD.

For more information on the running gait cycle, see this **YouTube** video: “Running Analysis - The Gait Cycle Made Simple [Ep17]” by James Dunne https://www.youtube.com/watch?v=GBG90AIPGdg.

4 THIGH MUSCLES ARE UNNATURALLY WEAKENED BY SHOE HEELS

The vastus medialis is a thigh muscle attached to the medial or inside edge of the kneecap. It is the one of four quadriceps muscles that straighten or extend the leg. The vastus medialis in particualr controls the knee in the last 15 degrees or so of motion when it is being fully extended or straightened.

One of the leading authorities on the human knee has been quoted as saying that the vastus medialis muscle is the key to the knee[1]. As noted in the previous chapter, this last 15 degrees of extension is when the screw home mechanism controls the knee in an abnormal, unnatural locking motion caused by the abnormal effect of shoe heels, as discussed in the previous chapter. Therefore, is also seems likely that the critical role of the vastus medialis is also abnormal and unnatural.

However, looking at the structure of the typically non-varus-positioned knee of those of African descent, the vastus lateralis muscle (which is located on the outside or lateral portion of the thigh) is typically much more developed and therefore much more critical functionally than the vastus medialis. In many star athletes, and especially common in black athletes, the vastus lateralis can be so highly developed that it almost creates a frog-leg look to the leg. See FIGURE 4.1.

Is it not likely that the vastus medialis is overdeveloped in the modern, varus-positioned knee, in contrast to a more natural dependence on development of the vastus lateralis in a non-varus positioned knee.

This interpretation is supported by the vastus lateralis muscle, almost identically developed, of a nearly full term human fetus, which appears to be non-African. See FIGURE 4.2. If anything, its vastus lateralis is more highly developed than that of a star athlete. Moreover, that exceptional fetal development occurred in the womb, so it was essentially produced through the action of genes alone, since gravity and load-bearing exercise are non-factors.

In comparison, the vastus lateralis of the normal modern Western knee is relatively atrophied. Such a modern knee must rely on the vastus medialis, as noted above, simply because of the excessive weakness of the vastus lateralis.

A Remarkable Case Study Provides Proof that the Vastus Lateralis Muscle Is Weakened By the Bow-Legged Position Caused By Shoe Heels

That this marked difference in muscle development is definitely not a racial difference is conclusively proven, totally by happenstance, in an extraordinary case study[2].

The case is of a young white male being treated for flat feet, presumably to relieve significant foot pain. Prior to surgery, he clearly has “knock-knees", the opposite of being bow-legged or varus-positioned, and also has very highly developed vastus lateralis muscles. See FIGURE 4.3A.

Six months post surgery to make his thighbones "normal," his legs have become bow-legged, with substantial thigh muscle wasting, focused particularly on the vastus lateralis muscles, which are much smaller post-op. See FIGURE 4.3B. (Note also the very different outward appearance of the knees, which is suggestive of the abnormal rotary remodeling of the knee that was discussed in the previous chapter.)

This case would seem to clearly prove that shoe heels significantly weaken the principal muscle supporting the knee, since they cause the bow-legged alignment that wastes the vastus lateralis muscle. Like the fetus above, it also proves conclusively that the difference in important thigh muscle size and shape is not racial, but instead a developmental effect of shoe heels, as we will discuss in more depth later.

The wasting effect on the vastus lateralis is continuous, extending over a lifetime, with the elderly showing the greatest relative effect of wasting[3].

It also explains why "*White Men Can't Jump*", as noted in the Preface. More on this will be discussed in a later chapter. For now, it is sufficient to make clear that artificially excessive pronation (unlike shoe heel-induced supination) is associated with valgus-positioned or "knock-knees" and can therefore lead to a very strong vastus lateralis, as seen in VIDEO 4.1, which shows a world class Caucasian high jumper's foot rolling inward, hyper-pronating off the edge of his shoe sole before successfully clearing the bar.

A recent study indicates that the overall quadriceps strength of valgus-positioned or "knock-knees" is 56% higher than the quadriceps strength of varus-positioned or "bow-leg."[4] That suggests strongly that the vastus lateralis muscle is key to the natural knee.

Similarly, most basketball players at the highest collegiate and the professional levels jump naturally from a knock-kneed position in order to achieve sufficient elevation to compete successfully, as shown in a typical example in FIGURE 4.4.

In addition, I think the wasted vastus lateralis muscle also explains the accumulation in many women of cellulite on upper, outside portion of the thighs, the "saddle-bags" replacing the little used and thus wasted vastus lateralis muscle.

Notably, all modern athletes have unnaturally tight hamstrings muscles and modern long distance runners typically have weak quadriceps muscles[5]. In effect, exclusive of strength training, the more modern shoe-wearing athletes run, the less high they can jump. Part of the reason why is due to an unexpected effect of shoe heels that will be discussed later, in chapter 8.

Also worth noting here is that the torque generated by the quadriceps muscles drops off markedly in the last 30 degrees of motion to fully straighten the knee[3, 6]. I believe this is an abnormal effect of the unnatural “screw-home” mechanism of the modern knee discussed in the last chapter, 3. Just like a car engine, the flatter the torque curve, the better the overall performance, and the modern knee does not have it.

Finally, for men the torque that is generated by the quadriceps muscles increases slightly from 60 degrees to 90. In marked contrast, in women it drops off significantly in the same knee positions[6]. This mostly explains why even tall female basketball players typically cannot dunk easily and why dunking is virtually non-existent in the womens' game, even at the pro level. As it turns out, typical modern female knees do not work the same way as typical modern male knees, structurally or functionally, as we shall see later in chapter 13.

The Hamstring Muscles Are Excessively Weak, Unbalancing the Thigh Muscles

In the modern thigh there appears to an unnatural imbalance between the principal muscles on the front, the quadriceps, which are relatively more powerful and those on the rear, the hamstrings, which are relatively weaker. Significantly weaker hamstrings than quadriceps have often been coorelated in studies with vulverability to injury.

It is reasonable therefore to believe that equivalent strength between hamstrings and quadriceps provides better, more natural balance. Moreover, in contrast, in most animals the hamstrings are more powerful than the quadriceps, suggesting that the modern imbalance is not natural.

(To be discussed later in Chapter 8, the hamstrings are directly weakened by the interaction of shoe heels with the pelvis and the illiotibial band.)

5 THE ANKLE JOINT IS ALSO ABNORMALLY RESHAPED BY SHOE HEELS

As you recall, the foot is forced into a tilted out, supinated position by elevated shoe heels. This poses an obvious question. Is the internal structure of the human ankle joint also changed like the knee joint has been by this abnormal foot position, which causes the lower leg (shin bone) to tilt out?

The easiest way to answer the question is to again compare typical ankle joints of primitive, barefoot populations with those of modern. The first example compares primitive Egyptian with modern European and shows an upper view of the anklebone (talus), including the lower surface of the ankle joint, the trochlear[1]. See **FIGURE 5.1**.

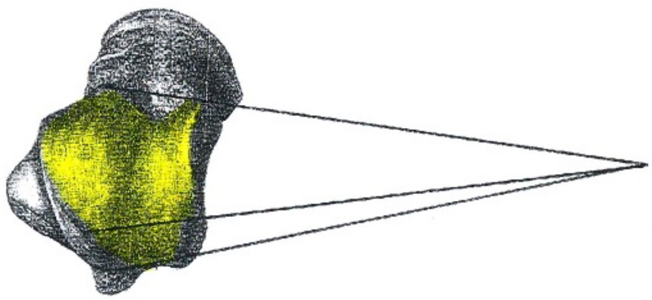


FIGURE 5.1

The most clearly apparent difference is that the trochlear surface (in white) of the primitive Egyptian, on the left of the figure, has essentially a regular rectangular shape. This shape is compatible with being a simple hinge joint.

In the middle of the figure, the modern European's trochlear surface has a similar shape, but differs significantly in that it is angled to the outside. This difference logically can be explained as a reshaping to accommodate the abnormal motion of the shinbone being tilted to the outside by elevated shoe heels.

On the right of the figure, the well-known cone structure of the typical modern ankle joint reflects the rotary torsion it is abnormally subjected to by shoe heels.

Another comparative example is that of a primitive Australian aborigine, which again shows clearly an ankle joint with a trochlear having essentially a regular rectangular shape, indicating a simple hinge ankle joint like that of the Egyptian[2]. See **FIGURE 5.2**.

While the primitive ankle joint is simple and regular, the modern ankle joint is irregular and much more complicated in structure, given its abnormal functioning dictated by the unnatural supination position of the modern foot.

Like the primitive knee joint, the shape of the primitive ankle joint is regular, with sides that look symmetrical. In contrast, and like the modern knee joint, the shape of the modern ankle joint is irregular, with asymmetrical sides.

Just like the modern knee, the modern ankle has a rotation movement built into the bone structure, as better seen in Fig. 2.2.

The Irregular Shape of the Modern Ankle Joint

The modern ankle joint has a lateral side with an articular surface all of which coincides with part of a circle having a constant radius. This suggests that the supination/tilting out mechanism has not affected the lateral side of the modern ankle joint[3]. See FIGURE 5.3.

The modern ankle joint's medial side surface is different. It is asymmetrical. The rear portion of the medial articular surface coincides with part of a circle having a larger radius than that of the lateral side. The forward medial portion coincides with part of a circle having a smaller radius than the lateral side.

The reason for this rear versus forward difference is as follows. Loadbearing is increased on the rear lateral portion with the larger radius when the foot and ankle are in the abnormal supination, tilted out position. In that tilted out position, the medial side of the ankle joint would be under reduced load, since the force of body weight has been redirected laterally by simple physics and geometry. By Wolff's Law[4], the lack of pressure on the medial side allows bone growth, increasing the circle radius on the medial side.

In contrast, an increase in pressure would be required to retard bone growth in the medial ankle joint's forward portion with the smaller circle radius. The unnatural foot supination/tilted out position of the lower leg (shin) bone somehow creates this abnormal increase in pressure on the forward, inside portion of the medial ankle joint, instead of on the lateral portion.

At first this is very puzzling. Why does location of the load-bearing shift from primarily on the outside of the rear of the ankle joint to the inside of the front side?

The Cause of the Paradoxical Shift in the Shape of the Ankle Joint's sides

This gets fairly complicated, but the change in shape is due mainly for the following two reasons:

First of all, as noted earlier, maximal vertical ground reaction force occurs during running when the knee is flexed and the lower leg bone is bent as far forward as it goes. This is called a maximum dorsiflexion position of the ankle joint.

In this ankle joint position, with the lower leg maximally tilted out abnormally, the ground reaction force has an abnormal horizontal ground reaction force component. That abnormal force component is essentially in the frontal plane, pointing in a direction directly to the inside.

That abnormal horizontal force component direction is in virtually the same direction that the subtalar ankle joint is moving at the same maximally loaded stance position of the running stride. That is, when the subtalar ankle joint is maximally pronated during running, it is subjected to an unnatural additional inward sideways force that increases pronation abnormally.

That abnormally increased pronation increases the load on the medial or inner side of the forward portion of the ankle joint, as indicated by its retarded structure noted above.

The Centuries-Old Misunderstanding of the Squatting Facets of the Ankle Joint

This pronation increase caused by the unnatural supination/tilting out mechanism is further reinforced by the absence of a natural stability mechanism, which is the second reason. Again, the absence is caused by elevated shoe heels.

On the forward part of the upper surface of the anklebone (talus) of all primitive, barefoot racial populations (including Neolithic Europeans[5]), it is very common to find what have always been call "squatting facets". These squatting facets essentially look like partial extensions of the forward part of the ankle's upper joint surface (the trochlear). The squatting facets can be located mostly on the inside, or the outside, or even include middle portions of the forward extension.

The accepted and completely settled explanation for their existence is that they are created to accommodate the habitual squatting position that is almost universally adopted by these primitive barefoot populations, which lack chairs to sit on in addition to lacking modern footwear. See FIGURE 5.4.

In the squatting position, the lower leg (shinbone or tibia) naturally moves as far forward as it can go. The forward motion is limited by the structural limit of the ankle joint. This position is called maximum dorsiflexion of the ankle joint.

That forward limit is reached when the lower portion of the tibia physically engages the upper neck of the talus. The abutment of the two bones of the ankle joint together creates the aforementioned squatting facets on the neck of the anklebone.

But squatting doesn't cause the facets, barefoot running does. If you refer back to Figure 3.2, remember that the maximum vertical ground reaction force at about 3 times body weight occurs during the running stride in exactly the same, fully dorsiflexed ankle joint position.

Again, the maximum regular forces that the human body encounters occur during running. By Wolff's Law, the maximally loaded position of the barefoot running stride is the fully dorsiflexed position in which the ankle joint is shaped. Squatting plays at best a very minor role because the forces involved are very low then.

So, these are definitely barefoot running facets. Their presence is indicative of the key stability role played by the fully dorsiflexed, locked ankle joint position of the runner's leg just when maximum load occurs when running. This position is effectively the position in which the human suspension system bottoms out and in which the human body is shaped by maximal forces.

The Renamed "Barefoot Running Facets" Stabilize the Knee When Running

The barefoot running facets are the forward endstop for the front of the ankle joint, serving to limit its forward motion in an efficient, structural way that minimizes muscular effort.

The fully dorsiflexed, foreward-locked ankle joint position provides a critically stable and efficient base for the runner's leg. Because it stops the forward motion of the lower leg (tibia), it also effectively reinforces the action of the thigh's quadriceps muscles to end the knee joint flexing that occurs to absorb the body weight force of landing. And it does so without any energy cost!

It is well known from prior studies that wearing conventional shoes with elevated heels causes the knee to flex more than when barefoot. This is because with such shoes the stabilizing base of the fully locked ankle joint of the barefoot is entirely missing.

With shoes, the tibia never abuts against the talus, so there are no "squatting" or "running" facets on the ankle bone of the modern foot.

The functional results are not good. Because the stabilizing base of the locked lower leg is gone with conventional shoes, the quadriceps muscles obviously must work harder than is natural.

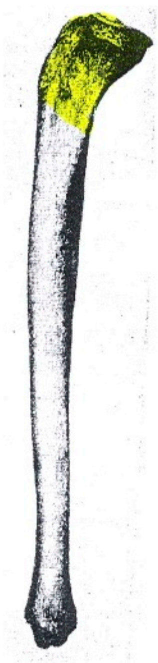
But that's not all. The muscles on the back of the lower leg, the solius and gastrocnemius, must work harder than is natural to stop the dorsiflexion action of the ankle joint. That abnormally increases the strain on the Achilles tendon and shortens it unnaturally.

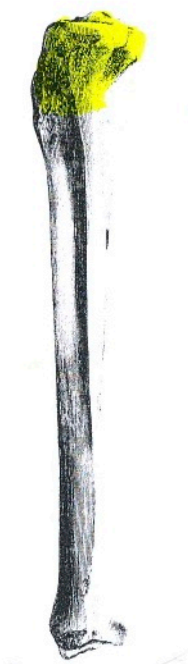
The unnatural strain on the Achilles tendon and on the quadriceps sets up a big part of the transition problem (going from barefoot to shoes or to shoes with different heel heights) touched on earlier. That transition problem will be discussed in more detail later.

The Puzzling Backward Angle of the Base of the Barefoot Runner's Knee Joint

This seems like the right point at which to digress slightly in order to clear up another long-standing misconception about another major joint of the lower leg anatomy typical of the primitive, barefoot population. It's directly related to the misunderstood squatting facts discussed above.

It has puzzled researchers from the Nineteenth Century until now why the primitive lower leg bone is slightly bent backwards, with the lower surface of the knee joint, the tibial plateau, tilted backwards at an angle about 5 degrees more than the modern knee[6]. In the few examples I have found in published studies, the angle looks greater, more like at least 15-20 degrees. See below on left in FIGURE 5.5.





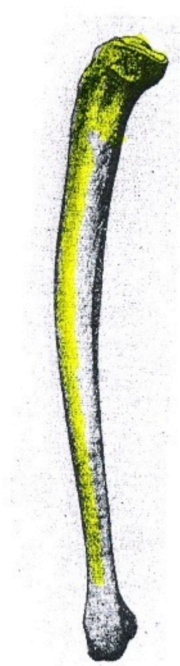


FIGURE 5.5 FIGURE 5.6 FIGURE 5.7

Again, the cause was thought to be the squatting habit of primitive barefoot populations. In contrast, the modern tibia is straighter and the knee's tibial plateau is closer to being horizontally oriented. See middle above again in FIGURE 5.6.

The answer to this puzzle about what is called tibial retroversion is strongly suggested by again referring back to Figure 3.2. Specifically to the lowest stride position shown there, when the body's suspension system has bottomed out under maximum load, with maximum knee flex.

Tibial retroversion of the normal primitive shin bone is further confirmation that this significantly flexed knee position of running is the most important leg position in molding the structure of the human body, not the relatively straight leg of standing and walking.

In that maximally loaded and flexed knee position, the tibial plateau of the barefoot runner's knee would be roughly horizontal. That horizontal position of the base of the flexed knee would seem like the most stable load-bearing position. It is natural and also much closer to the fetal angle.

In the same maximally loaded and flexed running position, the modern tibial plateau is tilted forward. But in that structurally much less stable position when running, the condyles of the thigh bone of the modern knee must be held in place on the tibial plateau by the knee ligaments and muscles.

The ligaments and muscles must work harder to resist the powerful forces acting on the condyles to slide forward when the runner's knee is flexed. And they must resist them with less natural direct bone structural support than the primitive runner's knee.

Another common structure among the same primitive barefoot runners is called tibial retroflexion. In retroflexion, the shinbone or tibia itself is slightly curved backwards. That has exactingly the same effect as tibial retroversion in that the tibia plateau is tilted backwards when standing upright and horizontal under max load in the flexed knee running position. See right above again in FIGURE 5.7.

Like tibial retroversion discussed above, tibial retroflexion of the normal primitive shin bone is further confirmation that the flexed knee position of Figure 3.2 is the most important leg position in molding the structure of the human body, not the straight leg of standing and walking.

A Different Ankle Joint Axis for Dorsiflexion and for Plantarflexion

Getting back to the irregular shape of the modern ankle joint, that abnormal shape is associated with a different axis for the dorsiflexion in the front of the ankle joint and for plantarflexion in the rear. Each axis is located in the frontal plane. In contrast, the primitive ankle appears to be simpler, very regular, with just one ankle joint axis.

In dorsiflexion the modern ankle joint axis slopes downward to the outside. In plantarflexion it slopes downward to the inside.

The logical explansion for this abnormality would seem to be this. As previously discussed, when elevated shoe heels plantarflexes the ankle joint, that backward motion automatically supinates the foot and ankle joint. That unnatural supination rotates the foot to the outside, raising the inside of the foot and ankle. By doing so, it also rotates upward the position of the planterflexion axis to a more level position for the ankle joint, which allows it to function more normally in its abnormal position.

Also as discussed previously, the elevated shoe heels exaggerate pronation, forcing the ankle joint downward during dorsiflexion. By doing so, it also rotates downward the position of the dorsiflexion axis to a more level position for the ankle joint, again allowing it to function more normally in a different abnormal position.

Xray Confirms Varus Position of the Front of the Subtalar Ankle Joint

A very recent study[1] of the configuration of the subtalar ankle joint appears to add to the confirmation of the basic thesis of this book. That is, that elevated shoe heels force the foot into an unnatural supinated position, tilted to the outside. The more the ankle and knee joints flex under increasing load when running, the farther to the outside the lower leg bone is tilted to the outside.

The really interesting, even surprising thing is that this clear and definite orientation to the outside is fixed throughout the forward motion or dorsiflexion of the ankle joint. Amazingly, it is fixed to the outside in supination even if the foot is forced to pronate excessively in reaction to the excessive unnatural forces described above.

The study's example x-ray of the subtalar joint taken in an anterior (front) part of the joint shows this clearly in the varus orientation of the surface of the joint[7]. See FIGURE 5.8. The extremely dense trabecular bone structure on the lateral half of the joint provides further confirmation in actual bone structure.

This dense structure indicates the excessive, unnatural force to which it has been subjected, by Wolff's Law. Again, this lateral tilting-out is all happening because of running in elevated shoe heels.

All the Basic Foot Types of Modern Runners Have Tilted-Out Lower Legs

All modern humans are affected by this unnatural problem. Pronating runners with flexible feet, supinating runners with rigid feet, and normal modern runners in between, the lower legs of all are tilted-out during the landing and first 30 milliseconds of stance. See FIGURE 5.9.

One of the earliest pioneers in the modern era of running research in the 1970's and 1980's, Peter Cavanaugh, discovered this in studies published in 1982 and 1987[8]. So whether the foot pronates excessively or never pronates at all (and instead rotates to the outside in greater supination), in all cases the lower leg is tilted-out abnormally.

In a different study[9] at the same time, another of the early pioneers, Benno Nigg, noted that the cases of runners who either pronate excessively or supinate excessively are unnatural. Those excessive motions occur only when running in modern running shoes, not barefoot.

Elevated Heels Cause Your Shoes To Wear Most On the Rear Outside Edge of the Heels

Your foot is always unnaturally supinated when it is landing during walking or running, so you land on the outside edge. Since elevated shoe heels unnaturally project downward below the level of the shoe wearer's foot sole when landing, it follows logically that the artificial heel projections must hit the ground first.

But, not only is your shoe heel affected by this artificial supination tilting-out, the heel bone (calcaneus) of the modern foot has a small bone protrusion at about the same spot.

It is called the lateral calcaneal tuberoscity and it is not present in primitive barefoot Africans[10]. See

FIGURE 5.10.

FIGURE 5.10

The fact that the foot is generally made more rigid when it is in the shoe heel-induced supination position would function to increase stress at the lateral calcaneal thereby causing an unnatural lateral calcaneal tuberoscity, as well as increasing lateral shoe heel wear, as noted above.

It is important to note also in Figure 5.10 that the rearmost portion of the calcaneus of the bushman (B) and Bantu (C) are essentially vertical, whereas that of the European (D) is tilted to the outside (note the level lines of attachment of the Achilles tendons of the three calcanei), again demonstrating proof of the effect of shoe heels.

Although less complete than the James Solomon Islands study, since it does not show the calcaneus of a European who has never worn shoes, it does show uniquely how the supinated or tilted out position is actually baked into the structure of the bone.

Elevated Heels Project Downwardly When Landing, Automatically Forcing Runners to be Heel Strikers

That's why nearly all runners wearing modern running shoes land heel first, technically called heel striking. Structurally speaking, it is impossible for this not to happen even if the modern shod runner's foot sole itself is actually perfectly level when landing, because of the abnormal downward projection of the elevated shoe heel, which inherently extends closer to the ground than the non-elevated forefoot of the shoe sole, so the heel will automatically touch first.

Human Evolution Indicates Nurture, Not Nature, Has Altered the Ankle Joint

For many decades the fossil record has been clear. The available ancient ankle bones going back several million years, from fossil discoveries like Lucy (see FIGURE 5.11) to the most recent discovery of many Homo naledi fossils, all are similar to the simple ankle joint structure typical of primitive barefoot populations. The Homo naledi talus even has obvious “squatting” facets. See FIGURE 5.12.

Given the critical survival nature of locomotion to our human precursors, it seems beyond doubt that the unbroken continuity of the simple, “primitive” structure of the barefoot ankle joint is absolutely baked into our genes as a firmly fixed natural trait.

Still, it is theoretically possible that the structural difference between modern and primitive barefoot ankle joint are a racial variation based on genetic differences. But those genetic differences would have to have evolved in an amazingly short period of time, well within the last one hundred thousand years.

Even in the absence of all the incriminating evidence relating to shoe heels already uncovered (with more to come), it seems virtually impossible for evolution to have produced such an abrupt and substantial change in modern ankle joints in so short a time.

The Internal Structure of the Ankle Bone is Unbalanced to the Lateral or Outside by Shoe Heels

Like the knee joint, the internal bone structure of the anklebone (or talus) also seems to indicate an unnatural imbalance to one side. The talus clearly shows relative over-development of the trabecular bone structure on the lateral side, due to increased pressure from the lateral side of the tibia (in parallel to the increase in medial pressure in the knee joint), resulting from the tilted out position of the tibia. See FIGURE 5.13.

Other Mammals Appear to Have Parallel Sided Ankles Too

I don't know if any similarly detailed studies have been done for mammals that are as detailed as those for humans discussed above. I would guess there are not, so I haven't made time to try to do comparative research on the anklebones of other mammals.

There is however a classic study by Hildebrand in 1960 on how animals run. Its drawings indicated that the precursors of modern mammals had what appear to be parallel-sided anklebones (that is, the trochlear joint surface). Modern cheetahs and deer appear to have them as well.

Horses appear to have them as well, but the joint is slanted somewhat, so it is less clear. Perhaps less relevant as well, since horses run on hooves that are actually the toenail of their middle toe, so the structure of their lower extremities has evolved in a much different manner than that of humans.

6 THE FOOT IS ALSO ABNORMALLY RESHAPED BY SHOE HEELS

As we have already discussed in the Preface, elevated shoe heels have also changed the overall shape of the human foot. As measured by a footprint, the modern foot of a shoe wearer clearly indicates the unnatural shift, rolling to the outside, that is characteristic of its abnormal supination - in contrast to the primitive, never-shod barefoot of a native Solomon Islander[1]. See again **FIGURE B** in the Preface.

Proof that this difference is unnatural and caused by conventional modern shoes with elevated heels is indicated in the same Lancet study, which compares the footprints of a native Solomon Islander with a European who had never worn shoes. Those other two footprints are nearly identical, clearly indicating that different races is not a factor. See again **FIGURE A** in the Preface.

As indicated previously, the abnormally supinated modern foot with tilted-out lower leg perversely creates a strong horizontal force component during stance that rolls the foot to the inside in a pronation motion.

This force is great enough that it shows up even in walking, wherein all forces are much less than in running. The result is to move peak pressures from the middle of the forefoot in the barefoot to the inner edge, focusing on the big toe (the hallux), in conventional daily footwear[2]. See **FIGURE 6.1**.

FIGURE 6.1

This focus of unnaturally high peak pressure on the big toe causes a significant structural collapse, a condition called "hallux valgus", which is a lateral deviation of the big toe. It is the most common orthopedic problem of the normal adult foot in shod populations (think particularly of women in high heel shoes), but exceedingly rare in barefoot populations[3] See FIGURE 6.2.

Again, this is not a racial difference. Hallux valgus was not common in medieval France, it became common in the 16th and 17th centuries in males (the early high heel adopters then, until the French Revolution), and since has been most common in women, especially so in contemporary times, now that relatively extreme high heels are common[4].

Are the Basic Motions of Pronation and Supination Missing in the Primitive Barefoot?

One of the most significant studies I have found is an old one referred to earlier[5]. It describes a typical primitive African barefoot as being turned in slightly (pigeon-toed). There is no eversion of the foot during walking stance. The foot sinks down 'on an even keel' due to a flattening of the main arch.

This is generally supported by the James study (cited in the Preface) that notes very little downward motion of the tuberosity of the navicular bone (connected to the front of the talus) under a body weight load, which means the main arch does not even flatten much.

The modern European foot is different. It is turned out about 20 degrees, with slight eversion, and with the lateral main arch remaining rigid and not supporting weight directly, instead sending it to the heel and forefoot.

This difference suggests that the whole range of modern foot stance motion is abnormally exaggerated from supination to pronation. It may be only an unnatural characteristic of the modern shod foot, tilted-out and made more rigid by elevated heels.

Note: for more information on the anatomy of the human foot see this **YouTube** video: https://www.youtube.com/watch?v=ROd1Acma64o ,which is titled “Foot Anatomy Animated Tutorial” by Randale Sechrest, MD.

7 SHOE HEELS TILT BOTH THIGHS AND HIP JOINTS OUTWARD

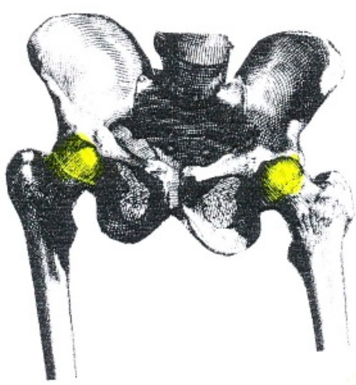
It should be no surprise at this point that elevated shoe heels tilt the thigh outward. After all, shoe heels tilt out the tibia, to which the thigh is directly connected at the knee joint.

The hip joint connects the thighbone to the pelvis. It is a ball and socket joint, which enables it to allow motion in all three planes. This is unlike the knee joint, which is more like a hinge joint, at least in its natural state.

The range of motion of the hip joint reflects the conclusion that it has developed abnormally to accommodate the unnaturally tilted out thighbone.

Referring to FIGURE 7.1, it appears that the whole range of hip motion is rotated abnormally to the outside. Even more telling, the central axis of the hip joint (F_2) is clearly rotated to the outside.

The abnormal development of the hip joint bones is clear when you compare the front of the hip joint, FIGURE 7.2, with the back, FIGURE 7.3.



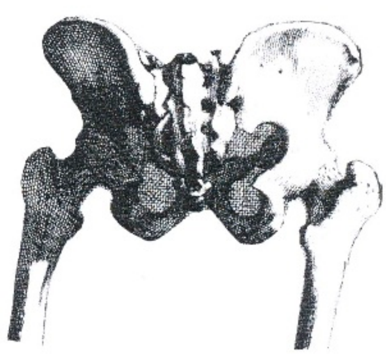
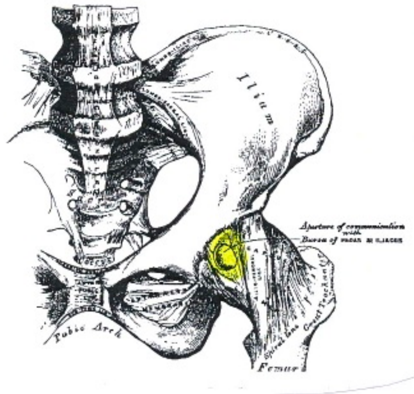


FIGURE 7.2 Front FIGURE 7.3 Back

What you see in Figure 7.2 is that the ball head of the left femur (or thigh bone) is substantially exposed in front, not covered by the acetabulum, the joint socket located in the pelvis and which holds the ball head. In Figure 7.3, you see the opposite in the back view, the ball head is rotated far inside the socket, more than completely covered by the pelvic acetabulum.

In FIGURE 7.4, a more detailed front view, you see similarly that the abnormal position of the ball head of the modern femur, which is not even covered by the ilio-femoral ligament. In contrast, the ball head is completely covered by the ligament in the parallel rear view of FIGURE 7.5.



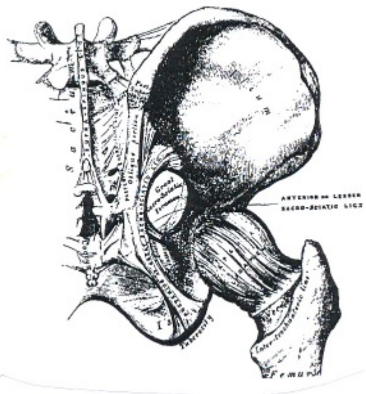


FIGURE 7.4 Front FIGURE 7.5 Back

The Hip Joint Incongruence is Incorrectly Blamed on Evolution

This obvious lack of critical joint surface congruence cannot be natural or effective biomechanically. Like the ankle and the knee, the inherent weakness of the modern human joint design is blamed on evolution.

Specifically, it is blamed on the bipedal, upright posture of the human body, especially during locomotion. Although it is true that this upright posture is unique among mammals, it is not a recent development that is still a work in progress.

As pointed out earlier, the enduring shape of fossil anklebones indicates a tried and true design millions of years old, not an unfinished, jury-rigged recent development. The same is true of the primitive barefoot knee.

The accepted current explanation for the apparently poor design of the hip joint is that it is designed for locomotion on all four limbs, just like all the other mammals. In other words, the bipedal human body has just incompletely and very imperfectly evolved from its original quadruped state.

Therefore, the accepted explanation goes, when the human body is repositioned into its former quadruped position, the ball and socket once again become correctly aligned in their more natural state. This explanation is illustrated in FIGURE 7.6.

Evolution Is Not the Reason for the Hip Joint Incongruence, for Two Reasons:

Although plausible, that explanation is wrong, because, first, as already shown in this chapter, elevated shoe heels rotate the femur outwardly, as already shown in the modern hip joint of Figures 7.1-7.5.

Second, just like in the knee, the design of the bipedal hip joint is shaped by the maximum forces to which it is subjected routinely (again, Wolff's Law). That is the flexed knee and flexed hip position of the midstance running stride shown previously in Figure 3.2.

In that maximally loaded midstance running position, the ball head of the femur and the acetabulum socket of the pelvis are correctly aligned. However, with elevated shoe heels, they are unnaturally misaligned in a rotated out position.

Nature is not at fault. Our shoe heels are.

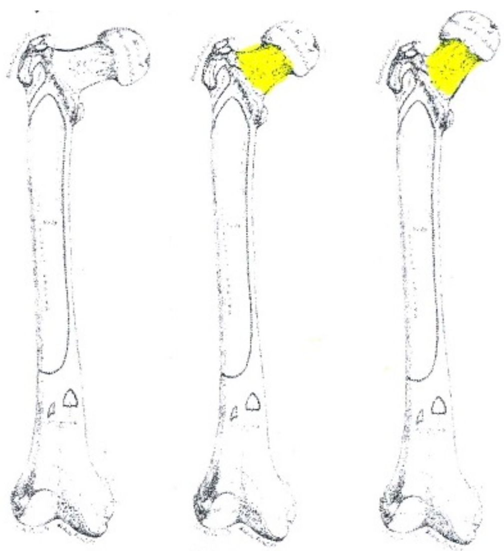
More on incorrectly blaming evolution for human design weaknesses later, in Chapter 37.

Like the Knee, The Modern Hip Joint and Thigh Bone Have Been Unnaturally Altered by Elevated Shoe Heels

The "normal" angle of inclination of the neck of the modern thigh bone (femur) is about 125°, as seen in FIGURE 7.7. The range of the angle of neck inclination is typically about 90° to 135° for modern thigh bones[1].

FIGURE 7.7 Modern Femur Neck Inclination

Coxa Vara Normal Coxa Valga



90°-124° 125° 126°-135°

A neck inclination angle less that 125° is termed **coxa vara**, which is obviously associated as the name implies, with genu varum or the bow-leggedness described in chapter 3 caused by shoe heels. A neck inclination angle of more than 125° is termed **coxa valga**, which is conversely associated with genu valgum or knock-kneed. Again, see Figure 7.7.

Notable even at first glance is the "normal" range for modern thighbones is heavily skewed in the direction of **coxa vara** (90° to 124°, or a range of about 35°) and away from **coxa valga** (126°-135°, or a range of 10°). This strongly suggests a parallel "normal" range for hip joints and knee joints that is heavily skewed in the direction of coxa vara and genu varum or bow-leggedness.

This usual amount of skewing toward bow-leggedness is exactly what we would expect to see, based on the effect of elevated shoe heels discussed in chapter 3. Moreover, the neck inclination angle is believed typically to decrease about 5° during adulthood, a progression toward increasing bow-leggedness that we would also expect to see, given the on-going effect of shoe heels to re-mold bone structure continuously over time throughout life.

Furthermore, the neck angle at birth is about 20° to 25° greater, which means a neck angle of 145° to 150°. That means a newborn's neck inclination angle is heavily skewed in the direction of coxa valga and genu valgum or knock-kneed. As the baby grows and learns to walk and run, the angle reduces over time.

The Effect of the Coxa Vara Angle of Neck Inclination of the Thigh Bone

A **coxa vara** neck angle results in a shortened leg. It also decreases the load on the spherical head of the femur or thighbone, but increases the stress on its neck, since the lower angle inherently functions less effectively as a natural arch. Also, it increases the effectiveness of the abductor muscles that stabilize the hip when load-bearing on one leg during walking or running[2]. See FIGURE 7.8.

Conversely, a **coxa valgus** neck angle results in a lengthened leg. It also increases the load on the spherical head of the femur or thighbone, but decreases the stress on the neck, since it functions more effectively as a natural arch. Also, it reduces the effectiveness of the abductor muscles that stabilize the hip when load-bearing on one leg during walking or running.

This coxa valgus condition will become significant later when we discuss females in more detail and then again later still when we discuss asymmetry.

Abnormal Outside Rotation of the Hip Joint Also Alters the Femur Neck Angle in the Horizonal Plane

The angle of the neck angle of the thighbone in the horizontal or transverse plane is called the angle of anteversion or retroversion. The neck of "normal" modern femur is rotated forward in the horizontal plane about 12°-14° of anteversion (relative to the position of the condyles of the femur forming the upper part of the knee joint at lower end of the femur). See FIGURE 7.9.

If the neck of the modern femur is rotated backward in the opposite direction in the horizontal plane, it is called **retroversion**. Retroversion is the condition that we would expect to see as a result of the discussion at the begining of this chapter concerning the effect of shoe heels in rotating the knee with the thighbone outward. Retroversion is the condition associated with supinated feet and bow-leggedness and therefore most obviously an effect of elevated shoe heels based on preceding discussions.

Like the coxa valgus condition, the prevalence of significant **anteversion** will be addressed in later chapters, when we discuss females and then later asymmetry.

The Abnormal Development of the Inclination of Modern Femur Necks

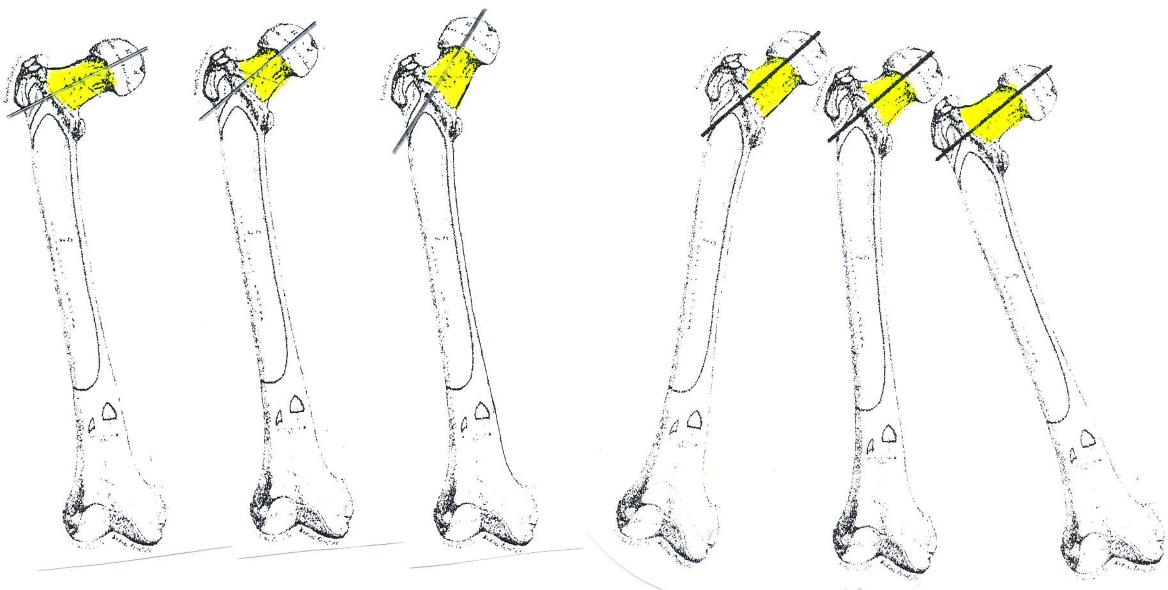
The way in which the neck inclination of the modern femur develops in reaction to the effect of elevated shoe heels is counter-intuitive.

If you simply align the modern femur necks at their normal angle to the pelvis, as shown below on the right side of **FIGURE 7.10**, you would assume that the modern coxa valga femur would coincide with the typical bow-legged position and that the modern coax vara femur would similarly coincide with the typical knock-kneed position.

FIGURE 7.10

Modern Femur Neck Inclination — **Femur Necks Aligned Normally**

Coxa Vara — **Normal** — **Coxa Valga** — **Coxa Valga** — **Normal** — **Coxa Vara**



90°-124° — 125° — 126°-135° — Bow-Legged — Normal — Knock-Kneed

Your reasonable assumption would be incorrect. However counter-intuitive, the opposite is what happens in reality.

If you simply rotate in the frontal plane the normal modern femur from the bow-legged position to the knock-kneed position, as shown on the left side below of **FIGURE 7.11**, you get a reasonable approximation of what happens in reality in reaction to the effect of shoe heels. In the abnormal bow-legged position, the normal modern femur neck is a more horizontal position, and in the knock-kneed position, it is in a more vertical position.

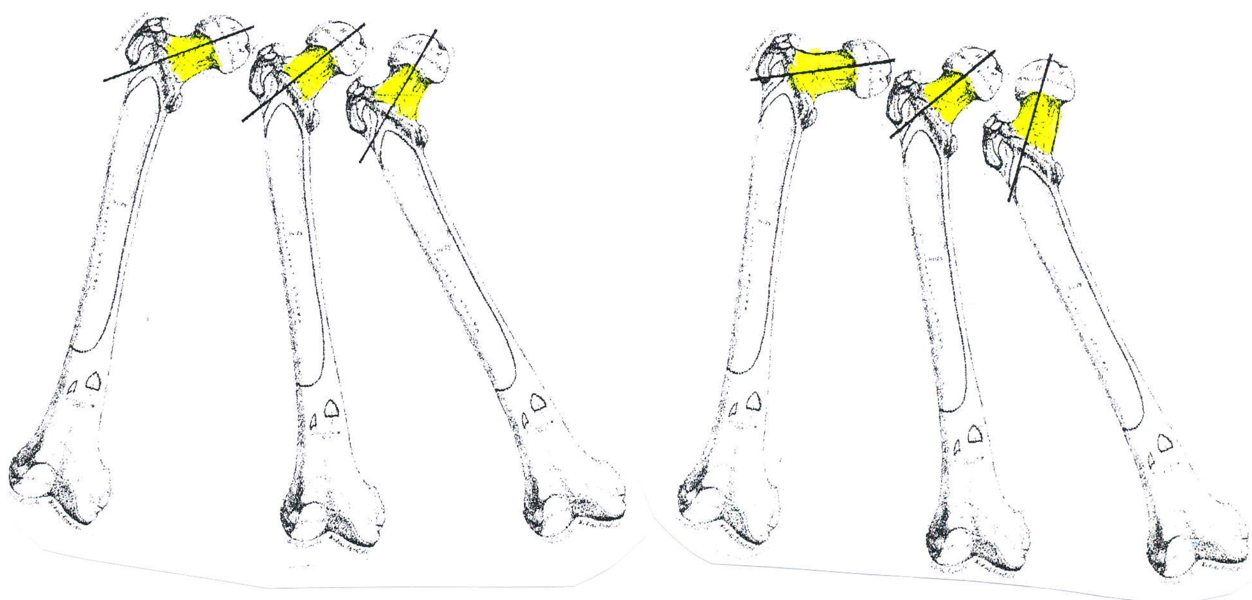
The structure of the modern femur neck is re-molded in accordance to Wolff's Law in reaction the misaligned forces to which it is subjected in coax vara and coxa valga. The necks of those abnormal modern femurs are subjected to misaligned peak forces at midstance during running, when shoe heels cause abnormal bow-legs and knock-knees, as described previously.

For c**oxa valga** femur necks, the result is an increase in the inclination angle, as shown on the right side below of **FIGURE 7.11**, to make the overall femoral structure more vertical and straighter, the better to structurally support the peak body weight force. Unfortunately, this shortens the moment arm of the side abductor muscles that stabilize the pelvis in the frontal plane as shown above in FIGURE 7.8, making resistance to pelvic tilting unnaturally more difficult.

Conversely, for **coxa vara** femur necks, the result is a decrease in the inclination angle, making it more horizontal, which increases the structural stress on the abnormally more acute arch, making it weaker. The result is that the neck becomes thicker and shorter (not shown), with however a longer moment arm of the side abductor muscles, stabilizing the pelvis and increasing its resistance to pelvic tilting.

F IGURE 7.11

Normal Femur Rotated **REALITY: Coxa Vara Normal Coxa Valga**



Bow-Legged Normal Knock-Kneed Bow-Legged Normal Knock-Kneed

Note: for more information on the anatomy of the hip see this **YouTube** video: https://www.youtube.com/watch?v=qlCvKEOZtpo, which is titled “Hip Anatomy Animated Tutorial” by Randale Sechrest, MD.

8 SHOE HEELS TILT THE PELVIS BACKWARDS UNNATURALLY

The natural position of the pelvis has been substantially alterred by the elevated heels of modern shoes, as you might guess by now. But exactly how is not at all obvious. Actually, it is quite subtle and surprising, like the action of the subtalar ankle joint.

Here is how. I stumbled across it in one of the oldest modern studies of running, "The Biomechanics of Running"[1], published in 1962 by an M.D., Donald Slocum, and Bill Bowerman, who was the famous track coach of the University of Oregon and also famous as one of the founders of Nike and developer of the "Waffle" sole running shoe and the Cortez model.

What the authors pointed out was that the pelvis automatically rotates forward in the sagittal plane (the flat plane centrally located that divides your body into a right half and a left half) when the thigh and foot rotate inward in the horizontal plane. And vice versa, when the thigh and foot rotate outward in the horizontal plane, the pelvis automatically rotates backward in the sagittal plane. Inward rotation of the pelvis increases the curve of the lower (lumbar) back; and outward rotation decreases the curve, causing a flatter position of the lower back.

The coupling behavior of the pelvis and femur was systematically explored and confirmed in a definative 2016 study by Jennifer Bagwell, Thiago Fukuda, and Christopher Powers, one of the leading experts in this field.[2] More specifically, they found that for every 5º of forward pelvic tilt there is 1.2-1.6º of internal femur rotation and, conversely, for every 5º of pelvic tilt backward there is 1.2-1.6º of external femur rotation. Their work conclusively confirms that of Bowerman and Slocum (who did not discover the coupling link but rather merely referred to the work of earlier researchers who they cite in their references).

You Can Do This Simple Confirmation Test

Bowerman and Slocum pointed out that you can confirm for yourself this direct connection between pelvis tilt and thigh/foot rotation with the following simple test:

> Stand in the normal erect position with the weight on both feet, then lift the right foot just above the ground. Now roll the pelvis forward (clockwise as seen from the right side), throwing the lumbar spine into the lordotic position; note the increased internal and decreased external rotation of the hip as demonstrated by the rotation of the foot. Next, roll the pelvis backwards to the flat-backed position and observe that the range of external rotation is increased materially while internal rotation is decreased correspondingly[1].

Of course, Bowerman and Slocum were not researching the affect of elevated shoe heels on the natural biomechanics of human running. Far from it. A few years after the study, Bill Bowerman became one of the leading originators and popularizers of the basic design of modern running shoes, starting with the Nike Cortez model (designed in 1965), with many others following – and all with relatively elevated heels of about 10 mm or 3/8ths of an inch, not a feature generally used in running or other athletic shoes before then, so far as I know.

The Backward Tilted Pelvis Causes an Unnatural Flat-back Position

What Bowerman and Slocum missed completely was, as I have already discussed, that elevated shoe heels cause the foot to supinate and lower leg to rotate outwardly. Since the lower leg obviously connects directly to the thigh at the knee joint, the thigh is also forced to rotate outwardly when running, automatically activating the rearward rolling of the pelvis into an unnatural flat-backed position.

So, to recap, the outward rotation of the thigh causing a backward rotation of the pelvis and flat back was described by Bowerman and Slocum as normal and therefore desirable in running. Instead, it is in fact an abnormality caused by shoe heels, and therefore highly suspect of creating unnatural problems.

A study in 1984 by Bendix has confirmed the relation the explicit relationship between elevated shoe heels and backward pelvic tilt.[3] Also, a study by Barbara de Lateur in 1991 found that high heels decrease the lumbar curve in men, creating a flatter, straighter lower back.[4] In addition, a 2001 study of 200 young women by Lee and others indicated that increasing heel heights significantly flattened the lower back by decreasing the trunk flexion angle.[5] See FIGURE 8.1.

The Backward Tilted Pelvis Causes Heel Footstrike

There have been a great many papers in the past few years on footstrike. The issue discussed primarily is whether a forefoot first contact or a midfoot first contact is more natural when the foot first touches down to the ground when running, rather than the heel striking first that is highly common with modern running shoes.

Slocum and Bowerman noted that the flat-back position of the spine when the pelvis is rotated backwards results in a backward shift in the body's center of gravity so that the body weight falls more toward the heels. They considered this desirable. Like the flat back position, they interpreted an abnormal condition to be normal.

The Iliotibial Tract Connects the Tibia to the Iliac Crest of the Pelvis

Before moving onto the problems, we need to get back to the iliotibial tract. The iliotibial tract is a super-long ligament connecting the outside edge of the uppermost tibia (shinbone) to the iliac crest, the upper rim located on the outermost side of the pelvis. See FIGURE 8.2.

FIGURE 8.2 Illiotibial Tract (in yellow) on Outside of Thigh

Unmentioned by Slocum and Bowerman, the iliotibial tract plays the critical role of connecting the lower leg (and therefore, the foot too, through ankle and subtalar joints) with the pelvis. Jennifer Bagwell, Thiago Fukuda, and Christopher Powers also only describe the specific parameters of the pelvis/femur coupling without identifying its interaction with the foot and ankle/subtalar joints.

The direct connection is by ligament alone, not muscle, so the mechanism happens automatically, without muscular control by the thigh muscles. In an important sense, the thigh is passive in this mechanism and in effect just goes along for the ride.

The control comes from the elevated shoe heels shifting the subtalar ankle joint outward, rotating the ankle joint and tibia outward, and thus the pelvis backwards, all because of the iliotibial tract connection. This shoe heel-induced abnormal motion between pelvis and femur is focused on the hip joints, where it unnaturally causes hip misalignment and associated osteoarthritis and/or femoroacetabular impingement.

The Unnatural Backward Tilt of the Pelvis Causes the Hamstring Muscles to Abnormally Tighten and Weaken

As mentioned previously, elevated shoe heels directly cause the muscles on the back of the lower leg to tighten abnormally. They also cause the muscles of the back of the thigh, the hamstrings, to tighten because of the backward tilt of the pelvis.

The tightening happens because the top of the hamstrings is attached to the ischial tuberosity of the pelvis (the bottom of the hamstrings connect to the top sides of the tibia). So when the pelvis is tilted backwards by shoe heels, the ischial tuberosity moves closer to the tibia. See FIGURE 8.3.

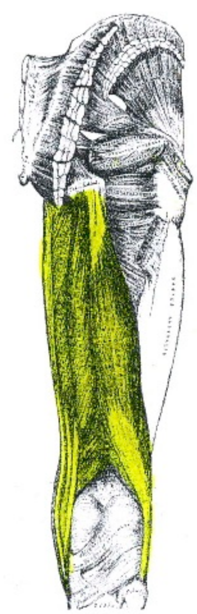


FIGURE 8.3 Hamstring Muscles (in yellow) on Back of Thigh

Bringing the upper and lower hamstring attachments closer together automatically shortens their range of motion, which tightens them abnormally. It also weakens them through disuse, or more specifically in this case, less use.

The weakening occurs as a result of the same motion, since the hamstring muscles do not have to work to bring their attachments together. So they do not strengthen naturally. They are brought partially together automatically by the unnatural backwards pelvis motion.

Summing up, the effect of shoe heels can be shown in its several resulting postural forms, as shown in FIGURE 8.4.

9 THE ABNORMAL FLAT-BACK CAUSES AN UNNATURAL FLAT-BUTT

The same shoe-heel induced backward tilt of the pelvis also causes the gluteus maximus muscle to weaken. Its upper, inside attachment is to the iliac crest of the pelvis down to the lower part of the sacum (the base of the spine that joins the two pelvis halves in the rear and the coccyx below it. See FIGURE 9.1. Its lower, outer attachment is the femur and iliotibial tract.

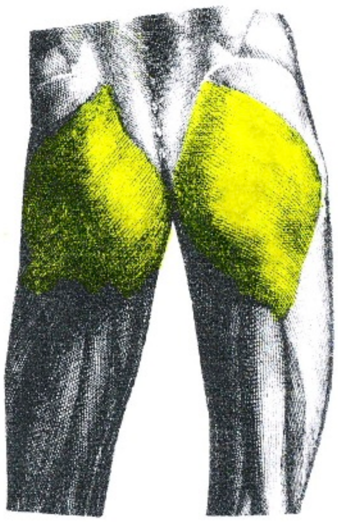


FIGURE 9.1. Gluteus Maximus Muscles (in yellow)

The effect of the backward pelvic tilt on the gluteus maximus is roughly twice as bad mechanically as it is on the hamstrings. The adverse effect is so magnified because both attachments are moved automatically toward each other.

The shoe heel simultaneously rotates the tibia out (together with the iliotibial tract attached it) and rotates the pelvis backwards. Essentially this rotation occurs due exclusively to the mechanical interaction of elevated shoe heels, bones, and ligaments. The unnatural mechanical interaction is powered passively by the bodyweight force of gravity, not by the force generated by muscles.

My best estimate is that the epicenter of the muscle weakening is the coccyx, meaning that the relative motion of the gluteus maximus muscle attachment is greatest at the coccyx and its counterpart on the iliotibial tract. In other words, the gluteus maximus muscle works the least hard at that location, in a relative sense.

So here is the net effect. The coccyx would be the pelvic bone that projects rearward the farthest, but it is rotated in the most.

And the development of the gluteus maximus muscle is significantly reduced, with the reduction centered around the coccyx and fanning out to the sides. The unnatural result is an abnormally flat back and an abnormally flat-butt, directly below it.

Most would agree that this change has a disagreeable aesthetic effect. However, the functional and structure effects go far beyond aesthetics. In fact, the unnatural flat-butt has dire effects that cascade throughout the entire body, affecting almost every part.

For starters, just like the backward tilting pelvis effect on the gluteus maximus was twice as great as the effect on the hamstrings, the effect of the flat-butt is doubly magnified, as we shall see in the next chapter.

Note: for more information on the anatomy of the muscles of the thigh and gluteal region see this **YouTube** video: https://www.youtube.com/watch?v=kXg3akhbrrg, which is titled "Muscles of the Thigh and Gluteal Region - Part 1 - Anatomy Tutorial" from AnatomyZone.

10 THE ABNORMAL FLAT-BUTT RESULTS IN AN UNNATURALLY SOFT BELLY

The double magnification comes from the fact that muscle groups work in tandem over a joint, like the front and back muscles of your legs. They are antagonistic to each other, meaning when one muscle group extends the joint, its antagonist group does the opposite and flexes that joint.

In a direct sense, the two muscle groups work against each other. And the development, or lack thereof, of one group directly effects the muscular development, or lack thereof, of the other.

There should be a natural balance between a pair of antagonistic muscle groups. In fact, there has to be. If there is not, the weak muscle group tends to become injured, particularly under repetitive stress.

For example, it is pretty well established now that relatively strong quadriceps paired with relatively weaker hamstrings leads to hamstring muscles pulls, particularly on the weakest leg.

In this case, the antagonistic muscle group is the abdominals, primarily the rectus abdominis. See FIGURE 10.1. But the problem is much more that just that the abdominal muscles are paired with an abnormally weak muscle group led by the gluteus maximus.

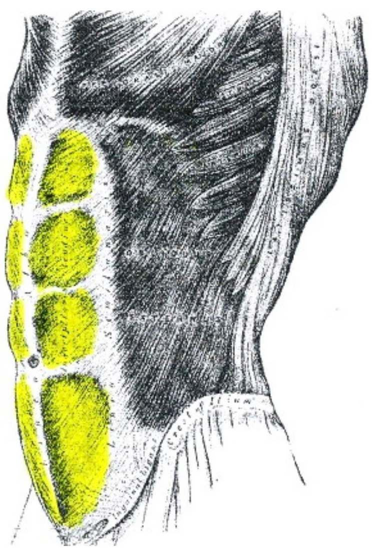


FIGURE 10.1. Rectus Abdominis Muscles (in yellow)

The biggest problem is that the automatic backward tilting of the pelvis has essentially the same effect on the abdominal muscle group as it does on the gluteus maximus. That is to say, the backward tilting moves the upper (rib) and lower (pubic) attachment points of the rectus abdominis automatically closer together.

This happens at the midstance, maximally loaded position in running when the abdominal muscles would normally be fully activated to absorb the peak force of body weight. The result again is a severely weakened muscle group.

Lack of Primitive Barefoot Population Evidence Forces a Slightly Different Methodology

Unfortunately, I haven't located comparative information from studies of primitive, barefoot populations relative to the flat back, flat-butt, and soft belly characteristics of the modern human body. Bones and fossils leave a physical record to analyze that muscles do not. So is it impossible to figure out directly what structure and function that backs, butts, and bellies that have not been altered by shoe heels should have?

There is however a fall back approach. I believe it is a reasonable assumption to make that athletes who are exceptionally gifted and durable physically are likely to be very close to the natural primitive norm of a body undeformed by modern shoe soles with elevated heels. At any rate, they are the closest we have without new field studies.

There are some additional arguments to support that reasonable assumption, but they fit better into another topic we will get into later. So for now, just listen to where the reasonable assumption can take us.

Famous Superstar Athletes Who Were Absolute Physical Phenoms Shared a Key Trait: Rock-Hard Abs

Two such almost superhuman athletes are Hershel Walker and Michael Jordan, both of whom unquestionably stood well above their peers at the collegiate and professional level and did so for a long time. One key physical trait they shared is phenomenally developed abdominal muscles.

Hershel Walker was well-known for having grown up on (and maintained) a training regime that focused on doing almost unlimited sit-ups. See VIDEO 10-1.

Michael Jordan had exceptional six-pack abs, as you can verify in the movie, **Space Jam**. See FIGURE 10-2.

To digress slightly to emphasize that point, Michael's abs were so exceptionally tight that during college he was cut slightly on the stomach by a sword-wielding showman in a surprising accident. The swordsman routinely placed watermelons on the stomachs of volunteers. Then with great flourish he sliced the watermelon in half without harming the volunteers. The swordsman's technique worked flawlessly until Michael, but no one knew until then just how unusually hard his abs were.

In addition, dominating the current generation of superstar athletes is Usain Bolt, the current world record holder as well as 2008 and 2012 Olympic champion in the 100 and 200 meter sprints and 400 meter relay. He also has phenomenally developed abdominal muscles. See FIGURE 10.3.

Similarly, a young barefoot boy has symmetrical abs. See FIGURE 10.4. As does the classic Renaissance (1503) statue of Michelangelo's David (See FIGURE 10.5), whose symmetrical abs are typical of all non-modern sculpture (See FIGURE 10.6). In contrast, a typical modern Western man has asymmetrical abs, even if well developed. See FIGURE 10.7.

Oddly, the most popular texts on biomechanics and kinesiology, which seem excellent in every other way I can discern, have little text and no figures focused on the abdominal muscles. This seems surprising to me since I thought that there has been a fair amount of attention in recent years generally in developing and maintaining a strong “core”.

At any rate, since as I have shown, shoe heels have the effect of weakening the abdominals, we will return to this important issue later.

11 A MAJOR MISALIGNMENT: BOTH FEET AND LEGS TILTED OUTWARD, ROTATING THE PELVIS BACKWARDS

Summarizing what happens when we run, because of elevated shoe heels, each foot is tilted to the outside. Instead of straight ahead, each foot is pointed in a different direction, away from each other. The right foot to the right of center, and the left foot to the left of center.

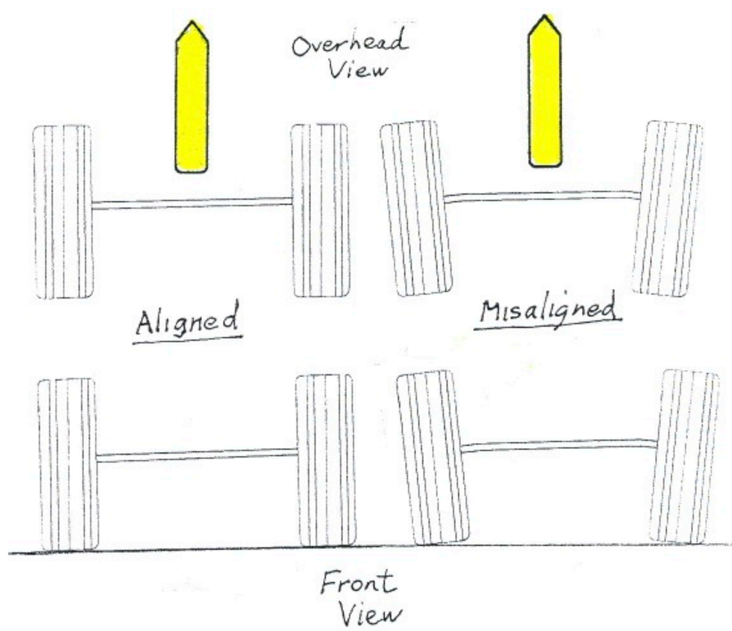
As a result the unnatural foot position, each leg is tilted to the outside and away from the other leg. Each leg is pointed in a different direction and neither of those different directions is straight ahead. The abnormal position of both legs rotates the pelvis backwards into an abnormal position.

All these abnormalities together present a serious misalignment problem. Each leg is headed in a different direction, but both are connected together by the pelvis. How does the body cope? What happens?

Your Body Has A Major Front End Misalignment That Causes Unnatural Breakdowns and Accidents

Imagine for a minute this crude car analogy, where your legs and pelvis are the front end of the car. Your legs are the wheels and suspension, and your pelvis is the rest of the front end of a car. Because of elevated shoe heels, your front end is not correctly aligned, to put it mildly. It is splayed out abnormally.

In effect, each wheel has over-inflated tires (like your abnormally supinated foot is unnaturally rigid) and is also tilted-out to wear on the outside edge of the tire. In addition, each wheel is pointed in a different direction to the outside, not straight ahead. See FIGURE 11.1.



It is easy to forecast what will happen. Your car's wheels, suspension, and front end will wear out quickly, unless they cause an accident first. Breakdown or accident, those are inexorably the only two possible outcomes. The car will never make to anywhere close to its warranty mileage.

Compared to a car, your body is a far superior and much more accommodative biological machine. But the result is the same in the end, if more subtle. Just a slower, much more subtle breakdown over a much longer period of time.

In short, then, elevated shoe heels create abnormal body structures that cannot work together as a complex, interrelated system in a natural way. They can only cause an early, unnatural breakdown, both more rapidly and in abnormal ways.

12 SHOE HEELS TYPICALLY MAKE BOYS BOW-LEGGED

There is good evidence that there are two basic ways in which your body must breakdown structurally in response to your fundamentally misaligned front end.

The first way is as just described above, which is most typical in males, is with both knees bent out to opposite sides, in a bow-legged position. Although created beginning early in life primarily from running, the bow-legged stance manifests itself also when walking or standing because the typically male leg bones become structurally molded into that position permanently.

The medial or inside portion of both of the typically male knee joints is under abnormal, excessive pressure, which retards bone growth. The lateral or outside portion of the male knees is under abnormally light pressure, which stimulates bone growth. All this according to Wolff's Law.

A Wide Spectrum of Variation in the Angular Degree of Typical Male Bow-Leggedness

The result over time is that typically both male knees tend to become permanently bent out into a classic bow-legged position. See **FIGURE 12.1A** below. As a general rule, this is the structural state of most modern males, although the amount or angle of bow-leggedness varies widely. There is a wide spectrum of variation in the amount of typical male bow-leggedness, depending on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

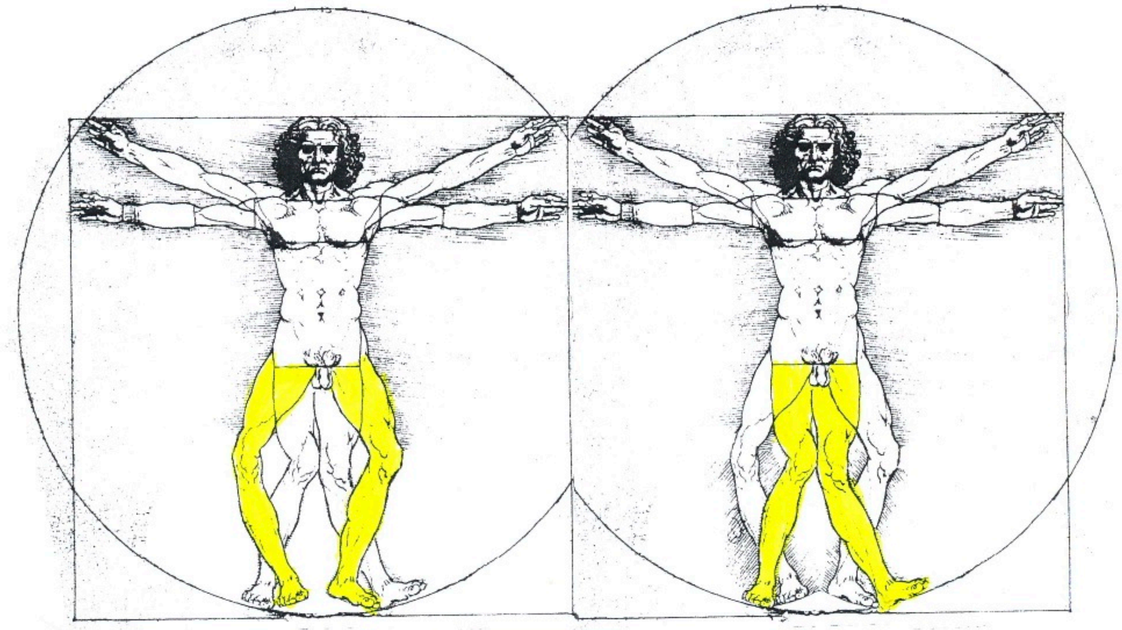


FIGURE 12.1A Bow-legged FIGURE 12.1B Knock-kneed

The range of variation is sufficiently great that any particular individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

One noteworthy male characteristic resulting from being in a sense pushed into this abnormal position is that it contributes to a further stiffening of male joints, which are already less flexible than those of women (by reproductive design). This is because being pushed unnaturally in one direction only repeatedly gradually reduces the range of motion of the involved joints in the opposite direction.

Thus, the abnormally rigid foot created by the unnatural supination induced by elevated shoe heels causes further rigidity everywhere else in the male body, but particularly in the lower back because of the backward rotated pelvis. More about this will be presented later.

The Principal Unique Factors Behind the Male Type of Breakdown Are Relatively Low Heels and High Activity

The principal factors that create this typical male state are relatively low elevated shoe heels and relatively high activity levels. Many studies confirm that boys are more physically active than girls[1]. And, generally among males, high heels are relatively uncommon, except among cowboys.

By the way, the best historical information available is that elevated shoe heels were invented by medeval Asian horsemen, who used them to anchor their shoes more securely in their stirrups[2]. This is almost comically ironic now in hindsight.

Cowboys archtypically have bowlegs, commonly thought to be the result of endlessly long days riding in the saddle with legs bowed around the body of the horse, the better to keep from falling off. Perhaps that is a minor factor, but like the most famous Nike ad about Michael Jordan's superhuman performance, it is not the horse; instead “it's the shoes!” In this particular case, the cowboy boots. Remember tge Gary Larson cowboy cartoon, Figure 3.13.

There is another factor relative to the amount of bow-leggedness: luck. Luck in the form of genes, which is whatever is an individual personal natural disposition toward developing bowlegs. That is currently an unknown that we will discuss later.

Accidents Like Ankle Sprains Are Another Major Factor In the Development of Bow-Legs

The other form of luck besides genes is accidents. Because of shoe heels, body structure is weaker than natural and therefore prone to unnatural damage that can profoundly effect the development of an individual's body afterwards.

For example, one of these weaknesses is the unnatural structure of modern ankles. Elevated shoe heels cause supinated feet generally, tilting or rolling ankles to the outside (or laterally) in exactly the same direction of most ankle sprains. And lateral ankle sprains are by far the most common sports injury and also the most common injury requiring Emergency Room visits (although most sprain ankles go without any proper professional treatment).

These acute injuries were once dismissed as generally temporary. But studies now are making it increasingly evident that at least many (or perhaps even most) of these injuries are leading to chronic, permanent injuries. We will get back to this later.

The Transition Back to Barefoot Running Has Become Difficult If Not Impossible for Most

As noted above, because of Wolff's Law, the abnormally bent out legs and backward tilted pelvis caused by elevated shoe heels gradually rebuilds our skeleton over time into this unnatural structure with abnormal function.

Each individual person has their own set of factors that has altered their own unique personal structure. It can be fairly close to natural with relatively normal function. However, each individual’s personal structure can also be at the other extreme, highly unnatural with very abnormal function. Or it can be somewhere in between the two extremes. There are additional complications we will discuss later.

But if you have more than insubstantial structural changes it is impossible to transition back to the natural, barefoot condition simply by removing your shoes. The reason is that the abnormal shod structural state has become the artificial new norm for you.

The sad reality is that you have become dependent on elevated shoe heels to maintain the abnormal alignment that has become baked into your anatomy. For example, if your legs have been remolded into a bowed position by shoe heels, removing the heels will not change that.

Moreover, removing the heels will now create unnatural pressure on the outside or lateral portion of your knee, just as surely as putting on elevated heels originally created unnatural pressure on the inside or medial portion of your knee.

In a figurative sense, most of us have inadvertently painted ourselves into a corner by wearing modern shoes with elevated heels. In fact, I think our collective situation is even worse than that.

Switching from Higher Heels to Lower Heels or Barefoot Causes New and Different Injuries

The first part of the bad news is that you have already switched back and forth almost randomly throughout your life between higher heels, lower heels, and no heels, as noted earlier. So you are already locked into the additional but opposite structural problem discussed immediately above caused by removing the unnatural support of elevated shoe heels.

The second part is actually worse. As best I can determine from the limited available evidence, reducing or removing the unnatural shoe heels after your body has been remolded to them causes something like a structural collapse inward of the many interconnected but misaligned parts.

In terms of your body, it is sort of like building it into a house of cards and then removing one, causing the whole structure to collapse.

This reaction of inward collapse is inherently complicated due to the massive complexity of the human body. And being unknown until now, it has not been formally researched at all. So it is not possible for me to describe it to you in simple terms, even to the limited extent I understand it at this early stage.

But because we have all already done this switching back and forth, it is possible to describe the apparently related effects on the body that have been researched. The short answer is that substantial asymmetries are created between the right and left sides of your body making them unnaturally different. And these asymmetries cause new and different problems beyond those simpler, relatively symmetrical ones we have already discussed.

This is pretty complicated and the subject of its own later chapter. So for now, we will move on to how the misalignment of backward rotated pelvis and outward tilted legs changes the basic shape of the pelvis.

13 HIGHER HEELS & WIDER HIPS ULTIMATELY HAVE THE OPPOSITE EFFECT ON THE FEMALE BODY

To recap the previous discussion, the effect of elevated heels on males tends to cause a bow-legged stance (technically called genu varum). In females, the opposite effect of knock-knees tends result from high heels (called genu valgum). See **FIGURE 12.1B** above.

The Factors Causing the Opposite Effect: the Typical Knock-Kneed Position of Modern Females

The reason for the opposite modern male/female structural reactions are as follows. First and foremost, females tend to wear much higher heel shoe than males.

Second, and perhaps as important, females tend to have a wider pelvis but shorter legs than men, both of which physical characteristics together create a greater angle of the thigh from vertical (called the Q angle).

Finally, and this may be the decisive factor, the major hormonal differences, particularly that kick in at puberty, which significantly increase female joint flexibility, as anyone who has attended an adult coed yoga class is well aware. Male joints tend to be much stiffer, with less range of motion, and the effect of shoe heels is to increase significantly that relative difference.

The female's more flexible joints include the hip, knee, ankle, and, most importantly, the main longitudinal arch of the foot[1]. Puberty coincides with time period during which the two sexes diverge most significantly with regard to the above structural differences.

Despite Opposite Effect on Legs, The Underlying Cause Is the Same for Females and Males: Elevated Shoe Heels

Most important, it must be emphasized that the cause of the abnormal structural changes remains the same for females as males, as you should expect. The elevated shoe heels cause the subtalar and ankle joints to rotate outward, causing the tibia to rotate outward into the tilted out position that we have discussed at length before. This abnormal position results in what is technically called external tibial torsion.

The Major Effects of High Heels on Modern Females

The major effects of elevated shoe heels on modern females are fairly easy to summarize. The relatively higher heels acting on the very flexible foot and ankle joints – particularly the more flexible main longitudinal arch of the foot – result in the foot pronating excessively (thereby crushing the big toe, twisting it inward).

The tibia rotates inward with the excessive pronation of the modern female foot, but remains unnaturally outwardly rotated relative to the femur (thigh bone). So the kneecap (patella) is misaligned in the knee joint (called patella subluxation).

The large angle from vertical of the thigh (excessive Q angle) forces the modern female knee inward into a knock-kneed position, which reinforces the excessive pronation of the foot.

The thighbone rotates internally on the hip joint, following the excessive pronation of the foot and inward rotation of the tibia.

And, finally, the iliotibial tract (or band) ligament causes the pelvis to rotate forward automatically, due to the aforementioned inward rotation of the tibia caused by the excessive foot pronation. See FIGURE 13.2

FIGURE 13.1

Elevated shoe heels thus have a dual action on female joints. In the first stage, the female joints are pushed outward, like those of modern males. In the second stage, the female joints then collapse inward, unlike modern males who typically do not develop the second stage.

The female-only dual stages that occur in opposite directions reinforce their hormonally-based flexibility advantage over males. This results from females being forced by shoe heels to use a much fuller range of their natural joint motion, and thereby modern females retain it, at least compared to modern males.

A Wide Spectrum of Variation in the Angular Degree of Typical Female Knock-knees

In similar manner to males, the result over time is that typically both female knees tend to become permanently bent inward into a classic knock-kneed position. As a general rule, this is the structural state of most modern females, although the amount or angle of knock-kneedness varies widely. There is a wide spectrum of variation in the typical amount of female knock-kneedness. For each individual, it depends on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any specific individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

The Female Hip Joint and Thigh Bone Have Been Unnaturally Altered by Elevated Shoe Heels

As noted earlier in chapter 7, the "normal" angle of inclination of the neck of the modern thighbone (femur) is about 125°, as seen in FIGURE 7.7. The range of the angle of neck inclination is typically about 90° to 135° for modern thighbones.

A neck inclination angle less that 125° is termed coxa vara, which is obviously associated as the name implies, with genu varum or the bow-leggedness described in Chapter 3 caused by shoe heels. A neck inclination angle of more than 125° is termed coxa valga, which is conversely associated with genu valgum or knock-kneed. Again, see Figure 7.7.

Notable even at first glance is the "normal" range for modern thighbones is heavily skewed in the direction of coxa vara (90° to 125°, or a range of 35°) and away from coxa valga (125°-135°, or a range of 10°). This strongly suggests a parallel "normal" range for hip joints and knee joints that is heavily skewed in the direction of coxa vara and genu varum or bow-leggedness. As just discussed in chapter 12, bow-leggedness is typical of males.

The Effect of the Coxa Vara Angle of Neck Inclination of the Thigh Bone

A coxa vara neck angle results in a shortened leg. It also decreases the load on the spherical head of the femur or thighbone, but increases the stress on its neck, since the lower angle inherently functions less effectively as a natural arch. Also, it increases the effectiveness of the abductor muscles that stabilize the hip when load-bearing on one leg during walking or running. See FIGURE 7.8.

While the coxa vara condition is most typical of males, many females also have the coxa vara condition, particularly those who are more athletically active. This may partially account for the greater injury problem of female athletes compared to males.

The increased injury would be expected to result from the two stages typical of female response to elevated shoe heels mentioned above in this chapter. First, shoe heels force the knee to rotate outward unnaturally, and second, that abnormal position causes excessive pronation of the foot, which rotates the knee inward unnaturally.

Conversely, for most other females, the effect of shoe heels typically results in a coxa valgus neck angle. That causes a lengthened leg. It also increases the load on the spherical head of the femur or thighbone, but decreases the stress on the neck, since it functions more effectively as a natural arch. Also, it reduces the effectiveness of the abductor muscles that stabilize the hip when load-bearing on one leg during walking or running.

Abnormal Outside Rotation of the Hip Joint Also Alters the Femur Neck Angle in the Horizonal Plane

The angle of the neck angle of the thighbone in the horizontal or transverse plane is called the angle of anteversion or retroversion. The neck of "normal" modern femur is rotated forward in the horizontal plane about 12°-14° of anteversion (relative to the position of the condyles of the femur forming the upper part of the knee joint at lower end of the femur). See FIGURE 7.9.

If the neck of the modern femur is rotated backward in the opposite direction in the horizontal plane, it is called retroversion. Retroversion is the condition that we would expect to see as a result the discussion at the being of this chapter concerning the effect of shoe heels in rotating the knee with the thighbone outward. Retroversion is the condition associated with supinated feet and bow-leggedness and therefore most obviously an effect of elevated shoe heels based on preceding discussions.

Like the coxa valgus condition, the prevalence of significant anteversion will be addressed in later chapters, when we discuss asymmetry.

But for the Major Effects of Elevated Shoe Heels, Men and Women Would Be Much More Alike

All of these major effects are well established, except the last (which you can confirm for yourself with the simple test described earlier in Chapter 8). What has been missing until now is the identity of the single unifying cause for all these significant effects: elevated shoe heels.

This description is of the extreme effects that elevated shoe heels can cause. But, like males, most females will lie on a spectrum somewhere between this extreme and a much lessor effect, depending on highly individual factors and luck.

If you think about it, this is all pretty extraordinary. The same basic cause - elevated shoe heels unnaturally tilting out the ankle joint and shin bone - has the opposite effect on women and men, greatly increasing the abnormal structural and functional differences between them. If we were like primitive, barefoot populations, without elevated shoe heels, men and women would be much more alike structurally.

The Difference in Pelvic Rotation Between Modern Male and Modern Female Is Substantial and Unnatural

The stark difference between the typical male pelvis backward rotation and the typical female forward rotation is shown most definitively by the radically different positions of the sacrum and coccyx (in yellow, located in the middle of the rear of the pelvis), as shown in **FIGURE 13.2**.

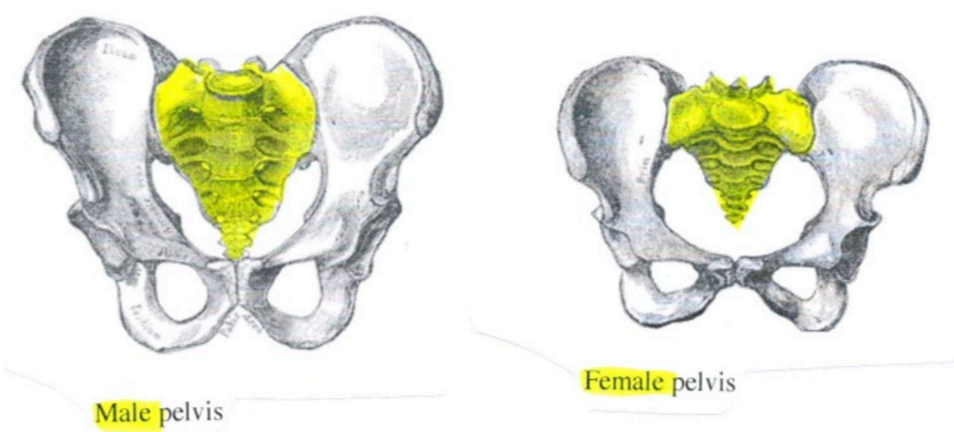


FIGURE 13.2

The sacrum, which joins the two sides of the rear pelvis, is the base of the spine, so its major difference in relative position shown in these figures indicates clearly how different the typical pelvic rotation position is in males and females. The wide difference is unnatural and caused by elevated shoe heels, as noted earlier.

Summarizing the basic difference in pelvic rotation (in the sagittal plane) between males and females, observe in **FIGURE 13.3** that women most typically have the rotated forward pelvic position shown in (a) Lordosis and (b) Kyphosis, although many other women have a (c) Flat back more typical of males, as is (d) Sway back, although many other men have (a) Lordosis more typical of females.

FIGURE 13.3

A Wide Spectrum of Variation Exists in the Degree of Angular Rotation of the Pelvis of Each Individual Male and Female

As was the case with bowed out or in legs, the result over time is that typically male and female pelvises become permanently rotated backward or forward, respectively. As a general rule, this is the unnatural structural state of most modern males and females, although the amount or angle of pelvic rotation varies widely, even occasionally its direction. There is, of course, inherently a wide spectrum of variation in the amount of typical male or female pelvic rotation. It depends on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any given individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

These Abnormal Changes to Women Make Them Prone to Both Acute and Chronic Injury

The injury rates for females in athletics is far higher than for males in athletics for nearly every category of injury. Women have far higher rates of arthritis as well. All are due to abnormalities caused by the dual effect of the higher heels of shoes on women, compared to the single effect of lower heels on men.

Does Typical Male or Female Use of Shoe Heels Predominately Dictate Structural Body Type?

A recent episode of **CBS 60 Minutes**[2] focused on a transgender female first year college student at Harvard, a champion swimmer who had previously come out as gay in high school. She transitioned to transgender (including testosterone therapy and breast reduction) during a year off before beginning college.

What I could see in the broadcast that is striking about her physical structure is that she walks with her legs in a bow-legged orientation typical of many males, rather than the straighter or knock-kneed position more typical of many females, such as that shown to her right by her girlfriend walking beside her. See VIDEO 13-1.

Since the transgender female apparently was a classic Tomboy who spent most of her time growing up with the guys doing guy things, one possible explanation for her atypical physique is that her legs became bowed-out doing the same high level of activities with low shoe heels that typically influences male structural development, as discussed in chapter 12.

Alternatively, by making her ankle, knee, and hip joints less flexible, her testosterone therapy in the past year may either have produced the bow-legged structural change or increased it in conjunction with her Tomboy lifestyle.

Another recent broadcast on transgenders in the military featured on PBS Newshour focused on another transgender female, who also walked in the same bow-legged position of many males.[3]

Therefore, summing it up simply, has a seemingly minor change to male-type shoes (and/or male hormones) in fact changed major structural features of her body from characteristically modern female to typically modern male? This is an interesting question for which there is absolutely no definite answer currently.

More research is urgently required. If the basic physique of a female can so easily be transformed in childhood to that of a typical male by adopting the low heeled footwear and using them in a typically male lifestyle, then it would be further proof of the absolute power of shoe heels to remold the human body.

14 UNNATURAL PELVIC SHAPE MAKES CHILDBIRTH UNNECESSARILY DIFFICULT

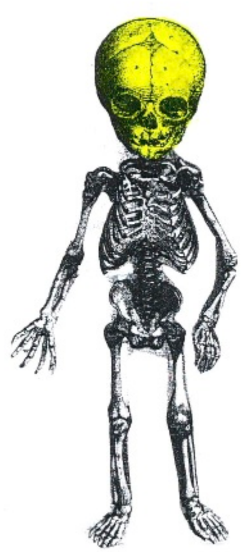
One general effect of the front-end misalignment on the pelvis is pretty simple. With both feet and legs routinely pointed in different directions to the outside, the pelvis in the middle is pulled apart.

The Unnatural Modern Pelvis is Wider and Flatter than the Primitive Natural Pelvis

The result is that the unnatural modern pelvis is widened and flattened. The natural pelvis of primitive barefoot populations is narrower and rounder. See FIGURE 14.1. This natural rounder shape is especially true of the brim through which childbirth occurs. In contrast, modern pelvic brims are noticeably flattened from front to back[1]. Therefore, childbirth is typically much easier for women in primitive barefoot populations.

Obviously, this is a deeply troubling problem with respect to women and childbirth. As usual, conventional wisdom is that the problem is caused by nature. Specifically, the conventional explanation is the incomplete evolution of humans from quadrupeds to their unique human bipedalism. Of course that's wrong; again it's the stupid shoe heels.

The main problem in human childbirth is the size and shape of a human baby's head. The head is huge, twice the size of our closest animal relative, the chimpanzee. The head on the skeleton of a newborn is so large it makes the skeleton look like it must belong to a space alien with an enormous brain (although at least not in the shape of the popular "cone heads" of 1990's Saturday Night Live). See below FIGURE 14.2.



The Brim of the Deformed Modern Female Pelvis is Too Small For the

Huge Human Baby Head

The bone of the female pelvic brim and the baby's relatively huge skull are about the same size (see FIGURE 14.3 and 14.4). So the fit is far tighter than other primates. But mismatched in shape also, so that the baby must enter the birth canal sideways, and then make a difficult 90 degree turn, all because of the unnaturally flattened brim and pelvis[2].

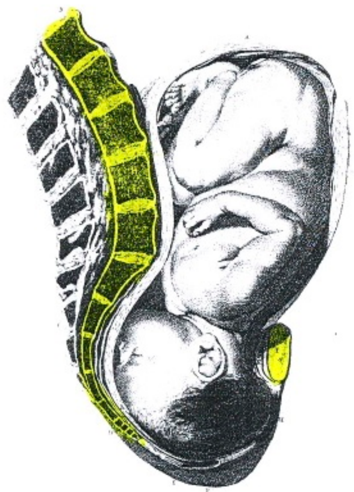


FIGURE 14.4

The head of the fetus has somewhat flexible sutures within the bone of the skull that help the fetus squeeze through the birth canal. However, that inherently difficult birth passage is the most traumatic event to which the fetus's brain is exposed, so the danger to it is great and any damage can have severe aftereffects extending throughout later life.

Although fairly high, elevated shoe heels were initially worn by men, by the 19th Century their use was predominately by women. Countless women and children have died tragically and needlessly in childbirth as a result.

And the cost is not just in lives lost in childbirth.

There are a few old studies that indicate that the babies of primitive, barefoot populations develop significantly faster, such as in learning to walk[3]. It seems reasonable to conclude carrying a baby to full term in nine months in an abnormally backward rotated and malformed pelvis is bad. It would lead to abnormal development in the womb resulting in birth defects and potentially abnormal development after birth as well. The need to fully explore this crucially important issue is urgent.

The Malformed and Forwardly Rotated Female Pelvis Pushes Many Important Internal Organs Out of Their Natural Position

The unnatural position of the female pelvis has other likely consequences of a heretofore unknown and adverse nature.

Critical to our understanding of the misalignment problem is that pelvis is the Latin word for basin.

See FIGURE 14.5. That basin is piled high with our internal organs. See FIGURE 14.6.

It would seem likely that tilting that basin into an abnormal backwards or forwards orientation would, for example, likely shift our intestines and bladder out of their natural positions, slowing down or even temporarily blocking passage of their contents. Heartburn, indigestion, gas, constipation, diarrhea, hemorhoids, and incontinance are likely direct effects of the abnormal position of the digestive system.

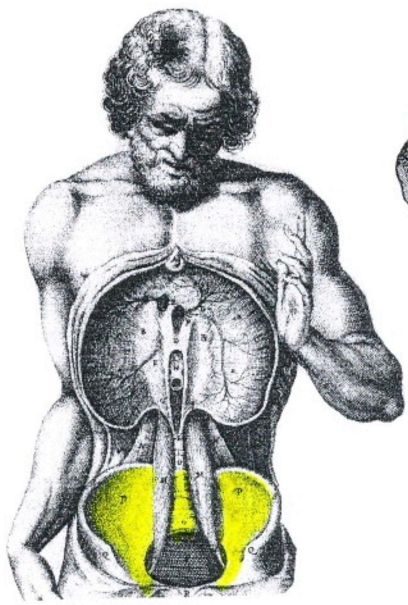


FIGURE 14.5. Pelvic Basin

FIGURE 14.6. Internal Organs Held In Pelvis

All of the other internal systems either contained by and/or supported by the pelvis would likely be similarly affected as well. The other major and minor organs have a multitude of interconnections and interactions that are amazingly complicated and often quite delicate. The function of these organs and the interdependent systems of these organs is likely to be degraded in approximate proportion to the degree of abnormal pelvic tilting.

The Unnatural Backward Rotation of the Malformed Male Pelvis Is Also Abnormal, Like the Female Pelvis Forward Rotation

The likely structural and functional consequences of the wider, flatter, and backwardly rotated male pelvis are parallel to those of the female pelvis described above.

A Wide Spectrum of Variation Exists in the Width or Flatness of the Pelvis of Each Individual Male and Female

As was the case with bowed out or in legs and pelvic rotation, over time, typically male and female pelvises become permanently both more wide and flat. As a general rule, this is the unnatural structural state of most modern males and females, although the amount of width or flatness varies considerably. There is inherently a wide spectrum of variation in the amount of typical male or female width or flatness. It depends on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

Childbirth for Non-Modern Mothers Is Apparently Much Easier

Anecdotal evidence suggests that childbirth is much easier for primitive, barefoot women than for modern women. It is apparently not unusual for women in hunter-gatherer groups to give birth very quickly, while retaining the immediate capability to keep up with the group's movements, which are largely unaffected by the birth, according the anthropologist Colin Turnbull[3].

The closest thing I know of to a modern version of this remarkable natural capability is the recent success of Chaunte Lowe in winning a major female high jumping competition only 8 months after the birth of her 3rd child. See **VIDEO 14.1**. The next chapter suggests why such a remarkable mother may have been able to do so. By the way, she went on to win her event in the 2016 USA Olympic Trials.

Note: for more information on the anatomy of the pelvic basin see this **YouTube** video: https://www.youtube.com/watch?v=P3BBAMWm2Eo, which is titled “Pelvic Floor Part 1 - The Pelvic Diaphragm - 3D Anatomy TutorialHip Anatomy Animated Tutorial” by from AnatomyZone.

15 RACIAL DIFFERENCES ARE GREATLY EXAGGERATED BY SHOE HEELS

As mentioned earlier, previous studies on primitive, barefoot human populations have always attributed differences in anatomical structure or function to racial causes. That is to say, to racial genetic differences that are preordained and unchangeable.

In contrast, I believe that I have provided good evidence that the main differences are due to changes wrought inadvertently by elevated shoe heels worn by modern populations. And also, that the changes have been major misalignments resulting in malformations that have reduced structural efficiency and functional performance, as well as having caused disease and injury.

Ironically, all of the early, 19th and early 20th Century studies that I have gone through are based on the deeply prejudiced assumption that the primitive, barefoot races were a lower order of human being, at an earlier stage of evolution than those humans of white Western European heritage. The sorry history of this unforgivable episode in scientific research is summarized brilliantly by Stephen Jay Gould. His award-winning 1981 book is titled, "**The Mismeasure of Man**".

The Superior Athletic Performance of the "Inferior Races"

Certainly one of the fundamental premises of this old racial prejudice – the functional inferiority of the "primitive" races – is laughable in today's world. What was considered back then the least highly evolved of the primitive races, the Africans, are today clearly the most successful in terms of athletic performance.

From Jamaican sprinters to marathoners from Kenya, their dominance in running today is only occasionally interrupted by outsiders, who have access to all the advantages that modern technology can provide.

In contrast, the principal advantage of the modern Africans is lack of modern technology. It is that their parents and they were usually very poor and physically developed barefoot, without modern shoes. This lack of exposure to modern footwear appears to be especially critical in the early years after birth. It may also be that conception by non-abnormal parents and spending 9 months in a non-abnormal womb could be just as important.

At any rate, transition to modern athletic shoes later in life does not appear to diminish their performance advantage, at least relative to their peers whose physical development has been deformed by shoe heels. By their late teen years virtually every elite athlete in Africa has been identified by local and foreign coaches and transitioned to modern athletic shoes, but they still retain their relative performance edge.

Another irony is the well-meaning Westerners are now providing modern athletic shoes to "help" these unfortunate barefoot runners by giving them what they think is better equipment. As this trend continues and strengthens, and as their third world economies continue to improve, their barefoot advantage will gradually fade.

Also unfortunate for their future performance, all the good formerly barefoot runners know that their biggest potential source of future income is an endorsement contract from an athletic shoe company, particularly a major one. They can't get the life-altering financial rewards of endorsements by continuing to run barefoot. So they learn early on to covet and use modern athletic footwear as soon and as often as they can.

Today, with most racial barriers gone, the widespread success of athletes with an African heritage cannot escape the notice of even the most casual observer. But, oddly, it is almost never discussed openly.

Racial Differences Are Too Sensitive to Discuss or Analyze

The situation is so odd. A book was published in 2000 with the provocative title: "**Taboo: Why Black Athletes Dominate Sports and Why We're Afraid to Talk About It**", by Jon Entrine. I went to that book in the hope that it would be a good source to find out more about the physical differences between black athletes and others. I was frankly amazed to find almost nothing very specific there about any such physical differences.

So, apparently, even in a book with such an explicitly provocative title, anatomical features and functional differences were in 2000 still too sensitive to discuss openly. And even for what appeared otherwise to be a courageous author apparently unafraid to tackle difficult issues.

Despite this conspicuous warning to stay away from more explicit racial differences, I am going to proceed. Not because I am foolhardy (or worse), but because essentially my evidence-based analysis is simply this: all significant human racial differences are based on physical changes caused by footwear, not fundamentally preordained by races or genes.

All Races Are Basically as Interchangeable as Our Footwear

I believe that is an exceptionally positive position. For starters, it means that if you have basis for any prejudice at all, it should be prejudice directed against conventional footwear design.

It is also positive because we can use that reality-based knowledge to develop effective means for all of us, whatever our genetic makeup, to be far healthier and far better athletes as well. What is achievable by those who have not been deformed by footwear can potentially also be achieved by the rest of us who have been so deformed - if only we understand the true causes in order to develop effective solutions.

Our current deformities have severely limited our own performance in every aspect of life. They have also severely limited our view of the limits of human performance. Our current imagination is trapped by the limits imposed by our existing deformed state.

The limits of human performance are much higher than we can currently

imagine now

With this new understanding of our current state of deformity, the bell curve of human performance can be shifted dramatically upward. To put it more tangibly, we can all to a far greater extent "be like Mike" (and Michael Jordan could himself have flown even higher and been injured less).

What we now regard as highly exceptional is much closer to the natural norm of human potential. We only fail to realize this because of our current deformities anchor us within unnatural limits.

To give you another example of what I am trying to say, look at this picture of the limbo king of New York City performing in the 1960's. See FIGURE 15.1. This picture demonstrates an almost unbelievable performance extreme. But all of us have the genetic potential to come much closer to it than our current limited imaginations allow.

Another example of almost unbelievable human physical performance is a weightlifter doing a sideways split between two chairs, as seen in **VIDEO 15.1**. My point here is that what is exceptional, even quite extraordinary in human physical performance today likely just represents the normal capability of the human body undeformed by shoe heels.

Before everyone gets too comfortable with this vision, we do need to explain away an important anomaly. The superior athletic performance of African Americans who use modern athletic shoes must be carefully evaluated.

Certainly significant is a factor mentioned above, that most African American athletes are born and develop in families in poverty or near it. So their families' use of modern footwear, especially at the most important early ages through age six may be relatively far less common. But we still have to account for superstar athletes like Grant Hill, Kobe Bryant, and Steph Curry, all of whom must have had easy access to the latest kicks (athletic shoes), given their highly privileged family backgrounds.

Many Africans Have a Minor Genetic Trait That Reduces the Adverse Effect of Elevated Shoe Heels

Many Africans seem to have retained a genetic trait that most of the rest of us have lost in the migrations of genus homo out of Africa within the last hundred thousand years. The seemingly minor trait is almost impossible not to overlook and would seem to be completely trivial. Except that it appears to interact directly with elevated shoe heels.

What I am referring to is the main (longitudinal) arch of the foot, which in many Africans tends to be lower than in non-Africans. Unfortunately, reliable information on this trait is very limited, although fairly consistent. There is a great deal of confusion on this subject relative to definitions and function in the earlier research, but recent work seems clearer, although better work in greater depth still needs to be done[1].

A recent study by Yvonne M. Golightly et al. appears to be fairly definitive and includes a very large study population (1,691 adults age 45+ in rural Johnston County, N. C.). In the study, African

Americans were nearly three times more likely to have low arches than Caucasians, and Caucasians were nearly five times more likely to have high arches than African Americans.[2]

The Shoe Heels Apparently Have Much Less Effect on the Lower Arch of the African Foot

There is no research whatsoever on the effect of elevated shoe heels on the lower arch of the African foot, so I have to resort to my best guess, which I would prefer to characterize as careful speculation based on logical analysis of what limited information is available.

So, what I believe happens as a result of the lower arch of the African foot is that there is less abnormal foot supination caused by elevated shoe heels. The reduced abnormal supination is probably caused by a minor difference is the structure of the subtalar joint, the minor joint difference being associated with the lower arch structure.

None of this explanation has ever been researched before by anyone. At this early stage of analysis, it is only my working hypothesis, but it is the most logical one in existence that explains the few available facts.

Excessive Pronation Is Limited By the Low Arch Bottoming Out Into a More Stable Position

In short, with lower main arches, shoe heels should have less abnormal effect. Whatever less-abnormal foot supination is produced by shoe heels is absorbed by a counter-balancing pronation of the African foot that is made more flexible by the lower arch.

I think the less severe abnormal supination in the lower arch African foot still produces lower leg instability and still causes excessive and abnormal pronation as a result of the instability. But the lower arch of the African foot should be inherently more stable because, being lower, it cannot collapse as far in excessive pronation.

In other words, it would naturally bottom out in a more reasonably stable position. Low arches have been shown to correlate with fewer injuries[3]. However, another study suggests even more prevalent joint problems including osteoarthritis among the African American population.[4] As noted earlier, this issue needs to be studied in much greater depth.

The African Lower Arch Results in the Lower Leg Being Tilted Inward Into a Knock-Kneed Position

However exactly this shoe heel/ankle joint mechanism happens, the result of shoe heels on African athletes is relatively easy to observe in the everyday real world. Generally, instead of the lower leg being tilted out into a bow-legged position by a supinated foot, the lower leg tilts inward into a moderate knock-kneed position by a pronated foot. Remember Figure 4.4, the knock-kneed basketball shooters.

You can easily observe this knock-kneed effect in any professional NBA or NCAA collegiate basketball game broadcast on television. Using the slow motion feature of your video recorder makes it impossible to miss.

It is also easy to see that this moderate knock-kneed effect is a very useful adaptation in terms of superior athletic performance. The most obvious example is remarkable jumping ability, sufficient to almost effortlessly dunk the ball. This ability reaches almost ridiculous extremes, such as when 5 feet 7 inches Spud Webb won the NBA slam dunk contest.

Clearly, without the primary abnormality of bowed out legs, the rest of the human body naturally develops much more normally. So, the whole chain of major problems discussed in preceding chapters and caused by shoe heels is broken.

Lower Arches and Moderate Knock-Knees Are Not Unique to African Athletes

It is worthy of note that most non-African athletes with exceptional physical gifts also tend to have lower than normal arches and moderate knock-knees. The available research on this point is also very limited, but some important examples are worth discussing.

Refer back to earlier Figure 4.3, which shows a non-African patient, but with knock-knees having the highly developed vastus lateralis thigh muscle characteristic of African athletes. Figure 4.4 shows the same patient after "corrective" thighbone surgery that resulted in a bow-legged stance, and with far less vastus lateralis muscular development that is more typical of modern non-African populations, particularly male.

Clearly, then, non-African legs can naturally develop in a knock-kneed position to be just like African legs, and they can also be modified to develop into a bow-legged position characteristic of non-Africans. It' s all in how they individually react to specific elevated shoe heels they use.

And again referring to Figure 4.2, the non-African fetus definitely shows the hyper development of the vastus lateralis muscle common to Africans. Lack of exposure to shoe heels is the difference.

Many Non-Africans Have the Same Kind of Superior Athletic Performance

To grab just one example out of a great many, Duke University won the Men's NCAA Basketball Championship in 2015 with three freshman superstars, all of some African descent. However, the kid on that championship team with the greatest vertical leaping ability was a different freshman star who was a non-African (and who also won the 2014 McDonald's All American Slam Dunk Contest). See **VIDEO 15-2**.

Also, the dunking star of the Internet, with 5 million YouTube views, is another non-African, a professional dunker from Canada with a 48-inch vertical jumping ability, Jordan Kilganon, who is alleged in **The New York Times** to have performed the best dunk of 2015. You can judge for yourself. See **VIDEO 15-3**.

Not to mention Valery Brumel, the Russian who broke the World High Jump Record six times in the period from 1961-63 and was Olympic Champion in 1964. It was said that he could jump high enough to touch a basketball rim with his foot.

To sum up again my firm, evidence-based conclusion: all significant racial differences are based on changes caused by footwear (specifically, shoe heels) interacting with minor foot structures, not preordained by significant genetic differences.

It Is Not Possible to Assert That Lower Arches Correlate With Intelligence

I am taking the position that many of those of Africans descent appear to have a minor genetic trait in the form of a lower foot main arch, which would probably be totally innocuous except for its now apparent hidden interaction with elevated shoe heel. Since I am alleging the existence of this minor genetic difference, I want to be emphatic that there is to my knowledge no evidence whatsoever that this difference of a lower arch somehow correlates to lower intelligence. There is no known basis for such blatant, misguided racial prejudice.

As a matter of fact, the only relevant information of which I am aware strongly suggests the exact opposite. It has been reported that Albert Einstein had low arched feet. He was well known to get around Princeton in sneakers. However, as far as in known, he had superior physical ability in only one area, playing the violin. So Gary Larson's cartoon has no basis in fact, only in humor. See FIGURE 15.2.

In the Future Specific Genetic Markers Should Be Far More Useful Than Obsolete and Inaccurate Concepts of Race

I have been forced in the discussion above to make use of the term, “race”, because all of the existing studies relative to human body structure that are relevant to the research on which this book is focused are catagorized on the basis of existing racial concepts, some extremely prejudiced, especially those dating back to the 19th and early 20th Centuries.

Those obsolete and inaccurate concepts of race have often been inappropriately linked to being inherently primitive and barefoot. I am interested only in the barefoot part, which certainly is not inherent. I am only trying to learn whatever is available about the natural, normal state of the human body, and not in race generally or in any of the allegedly racial characteristics like skin color.

In point of fact, I am really only interested in genetic markers for human foot structure, and more specifically, for the main longitudinal arch and/or the subtalar joint. Unfortunately, no such foot genetic markers currently exist, at least to my knowledge (which anyway at this point is very limited in the field of genetics).

16 SHOE HEELS CAUSE FEET TO CROSS-OVER EACH OTHER

At this point, we will focus on the legs when running with elevated shoe heels. We will take the simplest case first, which is the symmetrical case, which we will examine in this chapter. Then we go on to see how natural symmetry is forced into abnormal asymmetry through the effect of shoe heels in the next chapter.

Both Tilted-Out Legs Are Therefore Tilted-In At the Hip and Anchored There, Causing Crossover of Feet

Some of the earliest work on asymmetry in running that I've seen was done by Steven Subotnick and his last book is the definitive podiatric textbook, **Sports Medicine of the Lower Extremity**. In it, he includes an illustration from 1979 that shows the distance between footprints in lateral sports(A), walking (B), running (C), and jogging (D)[1]. See FIGURE 16.1.

What you see in jogging (D) is a crossover of footprints, wherein each footstep crosses over in front and inside of the preceding footstep. Also shown in jogging (D) is the functional varus typically observed ("functional" meaning not caused by structural bone changes)[2]. See FIGURE 16.2.

The cause of the functional varus was unknown back then. But with our new understanding of the role of shoe heels, we can correctly interpret the observed crossover as a direct function of the inward collapse noted previously.

The simplest way to see this is as follows. Both legs are anchored to the pelvis at the hip, so if the legs are tilted-out relative to your foot by shoe heels, the legs are also automatically tilted-in relative to your hip. Your whole upper body mass keeps your hip from moving sideways very much, so what happens automatically is your feet move toward each other. The feet can even move past each other, crossing over each othe. The feet have to crossover automatically if the tilting out angle caused by shoe heels is sufficiently great to make it so. See FIGURE 16.3.

If both your legs were simultaneously tilted out, your feet would have to cross for you to remain standing. When you run, only one leg is tilted at time, but each tilted leg would push your relatively heavy upper body to the opposite side, which is difficult and highly inefficient. So your body compensates in the simplest and easist way possible, by moving your legs in with each step rather than moving your whole body out, from side to side.

The unnatural crossover problem is inherently unstable. Most obviously, it enables one to trip easily over one's own feet. Just as obviously, lateral stability of the feet is significantly reduced because each foot is abnormally positioned close to the body's center of gravity or even inside it, inside of an outside position necessary for stability.

This is a much more dangerous problem than you might think. The crossover of a jogger's feet greatly increases the likelihood of a lateral ankle sprain, which can cause lasting stability problems, or a fall.

17 SHOE HEELS MAKE RUNNING UNBALANCED AND ASYMMETRICAL

So far we have been considering only the simplest case, the symmetrical one. That is, wherein both right and left sides of the human body react exactly in parallel to the abnormal effects that are caused by elevated shoe heels, as discussed in preceding chapters, particularly the last.

Both sides of the human body certainly are symmetrical in general form, with each side having essentially the same set of parts. That is obviously true for your arms and legs. The major exception is of course the location of your single heart, which is located more over on the left side, and some other internal organs, which are located in asymmetrical positions in your trunk.

Unfortunately, we have a big problem. It is directly related to our unique evolution from quadrupedal to bipedal locomotion. With only two supporting lower limbs, balance between both limbs becomes a critical structural issue.

The Misaligned Front End Caused by Shoe Heels Collapses Into Asymmetry

Simply put, elevated shoe heels destroy this critical balance. The splayed-out to the sides position of the ankles and legs, as well as the backward tilted pelvis, creates an inherently unbalanced alignment of body parts unfit for running naturally in a forward direction. This is the unnaturally misaligned front end discussed in Chapter 11 and shown in FIGURE 11.1.

The equivalent situation in terms of a runner's "wheels" is shown in FIGURE 17.1A, showing the bones of the pelvis, feet, and knees, as viewed in a horizontal plane from above. Again, the fundamental problem is that the wheels or legs are misaligned, each pointing to the outside, instead of straight ahead in the direction of forward motion.

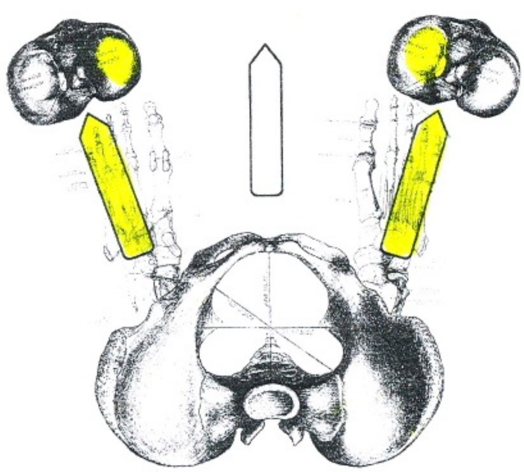


FIGURE 17.1A Both Ankle Joints & Knees Are Twisted Unnaturally to the Outside

The fundamental problem is that the only way to resolve the splayed-out misalignment is for the legs to collapse inwardly, so the unstably tilted out legs point more ahead instead of to the sides. The best case scenario in this bad situation is a moderate inward collapse, mostly occurring in the form of the longitudinal arch deforming downward in significant pronation. This best case is illustrated in FIGURE 17.1B.

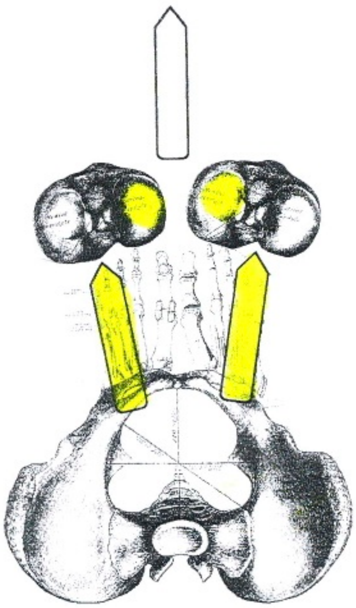


FIGURE 17.1B

However, this inward collapse in reaction to the fundamental misalignment shown in Figure 17.1A is unnatural and uncontrolled. It therefore does not typically occur in a balanced way. The trouble is this correction process is totally ad hoc.

It usually produces asymmetries between the right and left legs, often serious ones. This asymmetry problem between right and left legs is compounded by the abnormally tilted position of the pelvis connecting them, which effects the rotational capability of the low back (or lumber spine).

We will discuss the interaction between the legs and the pelvis in the chapter following the next. For now, we will focus on the well-understood and extensive asymmetry that exists between the right and left legs of runners equipped with modern footwear having elevated heels.

Bilateral Asymmetry Between Right and Left Feet and Legs Is Common

Both of the earliest modern running studies by Subotnick and Cavanagh already cited discuss individual cases of asymmetry of a substantial nature, even among elite athletes. For example, Cavanagh tested an elite 10,000 meter runner who, running at race pace, sustained a maximum force of 4 times body weight on his right leg and 2.5 times body weight on his left – an amazing 60 percent greater load on the right leg.

Even one of the superstar American marathoners of the 1970's, Bill Rogers, had significant differences in the patterns of pressure distribution between right and left feet, and his left leg was reportedly about 1 cm shorter than his right leg.

Most other studies that have focused on asymmetry have been limited to standing or walking, but there is general agreement in a multitude of studies that asymmetry in human locomotion is pervasive.

The Primary Function of the Right Leg is Propulsion, the Left Leg is Support

The best information I have been able to cull is from two different studies by Sadeghi et al[1]. The principal findings were that the right leg is most typically involved mainly in propulsion involving hip power in particular during the push-off phase of stance and is secondarily involved in support. The left leg is involved mostly in the function of support.

From the later Sadeghi review study, the consensus seems to be that, for right-handers, the right leg is typically the dominant leg and the shorter one, while the left leg is non-dominant and longer. Right-handers make up more than 90 percent of the population, so the general case is right leg being dominant, propulsive, and more powerful.

For left-handers, the opposite may or may not be true; there is much less consistency in the body asymmetries of left handers, a point we will return to in later chapters.

The Distortion of the Running Stride Illustrates the Underlying Distortion of the Runner's Body

The result of this most typical human physical structure on the running is illustrated in FIGURE 17.2A, which is from Muybridge's 19th Century pioneering photographic human motion studies. To each photographic frame was added a vertical line through the small of the runner's back, which passes through the approximate location of his body's center of gravity at about hip level.

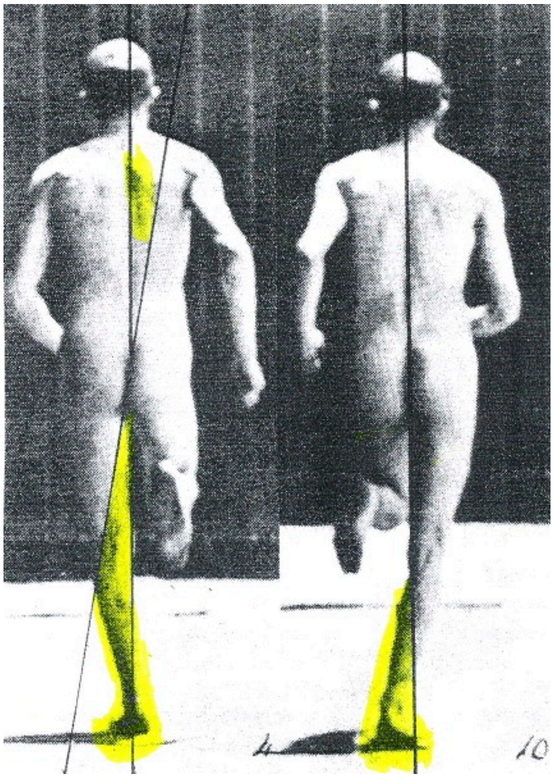


FIGURE 17.2A

The photograph on the right in FIGURE 17.2A (Frame 10) shows the short right leg in the mid-support phase of running. What is striking is the extreme crossover of the right leg, well inside the center of gravity, caused by the excessive outward tilt of the lower right leg, about 11 degrees. Also important to note is the nearly level position of the pelvis.

In contrast, the photograph on the left in FIGURE 17.2A (Frame 4) shows the long left leg in the same mid-support phase of running. No crossover is shown, the foot being directly under the center of gravity, because there is less outward tilt of the lower left leg, only about 9 degrees. But note how the pelvis is tilted down from the high left side, causing the runner's chest backbone to bow out to the right side.

The Dominant Right Leg Stays in the Same Position Relative to the Pelvis: Splayed-Out to the Right Side

To this general picture we can add from a study by Stefanyshyn and Engsberg[2] that the right foot tends to rotate to the outside more, while the left foot rotates to the inside more. I think this provides a hint as to the general case of how the abnormal and unstable splayed-out position (caused by elevated shoe heels) of Chapter 11 collapses inward.

Using logic and the few available facts as we know them, here is what I think the evidence shows about what happens when running. The dominant right leg typically wins the battle between the two legs pointed in different directions in the horizontal plane. It wins because, as noted above, the right leg is dominant and stronger, providing most of the propulsion. Again, this is the most general case, that of right-handers.

The right leg remains splayed out to the right relative to the pelvis, without rotating inward at the hip in the horizontal plane. The right leg also remains vertically tilted out, about 11 degrees in the frontal plane.

The Right Side of the Pelvis Is Rotated Abnormally Forward in the Horizontal Plane

At the same time, in the horizontal plane, the pelvis rotates forward on the right side, so the right side propulsion leg is pointed more forward generally in the direction of travel, despite remaining abnormally splayed outwardly. So the right leg completes its stance phase with the right side of the pelvis rotated abnormally forward in the horizontal plane. See FIGURE 17.1B.

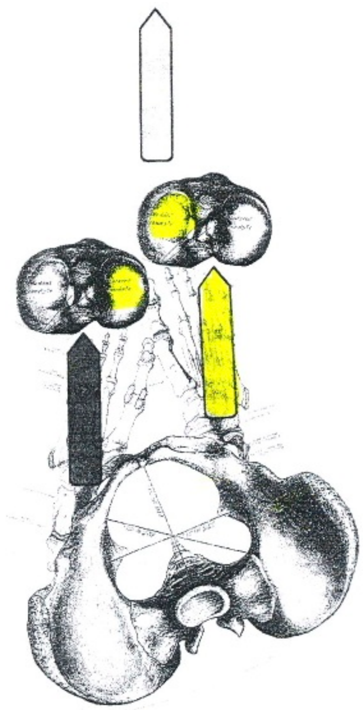


FIGURE 17.1C

Now we get to the critical part. With the right side of the pelvis rotated abnormally forward in the horizontal plane, the left foot must abnormally rotate inwardly toward the pelvis in order to be pointed forward in the same direction of travel as the right foot and leg.

The Left Leg Is Twisted Between the Left Foot Rotated Inward and the Left Hip Rotated Outward

But the left leg is attached by the hip to the pelvis abnormally rotated to the outside in the horizontal plane, away from the forward direction of locomotion. So when the left foot lands and is fixed onto the ground, the ligaments and muscles of the left hip rotate the left leg to the outside to its natural load-bearing position pointed forward relative to the left hip.

As a result, the left leg rotates to the outside, forcing the left foot to supinate at the maximally loaded mid-stance point of the running stride. This is highly abnormal. Normally the left foot would be pronating to absorb the body weight load at the maximally loaded mid-stance point of the running stride.

This is very bad news! At the same critical time in the support phase of the running stride, the left foot is being abnormally supinated, becoming rigid and higher, while the right foot is pronating relatively normally, becoming flexible and lower.

The result is a significant functional leg length discrepancy between right and left legs caused by elevated shoe heels.

The Battle in the Left Foot Between Normal Pronation and Abnormal Supination

With very little formal research to support this, I will nonetheless express the opinion that I believe elite runners tend to at least partially compensate for this abnormal supination by pronating relatively excessively with their left foot compared to their right, so their left foot toes-out more than the right foot. Their more flexible than typical joints in the foot and ankle allow this compensation, which causes less function leg length discrepancy than is typical. However, over training often negates this structural advantage, thereby increasing the discrepancy.

Conversely, less elite runners and joggers typically have more rigid foot and ankle joints, particularly males, and therefore toe-in more on their more rigid left foot. That signifies the relative supination of the left foot compared to the pronation of the right, which creates greater functional asymmetry in the form of a relative leg length discrepancy.

The Typical Left Leg is Shockingly Deformed, Functionally and/or Structurally

Based on this analysis, there is something else of critical importance to see in FIGURE 17.2A. It is absolutely shocking.

The left leg in Frame 4 is actually tilted in by 20 degrees, not out by 9 degrees, if you measure it relative to the pelvis, which is tilted down on the right by about 11 degrees (measuring from the best and only available anatomical landmark, the well-defined butt crack). See FIGURE 17.2C, which shows the relative position of both runner's legs at midstance with the pelvis maintained in a level position (by combining the lower portions of Frames 4 & 10).

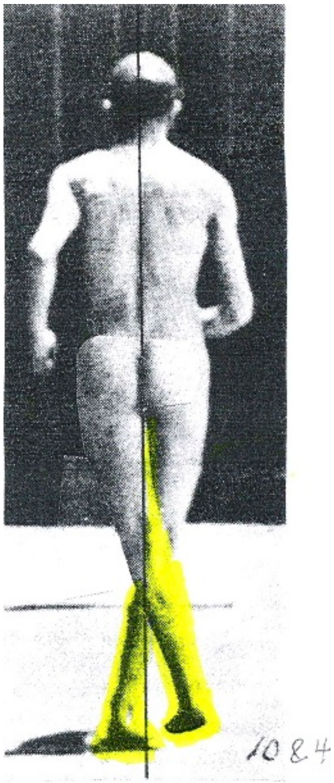


FIGURE 17.2B Level Modern Pelvis Makes Running Impossible

What this effectively means is the both legs are tucked up under the runner, but with even much more crossover on the left side than the right, instead of the less crossover that was superficially apparent by measuring the leg angle relative to the ground. This structural distortion is so great it makes the tucked-in runner's legs effectively like partially retracted landing gear of an airplane.

FIGURE 17.2B shows an impossible condition with so much crossover between abnormally tilted-in legs that forward motion running would be impossible. Only if the center of mass of the runner gyrated wildly and extremely from side to side with each stride would any forward motion be possible, and only then with incredible inefficiency.

Without the abnormal tilting motion of the pelvis on the left side, tilting downward to the right side once with each full stride, typical runners would trip over themselves with each and every stride because of the grossly excessive crossover.

Also, to make a critically basic point: shoe heels always cause the legs to tilt inward relative to the pelvis and center-of-gravity, forcing them into a crossover position, because tilting out would force the pelvis and center of mass of the runner into impossibly huge sideways gyrations incompatible with forward motion.

Willwacher Study Data Confirms Abnormally Tilted-In Legs At Midstance

The award-winning Willwacher et al. study[2] generally confirms the above results, although it has data only on the right leg and shows the leg inward tilt (hip adduction) as about **15** degrees for both sexes, as shown in Hip Angle Frontal Plane graph of Figure 6.

Unpublished additional study data indicating about **14** degrees of inward tilt for 129 males has been provided by Dr. Willwacher and is close to the less precisely measured 10 degrees for the individual male illustrated above in **FIGURE 17B**. For 93 females, the right hip adduction is higher at **17** degrees.[6]

Rare Photographic Proof That Crossover Is Unnatural, Caused By Shoe Heels

In utter contrast, see below a contemporary barefoot bushman runner whose legs in the midstance running position show no leg crossover, but rather shows vertical legs under a level, un-tilted pelvis. Also note his straight, well-defined spine.

FIGURE 17.2B' Barefoot Bushman With Naturally Level Pelvis

Both Legs Together Form an Immobilizing X-shape at Midstance in Running, Relative to the Pelvis

If you level the pelvis for the left leg at midstance (taken from **FIGURE 17A** and superimposed in **FIGURE 17B**), you can begin to see how truly bizarre is the abnormal structural running position of the modern human body. Remember, this is the maximal load-bearing position, 2-3 times bodyweight, the greatest stress to which the human body is routinely subjected during the childhood growth phase.

This is astonishing. In every stride the runner's legs are maximally loaded sequentially in a bizarre X-shaped, crossed position relative to the pelvis.

As seen in FIGURE 17A, the unnatural mechanical tilting out effect of shoe heels on both legs paradoxically causes both legs to tilt inward instead, called hip adduction.

That contradictory result is because both legs are connected to the pelvis, within which is located the body's center of gravity, which firmly resists side-to-side motion. The body's lack of relative lateral mobility dictated by the Newton's inertia law forces both legs inward.

An Even More Bizarre Change in Supporting Leg Position From Standing to Running

Again from unpublished data from Dr. Willwacher from his cited study, the standing or static hip angle for 129 males is **3** degrees of abduction or tilting-out, not adduction (tilting-in), and **2** degrees of abduction for 93 females.

But, at the beginning of the stance phase in running, the starting hip angle for the males is immediately **8** degrees of adduction (tilting-in), not abduction. This is an extraordinary full **11** degree tilting-inward immediate change from standing to running on the same support leg.

The hip angle for women is **10** degrees of tilting-in, again starting immediately at the beginning of the running stance phase, and an equally extraordinary full **12** degree tilting-inward, an immediate change in the transition from standing to running on the same support leg.

The Only Solution to an Otherwise Impossible Locomotion Problem

The left side of FIGURE 17.2C illustrates exactly the same impossible situation created by the position of the runner's body in FIGURE 17.2B above. Forward motion running cannot occur because of the extreme crossover of the legs.

The right side of FIGURE 17.2C shows, in the simplest possible and perhaps only efficient way to resolve the otherwise impossible condition. The right hip adducts inward as the pelvis simultaneously tilts down from right to left, in just the same way as occurs in the runner of FIGURE 17.2A.

It is important to note in FIGURE 17.2C that to accommodate this postural alignment, the right foot is forced into a more supinated or inverted position than the left, which thus becomes more relatively pronated or everted.

Limited Evidence Suggests All Modern Male Runners Have Pelvic Tilt Like FIGURE 17.2A

FIGURE 17.2D shows another common example wherein the runner's pelvis has to tilt downward on his left side (as indicated by the lower position of his left knee in the photo on the left) to accommodate a right leg that is substantially inwardly tilted relative to his pelvis, like the previous runner in FIGURES 17.2A & B above.

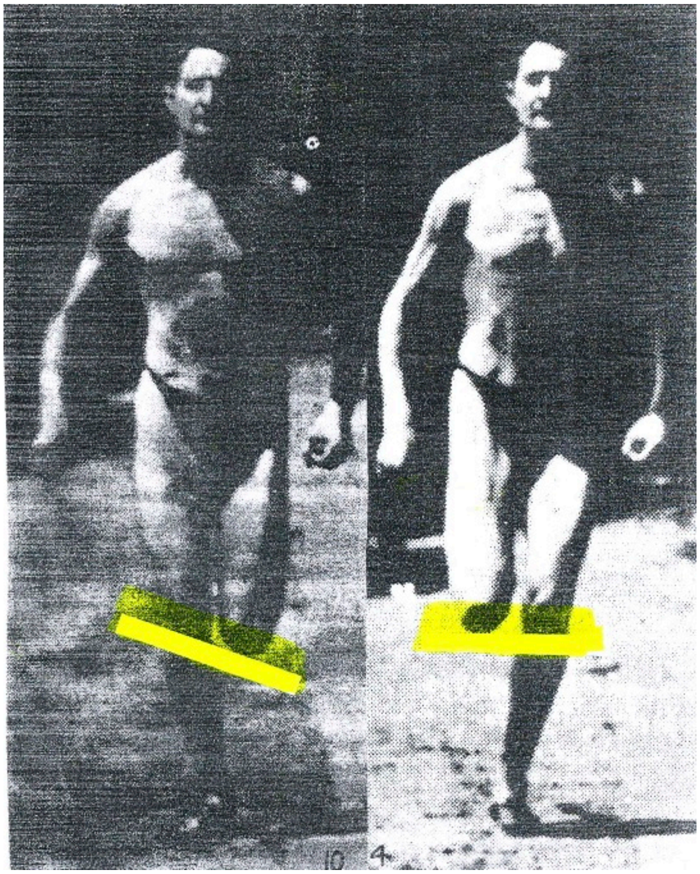


FIGURE 17.2D

This second example of a runner's pelvic tilt at midstance is much more noteworthy than you might think at first glance. This is not a cherry-picked example from a large number of other possibilities, many of which might provide contradictory evidence.

In point of fact, FIGURE 17.2D is instead the only other definite example available in the set of Muybridge photographic plates of runners. So every runner, 100% of the two of them, photographed by Muybridge demonstrates pelvic tilt (although on different sides).

None of Muybridge's other Plates of runners show definite front or rear midstance positions for both legs, although his Plate 19 comes relatively close and it clearly shows substantial pelvic tilt on the right leg in Frame 1, but a level pelvis on the left leg in Frame 8.

Moreover, Muybridge's Plate 21 shows only the left leg in midstance position in Frame 2, but shows both definite pelvic tilt downward and extreme thoracic asymmetry on the right side, as shown in FIGURE 22.1 (as we shall see in a later chapter).

Fig. 22.1 Thoracic Distortion At Midstance

Finally, his Plate 22 shows a runner leaning forward in apparent acceleration. Again, only the left leg is shown in the midstance position and the photograph is blurry, but does also seem to show relatively clearly the pelvic tilt downward and right side thoracic asymmetry.

Therefore, it is quite fair to conclude from his Plates that all five Muybridge runners in the available 1887 sample demonstrate substantial pelvic tilt on at least one of their legs in the midstance position, and both of the sample of two shown do so only on a single leg. Even for such a limited sample of only five, that consistent 100% would appear to at least point strongly in a statistically significant direction.

Current Video Evidence Provides Further Support For Pelvic Tilt

If you are uncomfortable about relying on such old data, recent video available on YouTube provides further confirmation that another male barefoot runner demonstrates pelvic tilt on only one leg, the right, as shown by the major rightward tilt of his upper torso in FIGURE 17.2E. His pelvis is substantially level in the midstance position on the other leg, although even so his neck still retains the rightward tilt in FIGURE 17.2F.

So this modern barefoot runner is like those shown above in FIGURES 17.2A&D, maintaining the 100% confirmaton on the slightly larger sample of three, all males. See also **VIDEO 17.1**.

Unsurprisingly, the Female Pelvic Tilt Appears To Be Different Than That of Males

Whereas in the 19th Century Muybridge apparently did not consider it appropriate to photograph women running, in the 21st Century we certainly do, and again YouTube provides an example. In the woman shown running in shoes in FIGURE 17.2G there is moderate pelvic tilt on the left leg and in FIGURE 17.2H there is roughly the same moderate pelvic tilt on the right leg. So this woman demonstrates pelvic tilt on both legs, not just one like the male samples. See also **VIDEO 17.2**.

Although the video quality is marginal due to poor lighting, **VIDEO 17.3** provides another example of the same pelvic tilt on both legs, this time of an adolescent girl runner.

Although this is a tiny female sample, if the 100% result holds up as statistically significant in a sufficiently large female sample, it could explain what otherwise is difficult to understand. In the 1990's, at least one woman, Ann Trason, dominated her male competitors in ultramarathon racing for several years, despite the substantial dominance of males at all shorter distances.

I think the reason is that over extreme distances the typical modern male tendency toward bow-leggedness increasingly becomes a problem. The female runner in FIGURE 17.2G&H above instead demonstrates the opposite, a more balanced tendency toward minor valgus thrust into a slight knock-kneed position at midstance. This is similar to elite African runners, as seen in **VIDEO 17.4**.

Summing up the preceding FIGURES and VIDEOS of this chapter to make an important point, in every single one of the eight runners above that we found with enough data to evaluate in a valid way, all had pelvic downward tilt on at least one leg in the maximally loaded midstance position! It seems likely that this important structural problem is very common and is caused by an unnatural interaction with shoe heels.

An Important Digression on High Heels Is Appropriate Here

This abnormal tilting downward motion of the pelvis (such as on the runners shown in FIGURES 17.2A-H) is an automatic accommodation that offsets the outward tilting of the leg when running, but is also caused by women's high heel shoes even while walking.

It is why women look so sexy walking in high heel shoes. The high heels automatically force the pelvis to move up and down on alternating sides with each step, causing in effect a slow motion hula dance while walking.

See the typically extreme pelvic tilt on each leg in the midstance position with each stride when walking in high heels FIGURE 17.2 I. See also **VIDEO 17.5.**

If crossover is impossible, as it was for Halle Berry when walking on a high rail in the movie *Catwoman,* the inevitable consequence is a highly provocative pelvic back and forth rotation from one extreme tilt on one leg to the other extreme tilt on the other leg, as seen in **VIDEO 17.6**.

The only other possible accommodation to high heels is significantly crossing each foot over the other, which you also often see. Typically you see both together, but varying with each step, at least partially to maintain balance.

But excessive crossover would seem to be counterproductive from the sexual allure point of view, since that crossover reduces or prevents the highly seductive pelvic tilt motion. You can get either one or the other, but most generally a combination of the two with both motions less than they would be alone.

Also, you can see in **VIDEO 3.2** the downward tilt on the left side with a fairly obvious left side "pelvic hitch" shown in the walking stride in high heels. That abnormal hitch is caused by the extreme abnormality that develops on the left side during running with elevated heels discussed above. This is likely the direct cause of the hip arthritis, which is particularly common in women.

The Left Leg is the Farthest Out of Natural Position and Reduces Gluteus Maximus Action

So, surprisingly, the left leg of FIGURE 17.2A is actually even more adversely affected than the right leg, just less obviously because pelvic tilt hides it. That seems to explain why it is effectively much less effective providing propulsion and is relegated to support only.

The reason is the gluteus maximus becomes relatively ineffective due to its attachment points on the pelvic crest being moved in about the same direction of pull as the gluts by the iliotibial tract without muscle power, caused by the shoe heel-induced supinated foot, as explained earlier in chapter 9.

The principal motive force in the propulsive phase comes at the hip, as provided by the gluteus maximus. With the abnormally rotated position of the pelvis, only the right hip and gluteus maximus work effectively.

Over Time These Functional Abnormalities Gradually Become Permanent Structural Abnormalities

Another point. Look again at the left side of Figure 17.2A. You can see abnormally high left side of the pelvis. At least at the beginning, this abnormality is strictly a functional problem in mismatched leg length.

But over time, it will unavoidably lead to changes in leg length based on bone structure, again by Wolff's Law as discussed earlier in Chapter 3. The functional differential overloading problems of the two legs are gradually frozen permanently into structural problems, just as they are with the knee.

Consider again the example mentioned earlier of an elite 10,000 meter runner who running at race pace sustained a maximum force of an amazing 60 percent more on the right leg than the left leg. Extreme force asymmetries like this are bound to create substantial structural effects over time.

Moreover, this example is of an elite runner performing at very high level of performance and therefore probably with much better than average structural right/left symmetry than the non-elite population, although obsessive over training may counteract the advantage, due to structural changes as noted above.

Right Handedness Correlates with Dominant Right Leg, Like FIGURE 17.2A?

An associated note is worth emphasizing because of its importance. The dominant right leg would seem logically to be related directly to right-handedness. If so, then FIGURE 17.2A probably illustrates the most general relationship between right and left legs, given the substantial predominance 90%+ of right handedness in the population. This would seem true at least for males, perhaps less so for more balanced females. This general right-handed asymmetry is critical here in the interaction between the lower extremities and pelvis, and remains just as critical as we go higher in the human body, as we shall soon see.

That would still leave the question of left-handedness and whether the relationship between legs simply switches positions or is less predominately either way. The answer seems to be less predominately either way, because left-handers seem to be less consistent in their brain hemisphere usage. For example, about half of them still use the left hemisphere predominately for language, like right-handers.

The Situation Is More Complicated Because of Very Common Random Injuries Like Ankle Sprains

My guess is that there are likely a number of functional and structural variations, at least as subsets of the basic sets, like that shown in FIGURE 17.2A. Individual genetic variations are obviously an important factor. But luck and accidents are likely to play a big role in what happens to each individual, given the extremely unstable and unnatural midstance running positions shown in FIG 17.1 A-C.

For one thing, both legs are tilted-in with so much foot crossover and supination, ankle sprains are highly likely, especially when modern shoes with elevated heels are worn. As noted earlier, such heels supinate the foot, increasing the likelihood of lateral ankle sprains, rolling to the outside. That happens so frequently that such ankle sprains are the most common sports injury and are the most common of all injuries that cause visits to hospital emergency rooms, even though most such ankle sprains are never treated at all by health care professionals.

It is becoming increasingly well documented that a large number of such seemingly simple ankle injuries do not heal properly and become chronic injuries. In such cases, it is highly likely that such injuries lead directly to asymmetrical functional and structural problems. And probably in a relatively random way in terms of specific right side or left side effects on the human body.

A Wide Spectrum of Variation Exists in the Amount of Crossover of Each Individual

As was the case with bowed out or in legs and pelvic rotation, width or flatness, typically both males and females permanently develop a significant degree of crossover over time. As a general rule, this is the unnatural structural state of most modern males and females, although the amount of crossover varies considerably. There is inherently a wide spectrum of variation in the amount of typical male or female crossover. It depends on individual genetics, specific use of many different elevated shoe heels through the years, and random luck with regard to accidental injury.

The range of variation is sufficiently great that any individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

Asymmetry Between Left and Right Knee, and/or Hip, and/or Ankle, and/or Feet Joints

The asymmetry discussed above relative to right and left legs directly results in asymmetrical joint structures and functions between the right and left legs. For example, the knee joint of the left leg may incorporate significantly more or less abnormal rotary motion in its structure and function than the right leg, as can the corresponding joints of the ankles or hips or feet.

The foot and/or ankle joints, including the subtalar joint, may become asymmetrical between the legs, so that the right foot pronates more and the left foot supinates more. In the hip joint, asymmetry can be present between legs relative to coxa vara and coxa valga and/or anteversion and retroversion of the neck of the thighbone.

So for any particular individual, the unnatural inward collapse of the right and left legs discussed above can occur mainly in the foot joints, the ankle joints, the knee joints, or the hips joints, or spread between them in any possible manner. Luck in the form of either genes or a particular injury like a badly sprain or broken ankle may be the determining factor in the exact configuration of the multiple leg joints of any particular individual.

Comparison of Modern Western Shod Runner and Native African Barefoot Runner

A fairly recent (May 26, 2013) video clip on **YouTube** titled "**Barefoot running Bushman versus me (shod Finn)**" https://www.youtube.com/watch?v=H1Ej2Qxv0W8 (or see **VIDEO 17.7**) includes in FIGURE 17.3A a rear view of a modern shod Finnish runner in the typical left side tilted down position just like that of the left side of Figure 17.1. FIGURE 17.3B shows the typical right level position just like that of the right side of Figure 17.1.

Notably, the typical Western shod running style of the Finn is so bad that the other Bushman standing behind the camera can be heard audibly laughing at it in the video clip. It reinforces the fact that the running style of the Bushman developed over a lifetime of barefoot running shown in FIGURES 17.3A and 17.3B is entirely different from that of the Finn.

The barefoot Bushman's legs are straight and not bow-legged and splayed-out. Remarkably, his pelvis is level on both legs! His spine is straight and extremely well defined compared to the Finn, whose pelvis tilts downward on left leg in FIGURE 17.3A, but is level on right leg in FIGURE 17.3B.

The video clip also includes front views of the same runners in the same positions, as seen in FIGURES 17.4A and 17.4B. The starkly different results of the comparison of body positions between a lifetime barefoot Bushman running versus a shod Finn running is the same as in the previous views.

The shod Finn now increases our sample total to 4 out of 4 male runners, 2 Muybridge's and 2 recent, who have a pelvic tilt downward on only one support leg during midstance, maintaining the existing 100% of the available sample..

Unfortunately, the Bushman & Finn video is extraordinarily rare in showing a modern Western shod runner in direct comparison with native barefoot runner. In fact, it was the only one my search could locate. I guess some new fieldwork is necessary unless I have missed others that might be out there somewhere. Certainly that should be easy to do in today's world.

I did come across a photo of an ancient bronze statue of a runner in motion whose body structure looks remarkably like that of the Bushman runner above and unlike that of the modern Finn. See FIGURE 17.4C.

Similarly, the only **YouTube** video clip I could locate of a native Western barefoot runner was of Zola Budd. It is titled "**Zola Budd 'world record' 2000 metres**" https://www.youtube.com/watch?v=FGSjpUIGbZs. Unfortunately, the 1980's era video is of very poor quality. The best still photo I could extract is FIGURE 17.5, which at least does seem to indicate a very straight leg style by Zola in comparison to the modern Western runner slightly behind her.

Again, more new field work is necessary to videograph barefoot Western/Caucasian runners who have never worn shoes, perhaps some can be located in the South Pacific. Alternatively, many of the population of India are Caucasian and have been barefoot throughout life, although most of those affluent enough to be "runners" have had extensive exposure to footwear.

Finally, a short Y**ouTube** video points out an important right/left asymmetry in the running stride even in Haile Gebrselassie, arguably the greatest distance runner of the modern era. It shows clearly in FIGURE 17.6A that his left foot lands in a much more supinated position, with a very high big toe indicating the naturally extreme activation of the windlass mechanism as the barefoot lands.

In contrast, the big toe on his right barefoot is much lower when landing as shown in FIGURE 17.6B, with the associated lower main arch of a pronated foot. See "Haile Gebrselassie Running in Slow Motion (Barefoot & Shod)" by James Dunne at https://www.youtube.com/watch?v=L3s7z8DXVwo.

I think this is an example of the general case for elite non-Western runners who presumably grew up exclusively barefoot and only began to wear shoes when they started to race at elite levels. They have a tremendous physical advantage running with a naturally developed physical symmetrical structure, but even that structure becomes deformed over time by elevated shoes heels. They are just less deformed and asymmetrical compared to modern Western runners, all of whom have been constantly exposed to the adverse effects of shoe heels over their entire lives.

The General Structural Position of Modern Human Legs and Hip Joints

Like FIGURE 17.2B above, FIGURE 17.7 show the abnormal, unnatural general structural position of modern legs and hip joints.

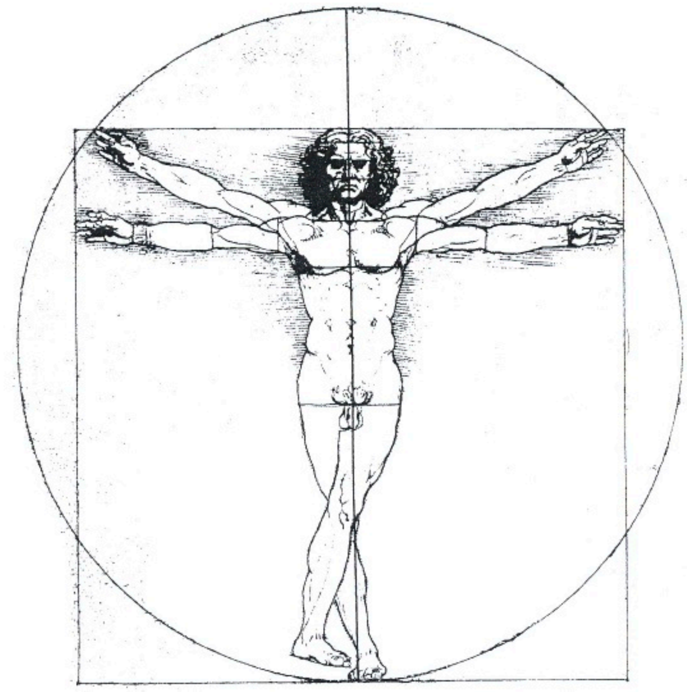


FIGURE 17.7

18 LONGTERM USE OF SHOE HEELS USUALLY MAKES RUNNING BAREFOOT PRONE TO INJURY

Returning yet again to FIGURE 17.2 A&B, you probably missed something that is crucially important, but which is not obvious in FIGURE 17.1, although it is obvious in other Muybridge frames showing side views of the runner. The crucial thing is that the runner is barefoot.

What you are seeing in FIGURE 17.2 A&B, then, is the effect of removing the elevated heels typical of the street shoes of that day. The new "normal" for the barefoot runner shown in FIGURE 17.1 – whose body has almost certainly been significantly deformed by habitual use of elevated shoe heels - is "abnormal".

It therefore requires continued use of elevated shoe heels to retain its unnatural "normal" state. Trying to return to a natural state by removing the offending shoes does not work when a body has been significantly deformed, as most have. Especially if the deformation is not just functional, but baked into the bones, which can be changed only very slowly over time, if at all.

Since running barefoot has become the new abnormal normal, removing shoes typically makes the abnormality even worse. Essentially, the body collapses further with the unnatural elevated shoe heel supports are removed. I believe that is why the asymmetry deformity illustrated in FIGURE 17.2 A&B is so extreme.

First Proof That For Most Going Barefoot Is Not the Solution

As noted earlier, the footprints clue cited in the old James report in the Preface (FIGURES 1 & 2) is all the more powerful as evidence since the footprints were taken with knee bent forward, supported on that single leg alone, so it was taken in roughly the typical midstance running position shown in FIGURE 3.2 above (although at only 1 full body weight, rather than 2-3 times typical of running).

Although obvious, it is nonetheless just as significant that those footprints were taken of bare feet. That provides good evidence that normally shod feet continue to roll unnaturally to the outside in the supination position even when bare, as clearly shown in FIGURE 2 because the foot and ankle bones, and associated ligaments, muscles and tendons, have been re-formed abnormally by shoe heels.

Therefore, instead of being an easy solution, simply going barefoot instead of correcting those abnormalities makes them worse for most individuals who have grown up wearing shoe heels! All the more perverse, those individuals whose shoe heel-induced deformities are worse than average will have even greater adjustment problems trying to run barefoot.

So those who need help the most are the least likely to get it barefoot. Only those with less of a problem to start with are likely to be able to transition safely to barefoot running.

This is why running shoe design is currently at a dead-end. There is no easy or immediate solution currently available, or even a known solution. Finding a solution for those individuals most in need will be an extraordinarily complex problem.

Other Evidence

This view is also supported by a recent study by Hoerzer et al that showed that the gait asymmetry of young adult runners is reduced when running in shoes compared to doing so barefoot[1].

A study by Munoz-Jimenez et al.[2] in 2015 found no significant difference in the degree of inversion/eversion (similar to supination/pronation) between barefoot and shod runners. However, Munoz-Jimenez also cites the findings of several other researchers, some of which are consistent with his research and some are not.

I believe the lack of consistency in their findings is obviously due to substantial variations in the footwear used for the shod condition in the testing of different studies. This inconsistency due to uncontrolled footwear variations is a common and fundamental problem with existing biomechanical studies.

Anyway, back to the main point. The very attractive and highly intuitive logic of returning to natural barefoot running has been made perversely illogical by shoe heels and replaced by a counter-intuitive, unnatural reality.

As a consequence, simply reverting to natural barefoot running is dangerous for many individuals, perhaps a majority, unless elevated shoe heels have not already significantly deformed your body. Individual variation rules, of course, so many individuals can be highly successfully running barefoot, but I believe they are the exception, not the rule.

19 SHOE HEELS TILT THE PELVIS ASYMMETRICALLY

As you may recall from Chapter 8, when elevated shoe heels tilt out the ankle and tibia, that automatically tilts the pelvis backwards because of the iliotibial tract connection between the tibia and the pelvis.

So when the right and left legs end up in an asymmetrical position relative to each other, as we have shown, the pelvis also becomes asymmetrically tilted. This is really bad.

I can't emphasize this enough. Asymmetrically tilting your pelvis is really, really bad, as we shall see!

Shoe Heels Cause Your Pelvis to Tilt Abnormally in All Three Dimensions

Everything above your pelvis is supported by it. Far more than just forming a basin that directly holds your lower internal organs, the pelvis also directly supports your backbone or spine upon which the entire structure of all of your upper body depends.

To grasp the extent of pelvic asymmetry problem, look at FIGURE 19.1. It shows the six directions in which the pelvis can move in all three dimensions. The pelvis can tilt forward and backward in the sagittal plane, either side can move up or down in the frontal plane, and the pelvis can rotate to the right or left in the horizontal plane.

What is really, really bad is what happens when your legs more or less collapse inwardly and asymmetrically (because of the inherently unstable splayed-out position of Chapter 11 and the running asymmetry of Chapter 17, particularly the left side of the pelvis).

Your pelvis is automatically moved into an asymmetrical position where one pelvis side is tilted forward, laterally tilted down, and rotated inward relative to the other pelvis side. Over time, the pelvis is thereby molded into an asymmetrical shape, of which FIGURE 19.2 includes several typical examples.

The Asymmetrical Pelvis Becomes Deformed and Forces the Spine Into Unnatural Positions

This abnormal, tilted position becomes the default neutral foundation of support for the spine, dictating inexorably that the spine will be tilted or twisted in an unnatural direction. That basic structural abnormality will fundamentally affect the upper body in an unnatural way. More about this is in later chapters.

Also, over time this asymmetrically positioned pelvis is distorted structurally by the unnatural forces acting upon it by the asymmetrically collapsed position of the legs, like those shown in Figure 17.1. The result is a human pelvis that is not just structurally flattened, but also asymmetrically deformed from one side relative to the other side.

Childbirth and Development Within the Womb Are Both Adversely Affected

All of the serious childbirth (and organ position) problems, with directly related functional problems, previously mentioned relative to the pelvis being tilted backwards for males or forwards for females become even worse with additional right/left asymmetry problems added to them.

As mentioned previously, there are a few old studies that indicate that the babies of primitive, barefoot populations develop significantly faster, such as in learning to walk. It seems reasonable to conclude carrying a baby to full term in nine months in an abnormally forward tilted and mis-shaped pelvis is bad. It would lead to abnormal development in the womb, including slower or incomplete development or even deformed development.

Studies indicate that about two-thirds of fetuses are carried in the same asymmetrical position in the womb. That apparently abnormal position is with the head down and right ear facing the mother's front. In other words, the fetus is rotated about 90 degrees to the left side, probably due to the mother's pelvic asymmetry, as shown in FIGURE 19.3.

The unnatural position would likely affect the development of the fetus adversely during its term in the womb and potentially after birth as well. Again, the need to fully explore this important issue is urgent.

Since Pelvic Symmetry Is Important, How Do You Tell If Your Pelvis Is Rotated Asymmetrically?

Leaving aside resorting to a clinical visit for analysis by an Orthopedist, there are some telltale signs you can observe yourself to gauge your own personal level of pelvic asymmetry.

First, and probably the easiest, if you have six-pack abs that are symmetrical between right and left sides, your pelvis is probably aligned properly. Interestingly, classic ancient sculptures up to the Renaissance have symmetrical abs, like Leonardo's David. Many modern six-pack abs have obvious asymmetry indicating underlying pelvic asymmetry, even with substantial muscular development, like the example shown in FIGURE 19.4. Of course, if your six-pack abs are covered by a spare tire, there's no easy way to know.

Telltale Male Equipment

Second, if you are male, pelvic asymmetry can be indicated by one testicle hanging lower than the other, such as the extraordinarily exaggerated testicular mismatch displayed by the famous pioneer of motion photography, Eadweard Muybridge, in FIGURE 19.5.

FIGURE 19.5 Extreme Example of Modern Male Asymmetry

This mismatch may be accompanied by a hanging or twisting of the penis to the right or left side. Apparently custom tailors adjust for the common mismatch of male equipment by politely inquiring whether you “dress right” or “dress left”. Presumably, Eadweard's tailor did not have to ask.

Hidden Female Equipment

If you are female, obviously no such simple test is available. However, with considerable difficulty, you can get what is probably the closest possible equivalent assessment. I noticed this mismatch, strictly by chance, when my girl friend was performing yoga au naturale and was in the plow position. As I happened by, I observed her labia were shifted noticeably relative to each other, so one side was distinctly lower than the other.

However, since the plow is a fairly dangerous position, I would not suggest that you try self-evaluation in order to avoid the potential embarrassment of involving another. Doing so would be a lot more difficult than whatever you may have learned to do from “The Vagina Monologues”. By the way, my girl friend was doing the plow yoga stretch to ease lower back pain, which is directly caused by pelvic asymmetry, as we will explore in the next chapter.

A much easier but possibly less accurate female alternative is self-evaluation of breasts. If they are asymmetrical, either in terms of one hanging lower than the other and/or one being larger than the other, that suggests the same kind of pelvic asymmetry as does the male equipment asymmetry discussed above.

Although the breasts are much farther away from the pelvis, the chest is still directly affected by pelvic asymmetry, as well become evident in later chapters. On the other hand, I do not know whether breast-feeding in which one breast is used more than the other can also affect relative breast size, so I am less certain of the accuracy of the breast evaluation.

Simple and Easy Pelvic Symmetry Self Tests (Although With Uncertain Accuracy)

There is an easier way for anyone of either sex to assess their pelvic asymmetry, although I am less certain of its accuracy. Just lay on your back flat on the floor with your legs spread apart comfortably, totally relaxed. Bend your head up slightly, enough to see what position your feet are in. If your feet are bent out at different angles, one rotated outwardly more than the other, your pelvis is probably asymmetrically positioned. The greater the difference in foot angle, the greater the pelvic asymmetry.

Similarly, when you are walking or running, if one foot angles in or out (toes-in or toes-out) more than the other, that also suggests pelvic asymmetry. But be careful to watch where you're going if you decide to check yourself this way.

Finally, again for either sex, you can feel with your hands down both of the sides of your rib cage on either side of your abdominal muscles, below the sternum, which is the central bone located at the center of your chest. The upper ribs are firmly attached to the sternum, but the lowest ribs are sometimes called “flying or floating” ribs because they do not and are only attached to each other by ligaments along the edge of the rib cage. If you can feel the lowest rib or ribs on one side protruding enough to be felt, but not so the lowest rib on the other side, that would also indicate pelvic asymmetry.

A Wide Spectrum of Variation Exists in the Degree of Asymmetry of Each Individual

As was the case with previous abnormalities, over time each individual typically becomes permanently more asymmetrical. This is particularly true at least while the individual remains physically active. With much less physical activity typical of aging, the structural asymmetry increase slows somewhat because there is no longer a force producing it. However, as muscles typically weaken significantly in the elderly, those structural asymmetries begin to dominate, forcing postural abnormalities common in old age.

As you may recall, the general rule is that this asymmetry is the unnatural structural state of most modern males and females, although the amount of asymmetry varies considerably. There is inherently a wide spectrum of variation in the amount of typical asymmetry. It depends on individual genetics, specific use of many different elevated shoe heels through the years, and luck with regard to accidental injury.

The range of variation is sufficiently great that any individual male or female can have a structural state that is more typically characteristic of the opposite sex. The tendency toward any typical structural state for either sex is only a tendency, with a wide spectrum of actual variations that always includes some exceptions to a general tendency.

20 SHOE HEELS CAUSE WIDESPREAD LOW BACK PAIN

Low back pain occurs in the lumbar spine or lower back, shown as 2 in FIGURE 20.1. It is said to affect 80 percent of U.S. citizens at some time in their lives, having apparently reached something like epidemic proportions.

The lumbar spine includes five vertebrae and a sacrum (essentially a similar number of vertebrae fused together), and connects at its lowermost part, the sacrum, to two rear sides (ilium) of the pelvis by the infamous sacroiliac joint.

The sacroiliac joint is considered the weak link of the entire vertebral column or spine

Like all of the other serious diseases discussed in prior chapters, the cause of low back pain has never been identified. Like the previous problems, it is generally thought to be a product of incomplete evolution to the unique upright bipedal locomotion of humans.

As we have seen earlier, this view is entirely incorrect. Low back pain is definitely caused by the unnatural direct effects of elevated shoe heels. In its natural, undeformed state the lumbar spine is strong and stable.

The Direct Cause of Low Back Pain

The primary cause of low back pain is the typical downward tilt of the left side of the pelvis, which has already been shown in Figure 17.2A of Chapter 17. Simply put, that downward pelvic tilt unnaturally jams the pelvis directly against the sacrum, obstructing the normal action of the sacroiliac joint, sometimes even to the point where it effectively locks up and ceases to function, especially in old age.

Also, as noted in previous chapters, particularly 8 and 12-13, shoe heels unnaturally tilt the pelvis, typically backwards in males and typically forwards in females. Inherently, then, the joint between the ilium of the pelvis and the sacrum of the lumbar spine - the sacroiliac joint - is abnormally affected by the abnormal position of the ilium.

Like the other joints discussed previously, the abnormal position of opposing joint surfaces caused by shoe heels adversely alters the structure and function of the sacroiliac joint.

The Structure and Function of the Sacroiliac Joint Are Unnaturally Altered in the Male Flat-Back

Critically, the range of motion between the pelvis and the lumbar spine is significantly reduced[1], which I believe corresponds to the backwardly tilted pelvis and flat-back condition typical of males. This results in what can be termed a static spine, as shown in B in FIGURE 20.2.

I think the forward rotation of the pelvis in the horizontal plane as discussed in chapter 16 compounds the problem, helping to lock the flat back into a relatively immobile position. As noted before, this is the general case for nearly all of the population, the right-handers.

The highly abnormal flat back is characterized by almost no axial rotation, as shown the spinal mobility summary shown in FIGURE 20.3. The unnatural absence of axial rotation extends all the way through through the lumbar spine and even includes the lowest three vertebrae of the thoracic spine of the chest area.

The abnormal, static position of the flat-back is obvious to the naked eye, if the lumber spine is naked and thus open for observation. You can confirm this obvious low back abnormally in participants in practically any episode of "**Naked and Afraid**" on the **Discovery Channel**, such as the example shown in FIGURE 20.4.

Compare this flat back to the curved lower back of the barefoot African squatting in FIGURE 5.4.

This abnormal absence of axial rotation contrasts dramatically with the rest of the thoracic spine above the three bottom thoracic vertebrae. This upper thoracic area has symmetrical, approximately equal ranges of motion for all three types of spinal motion: axial rotation, lateral bending, and flexion and extension.

The Female Lower Back is Typically More Convexly Curved, Called Lumbar Lordosis

In contrast, the dynamic spine, as shown as A in FIGURE 20.2, corresponds to the forward tilted pelvis and convexly rounded lumbar spine more typical of females[2], as shown in Figure 20.5, with a more highly mobile sacroiliac joint. The convexly rounded lumbar spine is also typical of primitive, barefoot populations.

Unfortunately, the joint is abnormally mobile, more than would be naturally the case without shoe heels. So abnormal hyper-mobility may be the main problem for most women, for whom low back problems are frequent and often severe.

The greater convex curvature typical of women compared to men noted just above[2] is called lumbar lordosis. Pregnancy can increase the lumbar lordosis significantly, as shown in Figure 20.6.

The Vital Connection Between Sacrum and the Lumbar Spine Is Tilted Into Instability

This relatively extreme pelvic forward tilting of the sacrum results in abnormal sliding motion between the upper surface of the sacrum (S_1) and the lowest lumbar vertebrae (L_5), causing inflammation, forward displacement, or fracture (or spondylolisthesis), as shown in Figure 20.7.

Weakened Abdominal, Gluteus Maximus, and Hamstring Muscles Create an Unstable Spine

As discussed in previous chapters, the abdominal, gluteus maximus and hamstring muscles are significantly weakened by the automatic action of the shoe heels tilting out the lower leg, which forces the pelvic backwards due to the iliotibial tract or band.

This non-muscular mechanism is contrary to maintaining the strength of the abdominal, gluteus maximus and hamstring muscles, which are absolutely vital to holding the pelvis in its natural upright position of support for the entire vertebral column of the spine, as shown as A in Figure 20.8.

In their abnormally undeveloped state, these three essential muscled groups are weak and thus easily fatigued. Without their necessary firm and continuous support, the pelvis automatically rotates forward into an unnaturally unstable position.

In this abnormal position, the trunk of the body slouches into a position wherein all the spinal curves become exaggerated, as shown as B in Figure 20.8. This happens particularly noticeably in a long race like a marathon.

It is important to note that the same position of the abnormally exaggerated upper trunk spinal curvature is created even in the more typically male flat back position. That is because its principal cause is weak abdominal, gluteus maximus, and hamstring muscles created by the flat back position, as previously discussed.

Note: for more information on the anatomy of the lumbar spine see this **YouTube** video: https://www.youtube.com/watch?v=0qR-Yfw9fOI, which is titled “Lumbar Spine Anatomy” from Randale Sechrest.

See also: https://www.youtube.com/watch?v=1iwmcCw4bAw titled “Sacroiliac Joint Dysfunction Animation - Everything You Need To Know - Dr. Nabil Ebraheim, M.D.

Relative to the whole vertebral column see: https://www.youtube.com/watch?v=NAd9g5nUurE titled “Spine tutorial (1) - Vertebral Column - Anatomy Tutorial” from AnatomyZone.

21 SEXUAL PERFORMANCE, SATISFACTION AND FERTILITY

Before we depart from the lumbar region, we should consider the effect on sex of the structural and functional changes caused by elevated shoe heels.

First and most obvious from the last chapter, shoe heel-induced lower back pain is bad for sexual performance and satisfaction, given the primary role of lower back in the basic in-and-out motion fundamental to the sex act.

Second, there is a basic pelvic alignment issue. As discussed previously, typically the male pelvis is abnormally rotated backward and the female pelvis is rotated forward, in the opposite direction.

The extent of this counter-rotation was indicated previously in Chapter 13 in FIGURE 13.3, which shows an upper view of a female pelvis and a male pelvis. The main difference you can see is that the male sacrum and coccyx are rotated far down into the brim or opening of the pelvis. That is to say, it is rotated backwards

Comparing its position to that of the female sacrum and coccyx, rotated forwards, shows clearly the substantial difference in the basic pelvic positions between the male and female.

This abnormal rotation in opposite directions would dictate that the male and female pubic areas at the front of the pelvis would be rotated out of their most natural position of directly opposing each other in the classic, face-to-face missionary position.

The Basic In and Out Coupling Motion of Male and Female Pubic Areas Is Thrown Out of Alignment

Putting the alignment problem a little more graphically, elevated shoe heels have caused the modern male pubic area to move unnaturally forward from its normal position by the backward rotation of the pelvis (viewed from the side, in the sagittal plane). The male pubis is thus unnaturally moved toward the end of its natural range of forward motion.

So the neutral, starting position of the male pubis is located unnaturally near the end of the natural range of pelvic motion that forms a basic in-and-out stroke of missionary position copulation. That is to say, the starting position of the male pubis is abnormally located near the finish position of a basic forward pelvic thrust.

In contrast, shoe heels have moved the modern female pubic area unnaturally backwards from its normal position by the forward rotation of the pelvis. So the female pubis is thus unnaturally moved toward the opposite end of its natural range of forward motion compared to the unnatural position of the modern male pubis.

Thus the neutral, starting position of the female pubis is located unnaturally near the opposite end of the natural range of pelvic motion that forms a basic in-and-out stroke of missionary position copulation. That is to say, the starting position of the female pubis is abnormally located near the beginning position of a basic forward pelvic thrust.

So if both partners start the copulating motion at the same time, the male begins by moving forward and the female by moving backward. The result is zero relative motion between their pubic areas. At the end of their ranges of pelvic motion, the male reverses to start moving backwards and the female starts to move forwards. Again, there is no relative motion.

While theoretically this well-synchronized motion might suggest itself as a possible form of birth control, of course it is not. Most couples can overcome this coordination difficulty with a little learning and concentrated effort. The point here is just that a supremely natural and pleasurable act is made abnormally more difficult and frustrating by the unnatural effect of elevated shoe heels on the human body.

Primitive Barefoot Populations Are Not Limited to the Missionary Position

The term "missionary position" is itself an uncomplimentary commentary from those in primitive barefoot populations about a notable lack of variation in sexual positions exhibited by those of supposedly more advanced civilizations. Of course, the viewpoint of those missionaries of the 18th and 19th centuries may have been that sex was for procreation only, not enjoyment.

Nonetheless, the far greater variety shown for example in the Kama Sutra of India may well indicate that those of more primitive, non-Western cultures were more physically able to perform a variety of sexual positions. Specifically, that they had the natural strength and dexterity required to comfortably and safely experience more physically demanding coital positions.

On that point, the rectus abdominals and gluteus maximus muscles are the opposing muscle groups that most control the pelvis. They are especially involved in performing the basic pelvic in-and-out motion fundamental to the sex act. But as you recall, they have been weakened by automatic mechanism of the iliotibial tract caused by shoe heels.

The Position of the Female Clitoris May Determine Whether Orgasm Occurs In Intercourse

Marie Bonaparte developed and published in 1924 an elaborate theory that the physical distance between the clitoris and vagina determined whether orgasm was possible for a particular woman during intercourse. She found that the distance needed to be less than an inch (or 2.5 centimeters).

While there is apparently some ongoing studies related to confirming and/or expanding these findings, I mention Mrs. Bonaparte only to emphasize the point that the structure and function of our sexual parts may well be themselves altered by the larger structural and functional changes we have already discussed that have been caused by shoe heels. For example, Marie Bonaparte's critical inch may well be affected by shoe heels.

As you might guess, there is however no research available now on sex and shoe heels, other than stiletto heels seem to encourage it, at least in pornography. For now I can only suggest the book from which I obtained the above information, "**Bonk: The Curious Coupling of Science and Sex**" by author Mary Roach. The book is quite informative, as well as very funny.

Mary Roach is also the author of the book, "**Stiff**", so she is also a convenient segue to my next topic, erectile dysfunction (although her book is actually on the curious lives of human cadavers, which she remarkably also manages to make both informative and funny).

Erectile Dysfunction Caused By Elevated Shoe Heels?

Erectile dysfunction is known to be adversely affected by cardiac dysfunction and I will make the case that shoe heels clearly play a big part in creating unnatural cardiac problems in a later chapter.

There is another issue to discuss here, which is impingement of organs on nerves. The spine consists of a column of vertebrae surrounding the spinal cord. The last left and right nerve branches off of the spinal cord exit from small openings between the S_4 and S_3 vertebrae of the sacrum and they control sexual function.

These sacral nerve roots are critical to the orgasm function, so the shoe heel-induced unnatural alteration of the sacrum position within the pelvis of both males and females shown in FIGURES 13.3-4 is a likely source of problems in achieving an orgasm.

Although unproven at this very early stage of research, it seems logical that unnatural pressure on at least one left or right nerve branch is caused by at least one organ such as the rectum, bowel, or bladder shifting out of its natural position and pressing on the bone of the sacrum. A partial hernia could be involved. Similarly, and just as critically, the flow of blood into the penis may also be constricted in the same manner.

This abnormal organ shift is likely caused by the shoe-heel-induced backward and asymmetric rotation of the pelvis. The resulting unnatural pressure presumably would be a cause of erectile dysfunction.

Shoes and Feet Can Have a Direct Role in a Sex Act?

I for one have never had erotic feelings toward feet. Actually, I think feet are pretty odd looking, if not ugly. Nevertheless, feet and how they can be used, as well as footwear, are extremely erotic for some individuals and in some cultures.

Everything you ever imagined that you wanted to know about such matters, as well as some things you might have preferred never to have known, are described in detail in "**The Sex Life of the Foot and Shoe**" by William A. Rossi. Prepare to be shocked and/or amazed if you get a copy.

Actually, it is a fairly scholarly work, since Mr. Rossi is in fact one of the world's leading authorities on footwear and was the distinguished longterm editor, now retired, of **Footwear News,** the leading shoe industry publication.

Both Human Man and Female Fertility is Reduced by the Abnormal

Position of the Pelvis

The unnatural position of the pelvis, as noted earlier in Chapter 14, causes a particular problem since it is effectively a basin that is piled high with our internal organs. Remember Figures 14.5 & 14.6. It would seem likely that tilting that basin backwards or forwards and asymmetrically would likely shift our intestines, and bladder out of their natural positions, slowing down or even temporarily blocking passage of their contents.

Other major and minor organs would likely be affected as well, because the multitude of interconnections and interactions are amazingly complicated and often quite delicate. Among the most delicate of these would be the male and female internal sexual organs critical for conception, thereby reducing fertility in both sexes.

This would seem to explain why modern human females are much less fertile than the females of other animal species. They also have many more spontaneous abortions and pregnancy diseases like preeclampsia.[1]   For generally the same basic reasons, modern human males have very low quality sperm.[2]

22 THE TWISTED THORACIC SPINE AND PRESSURED HEART

The structure and function of the thoracic spine and chest are utterly dependent on the position of the pelvis and the strength of the abdominal, glutes, and hamstring muscles that stabilize it.

As we have already seen, shoe heels have forced the pelvis into an abnormal, less stable position and have weakened those stabilizing muscles. And the human body is primarily deformed in its maximally loaded condition, the midstance position during running.

The Thoracic Spine Bows Out to the Right Side, Favoring the Evolution of Right-Handed Runners

As shown below in FIGURE 22.1, which is similar to the left side of previous FIGURE 17.2A, the thoracic spine is most typically bowed-out to the right as a direct result of the pelvis being tilted down to the right, due to the functionally and/or structurally high left leg. Also shown in the left side of FIGURE 22.1, there is a significant distortion of the right side of the chest, with obvious rotation axial rotation of ribs in the horizontal plane toward the right side (clockwise, as viewed from above).

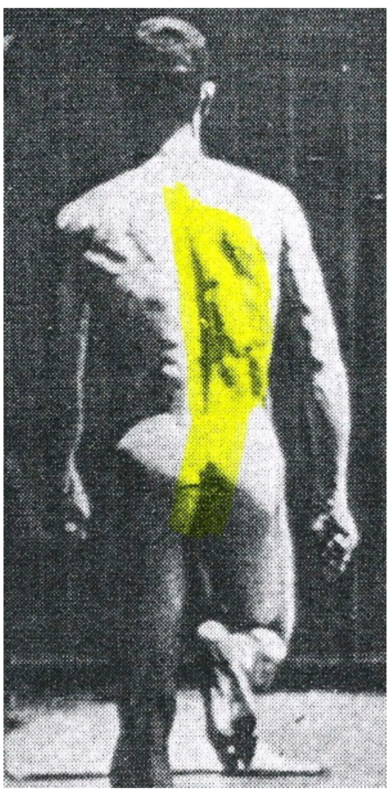
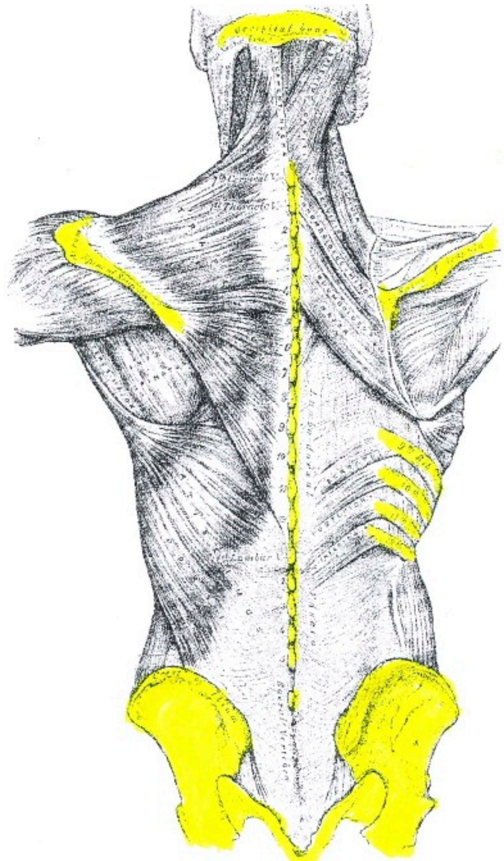


FIGURE 22.1 Chest Structural Distortions At Midstance Related to Heart Disease?

However, since the pelvis is tilted-down substantially on the right side, like **FIGURE 17A**, the spine is actually curved far to the left side relative to the pelvis, so the abnormal torque and excessive pressure may focus directly on the heart, stressing it and gradually distorting its structure and function.

See FIGURE 22.2 below for an overview of the involved muscles of the upper back.



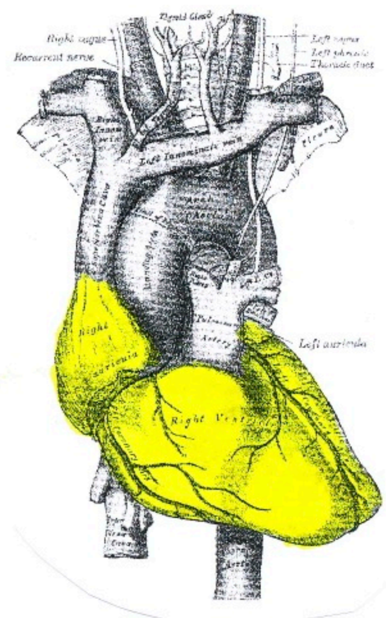


FIGURE 22.2 Layers of Back Muscles FIGURE 22.3 Heart with Major Arteries & Vessels

It should be noted here that early anatomists considered minor right thoracic outward bending like that shown in FIGURES 22.1 and 17.2A, which is like minor right thoracic scoliosis (and which is clinically observed in a stationary or standing state typically), to be the normal configuration of the spine[1]. This is important because it suggests strongly that this is the most common, basic thoracic pathology generally caused during running by shoe heels. Once established during running, this basic thoracic pathology persists not just in running, but also in walking, or standing, swimming, or even lying down.

Although FIGURE 22.1 does not include a parallel picture of the runner's right side in midstance supported by the right leg (Muybridge did not provide one), it is reasonable to assume it would be like the right side of FIGURES 17.2A. That is to say, with level pelvis and no thoracic bending or chest distortion.

I think both FIGURES 22.1 and 17.2A provide a clear suggestion about the evolution of right-handers, who make up most of the population, about 92-93 percent. Because of this high percentage, presumably both figures show right-handed runners (and probably with associated dominant right legs).

If so, then being right-handed clearly must put less structural stress on the heart, located on the left central part of the chest. As we have seen both figures, the greatest thoracic stress occurs during midstance of the left leg. The non-dominant, higher left leg forces the thoracic spine to the lower right leg, bowing away from the heart.

In contrast, if the right leg were structurally and/or functionally high instead of the left leg, the thoracic spine would bow out to the left, putting substantial abnormal stress on the heart that right-handers would not be subject to. So evolution heavily favored our prehistoric forebears who threw spears with their right hands and not with their left.

Evolution and Right-Handedness In Humans Compared to Chimpanzees, Their Closest Relatives

Besides being innate in over 90% of humans, right-handedness is also very common among our closest primate relative, the chimpanzee, who also gesture and throw with their right hands, although less predominately so than humans.

But chimpanzees are not bipedal, although they can stand relatively upright. Unlike humans, their principal mode of locomotion is climbing and swinging between branches of trees, a mode called brachination. The formative locomotion stance for chimpanzees may be hanging by the left arm while using the right arm to eat or gesture or fight.

This would be analogous to the critical maximally loaded midstance position in the human running stride, although much less formative because of significantly reduced forces. Another mitigating factor is that, as we shall see in a later chapter, the upper torso of the chimpanzee is measurably far stronger than that of humans, suggesting it is much more symmetrical.

At any rate, a static left arm and mobile right arm is generally protective of the chimpanzee heart in a similar manner as the left support leg and right propulsive leg is for the human heart. It would therefore be important in evolutionary selection, but less so than in humans. On the ground, chimpanzee locomotion is unlike that of humans, whether running or walking. Rather, it is like that of other non-human primates. Chimpanzees knuckle-walk and are quadrupedal when running, so the structure and function of their bodies are very different from humans, despite the superficial similarity of right-handedness.

The Highly Perverse Effect of Shoe Heels On Human Cardiovascular Function

Despite right-handedness evidently being more protective of the human heart than the alternative of left-handedness, elevated shoe heels have the perverse effect of substantially amplifying what would otherwise be a minor structural asymmetry that is heart protective. Instead, shoe heels turn the minor asymmetry of right-handedness into a major structural asymmetry that is heart destructive by exaggerating it in a highly unnatural way. See the complicated structure of the heart above in FIGURE 22.3.

Better for Right-Handers, But Asymmetry Is Still Not Good for Cardiovascular Function

As shown in both FIGURES 17.2A and 22.1 above, functional and/or structural asymmetry in the frontal plane still distorts the entire chest area, including the left side with the heart, the terminus of an elaborate network of arteries and veins. How exactly this affects normal function is unknown, having never yet been formally studied.

However, it is reasonable to conclude that the left area of the chest would be subject to abnormal compressive forces by the bowing out to the right of the spinal column. That would be in addition to the unnatural axial rotation in the horizontal plane that is also indicated clearly in the two figures.

These unnatural compressive forces in the frontal plane and rotational or torsional forces in the horizontal plane are likely to degrade cardiovascular function, increasingly over time.

The Shoulders and Arms Are Weakened by the Twisted Thoracic Spine, Predicting Cardiovascular Risk

Grip strength has been shown recently to be a very good predictor of risk for cardiovascular death, heart attack, and stroke[3]. Unknown to the researchers, the reason for this is likely that grip strength is logically a good inverse marker for general and asymmetric weakness in the arms and shoulders caused by the twisted thoracic spine implicated in cardiovascular disease, as discussed above.

Besides strength differential, asymmetry in the arms and shoulders can be indicated by one shoulder drooping or slumping lower than the other shoulder, so that the arm on that side can also hang lower.

Lack of Support From Weak Lumbar Muscles Increase the Curve of the Thoracic Spine Unnaturally

Over time, the greatest degradation of cardiovascular function is like to occur with unnatural rotary motion in the sagittal plane. As shown earlier in FIGURE 20.8B, the increasing weakness with age of the abdominals, glutes, and hamstrings leads inexorably to increasing unnaturally the curve of the thoracic spine. The collapse inward of the chest, from a rotation forward in the sagittal plane, causes significant additional abnormal pressure on the heart.

Among the elderly, the extremely stooped-over back – the classic dowager's hump – is quite noticeable. However, the increase in the upper back curve can be already quite advanced at a younger age, just less apparent.

In throwing athletes, the opposite position of the shoulders is present; that is, upright, with less thoracic spine curvature. This enables them to rotate their arm overhead farther backwards, so they have a greater range of motion throwing forward[4].

The modern shoulder is prone to injury by the overall misalignment of the shoulders supported by the unnaturally curved chest and trunk. For example, there is currently an explosion of elbow injuries and Tommy John surgeries to replace the ulnar collateral ligament, particularly of baseball pitchers, especially young ones.[5]

Lack of Cardio-Fitness and Obesity Are Factors in Heart Disease

The functional and structural disorders caused by elevated shoe heels significantly increase the difficulty and/or discomfort or outright pain from exercise. That reduces or eliminates the capability to exercise at a level sufficient to maintain a healthy heart.

Substantial asymmetry can make even simple non-rigorous exercise like walking difficult to perform. Even when it is fairly easy to do, the asymmetry reinforces itself during walking, worsening the asymmetry underlying the cardiac problem. This also tends to produce pain during or after walking, especially in the elderly, making continued walking ever more difficult. It becomes a self-defeating cycle.

Inability to exercise adequately for the same reasons is also an obvious factor in the current obesity epidemic.

An interesting side note to obesity: obese men often are able to move somewhat more gracefully than you might expect, despite their extra weight. This is because their extra weight, especially if present from childhood, tends to force their feet to pronate excessively, producing the same inward leg rotation and knock-kneed position much more typical of women than men. This can result in a more limited knock-kneed position due to typically much lower shoe heels, but can be counteracted by greater weight.

This reinforces the earlier discussed notion in Chapter 15 that, between the two, the knock-kneed position provides better support for males than the bow-legged position in exercise and sports, judging from the leg structure of superior athletes.

Atherosclerosis Has Been Found In Many Ancient Mummies

Puzzling evidence of heart disease in the form of atherosclerosis has been found in a limited number of ancient mummies in Egypt, the Aleutian Islands, Peru, the American Southwest, and Europe. Although the Egyptian mummies were from royalty who may have had a modern life style with rich, unhealthy food and little exercise, many or most of the other mummies appear to have had very healthy diets and plenty of exercise. So far as we know, none wore elevated shoe heels.

Does that mean that neither healthy diet and exercise, nor absence of shoe heels, protects against heart disease? I think not. It may just mean that a gradual build-up of fatty deposits in the arteries, including around the heart, occurs naturally over time in many individuals.

The mummies provide no proof of death or impairment due to the atherosclerosis found in them. On the other hand, the 5,000 year old mummy named Otzi the Iceman was a relatively old man (about 45, very old for that prehistoric time) with both a genetic predisposition to atherosclerosis and actual calcification consistent with atherosclerosis[2]. He was found high in the Italian Alps and was wearing moccasin-like shoes without heels. It is unlikely he was able to hike up to altitude at which he was found while suffering from anything like actual modern cardiovascular impairment.

Rather, the evidence suggests that, despite his level of apparent atherosclerosis, Otzi was most likely asymptomatic or at least did not have significant impairment. I would make the case that his apparent lack of modern cardiovascular impairment despite his apparent atherosclerosis was probably due to an absence of asymmetrical body structure that is caused by shoe heels, as discussed previously.

Indeed, his example suggests that modern cardiovascular disease in the dangerous modern form of death or severe impairment may be caused by atherosclerosis only in the presence of asymmetrical body structure caused by modern shoe heels.

Most other forms of cardiovascular disease, particularly including aortic aneurysms and dissection, as well as congestive heart failure, may also be caused or worsened by the same asymmetrical body structure caused by modern shoe heels.

Note: for more information on the anatomy of the shoulder see this **YouTube** video: https://www.youtube.com/watch?v=D3GVKjeY1FM&index=5&list=PLdFi-NEDU0HcJLwxK7Jn4kbvx-BUEDwPb https://www.youtube.com/watch?v=0qR-Yfw9fOI, which is titled “Shoulder Anatomy Animated Tutorial” from Randale Sechrest.

23 SCOLIOSIS IS CAUSED BY ELEVATED SHOE HEELS

Scoliosis is an abnormal, asymmetical curvature of the spine in the frontal plane, as shown in the old photograph of an articulated skeletal scoliosis example of FIGURE 23.1 It shows how the most typical scoliosis "C" curve bends away from the heart. Typically the pelvis is tilted downward to the side and the thoracic spine curved in a "C" or "S" shape when also including the cervical spine, as shown in FIGURE 23.1 (as viewed from the back). Scoliosis can result from accidental injury, but most forms are idiopathic, meaning no cause is known.

FIGURE 23.1 Twisted Spine of Scoliosis

When I examined the published research on scoliosis, there appeared to be an immediate direct linkage of scoliosis with the characteristics to the typical form of running asymmetry described in Chapter 17 and shown in FIGURE 17.2A.

The Same Basic Spinal Asymmetry Exists in Scoliosis as in Running

Most striking was a clear consensus that idiopathic scoliosis most typically involves right hip abduction (meaning rotated to the outside) and left hip adduction (rotated to the inside). As you recall, this specific asymmetrical position of the hip is exactly what was discussed relative to the running asymmetry shown in FIGURE 17.2A.

The typical pelvic asymmetry is the same. The pelvis is rotated forward in the horizontal plane on the same side as the main thoracic curve, as shown on the right side in FIGURE 17.2A.

Also, muscular contracture of the right hip in the abducted, outwardly rotated position is typical of idiopathic scoliosis. That is exactly the relative outcome to be expected of the right leg shown in the right side of FIGURE 17.2A.

This is because, as described in Chapter 17, the right leg remains fixed in the same position, tilted outward by shoe heel (that is, abducted) relative to the pelvis throughout the stance phase of running on the right leg.

The hip of the left leg is also contracted, but in the opposite, adducted (or rotated in) direction, as was the case in the running example of Chapter 17.

The right leg in both scoliosis and running is typically dominant. Scoliosis patients typically stand at ease only on their right leg.

Scoliosis does not occur in those who cannot run, like the blind (although the new use of running guides may change that).

The Femoral Neck-Shafts and Hip Sockets Show Deformity From Inward

Tilting, Like In Running

Another piece of evidence from scoliosis research emerges that seems decisive. The angles of the neck-shaft of the femurs of scoliosis patients is much greater than normal, as shown in FIGURE 23.2.

Even more relevant, the hip socket is inset into the pelvis. These are precisely the abnormal adaptations you would expect to see resulting from supporting legs being tilted very far inward compared to the body's center of gravity.

As you recall again from Chapter 17, the runner's right leg was tilted in at an angle of 11 degrees and the left leg at an extreme 20 degrees relative to the pelvis. And this is an apparently “normal”, asymptomatic runner, not a scoliosis patient.

The conclusion here is obvious, that scoliosis is just a more extreme, highly developed form of the same kind of pelvic and spinal asymmetry seen in asymptomatic, outwardly normal individuals. The extreme asymmetry of scoliosis is just the logical progression of the substantial asymmetry clearly observable in an apparently healthy runner whose body has been deformed from the use of elevated shoe heels.

Therefore, even apparently healthy runners show definite signs of the same basic asymmetric functional and structural deformities as do scoliosis patients. The most outstanding proof of this is the superstar sprinter Usain Bolt, the “fastest man alive” who was previously mentioned in Chapter 10 relative to his magnificent abdominal muscles.

He has a minor curve in his lumbar spine and developed a more substantial spinal S curve in his teenage years. He has however successfully managed his scoliosis with strength training of his core, as is obvious in his highly developed and perfectly symmetical abdominal muscles.

The fact that Usain Bolt can physically perform at a superhuman level relative to all of his peers strongly suggests that all of the rest of us suffer from undetected forms of scoliosis that are more highly developed than his. It also suggests that his World records will be broken in the future, potentially by substantial margins, by athletes whose spines have never been made scoliotic by elevated shoe heels.

It is interesting to note that Bolt's sprinting success was likely due in part to his early and adolescent life in rural Jamaica, most or all of which was likely spent barefoot, like that of the multitude of other World class Jamaican sprinters, both male and female, who have clearly dominated the last few Olympics.

Scoliosis Is Just the Earliest Manifestation In Life of the Effect of Elevated Shoe Heels

Scoliosis strikes early in life, during childhood through adolescence, particularly during growth spurts of girls. What this means is that scoliosis victims are those who are most susceptible to the asymmetry effects caused by elevated shoe heels.

Because scoliosis strikes during the growth years, the asymmetrical effects of shoe heels on the structure and function of the human body are magnified. The victims of idiopathic scoliosis are simply those with the most innate asymmetry.

But those effects continue to develop in intensity throughout life, even for the vast majority who avoid scoliosis in its more acute forms. As we will discuss later, the effects of shoe heels again become magnified later in life, and become especially obvious among the elderly.

Shakespeare's Most Famous Villain, King Richard III

We cannot leave this discussion about scoliosis without mentioning King Richard III, whose bones were found recently buried beneath an English parking lot. The bones of the hunchbacked evil king depicted in Shakespeare's play indicate definitively an advanced stage of scoliosis.

In his day, King Richard was renowned as an effective fighter as an armored knight, despite his obvious spinal deformity. Recent elaborate tests involving armor, swords, and horses used by a young English man having a very similar level of highly noticeable spinal scoliosis indicate conclusively that such capability was indeed possible despite the substantial deformity of scoliosis.[1] **SEE VIDEO 23.1**. Interestingly, the "modern" twin Richard III runs with a knock-kneed position more typical of females, who are much more prone to develop scoliosis than males.

A recent documentary episode of **Independent Lens** on PBS on the life of master magician James Randi shows clearly the slow progression of scoliosis over the course of an overtly normal full lifetime. It shows a naturally symmetrical physique in his childhood and early adult life, but markedly abnormal asymmetry typical of scoliosis, but only late in life.[2] **SEE VIDEO 23.2**.

This suggests the important possibility that the severely stooped over and asymmetrical postural deformity so often present late in life is an unnatural effect of shoe heels. It is therefore normal only for modern humans, whose ability to ambulate is slowing and painfully ended.

The same kind of scoliotic stooped over and asymmetrical postural deformity in the form of a rightward lean is also evidently the product of extreme physical exertion, as seen in **VIDEO 23.3**, which is a brief slow motion video clip of two runners in a 150 mile Greek ultramarathon.

Extreme physical exertion seems in effect to compress time to create the same postural effects of age, at least temporarily. This seems to be true even of extraordinarily elite athletes, like exhausted NBA MVP Stephen Curry, seen walking with a noticeable right lean in VIDEO 23.4. A similar video slow motion clip shows a similarly exhausted NBA MVP LeBron James, also walking with a noticeable right lean in VIDEO 23.5.

Interestingly, both athletes are showing a significant degree of bow-leggedness and varus knee thrust, and Curry shows some evidence of crossover, whereas LeBron does not, instead maintaining a very wide stance.

It is also interesting to note a similar asymmetrical posture in a middle-aged adult Walt Disney in

VIDEO 23.6. That shows that the effects of shoe heels do not distinguish between elite athletes and an artistic & commercial genius.

Research Note: Are Different Forms of Scoliosis Typical in Males As Versus Females?

FIGURE 23.3 shows a female in a single left leg stance while standing rather than running, but shows an "S" curve wherein only the thoracic spine curves to the left. That is in contrast to the more general "C" curve to the right of both the thoracic and lumbar spine, like the running male in FIGURE 17.2A.

This spinal curvature difference between the sexes suggests the possibility that it is due to the basic difference in pelvic rotation between the sexes, with male pelvises typically rotated backward in a more static position and females pelvises typically rotated forward in a more dynamically flexible position, as discussed previously in chapters 11-13.

The difference may account for the far greater incidence of scoliosis in females. With its obvious direct effect on the position of the shoulders, it may account also for the much different throwing style typical of females compared to males.

In any case much more empirical research needs to be done in this area to replace what can only be reasonable and interesting conjecture now with definite facts that lead to effective treatment and prevention as soon as possible in the future. Moreover, as we shall soon see, the position of the thoracic spine has a huge and critical effect on the neck and head above it.

Finally, previous FIGURES 17.2E&F show the neck of a male runner tilted to the right on both legs during midstance, which is the same position of the neck shown in FIGURE 23.1 above. This right tilt of the neck (and thus also the head) is highly significant, as we shall soon see in Chapter 25 and 26.

Twisted Spines and Back Pain

The widespread epidemic of back pain is the direct result of shoe heels, affecting nearly 30% of all U.S. adults each year. Sometimes unusually fit adults like Golden State Warriors Coach (and former professional basketball star long range jump shooter) Steve Kerr are incapacitated even years after back surgery.

24 THE CERVICAL SPINE IS BENT AND TWISTED BY HEELS

The word "whiplash" when applied to injuries is particularly useful here in beginning an analysis of the effects of elevated footwear heels on the cervical spine. That is because the rough analogy of the spinal column to a whip is an extremely apt one in evaluating the unnatural effect of shoe heels.

If the lumbar spine is the handle and the cervical spine is the end portion of the whip, then the aptness of the analogy is that the motion of the handle is potentially magnified greatly at the end of the whip.

That is precisely the point I want to make. The lumbar spine is the base of the entire spine and controls the rest of it.

And the lumbar spine is unnaturally misaligned due to elevated shoe heels. As a result, the thoracic spinal also becomes misaligned, as seen in the elderly and in scoliosis patients. Only lumbar spine problems result in more hospital visits than the cervical spine.

But actually the most significant misalignment problems occur in the cervical spine, as we shall see. Although the cervical spine moves in all three dimensions, the most obvious potential problem is in the sagittal plane, at the back of the neck.

As shown in FIGURE 20.8A, a lessor curve is more natural and stable, but as the curve increases as shown in FIGURE 20.8B, so does abnormal instability.

I have not found research findings on the posture of the cervical spine in primitive, barefoot populations. But based on what I have carefully observed in elite athletes I would say definitely that a relatively flat, non-curved cervical spine is more typical and therefore probably more optimal.

The Cervical Spine Is Excessively Curved Backwards, Deforming the Rear of the Vertebrae

If, however, you look at a spine typical of modern shoe-wearing populations, as shown in FIGURE 24.1, two cervical anomalies stand out. First, the curvature appears to be greatest in the cervical spine, compared to the lumbar and thoracic.

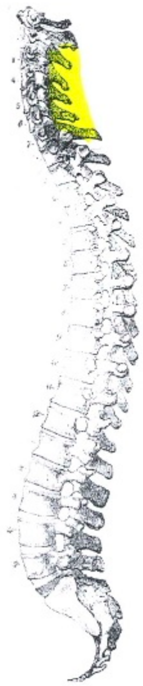


FIGURE 24.1

Second, the spinous processes of the cervical vertebrae are located at the back of the spine are highly irregular, if not malformed compared to the spinous processes of the lumbar and thoracic spines. The bones of the back of the neck simply and obviously look deformed.

I think both of these anomalies are structural deformities of the cervical spine caused by functional and structural misalignments below, in the lower spine, pelvis and legs. Those misalignments caused by shoe heels, as we have previously discussed.

The Larynx is Deformed, Affecting Speech, including Singing, and the Swallow Reflex

The most obvious probable outward effect in the excessively curved cervical spine is an excessively protruding Adam's Apple. That might seem trivial until you consider that it is the front of the larynx which supports the vocal cords. That suggests that if you can't sing well, it is because of a malformed larynx that can be attributed to an adverse effect of shoe heels.

If this seems improbable to you, check out star basketball player Bobby Hurley's throat as he experiences extreme crossover effect in his right leg, as seen in FIGURE 24.2. This also helps to explain why exercise-induced laryngeal obstruction is common in athletes. Similarly, in FIGURE 24.3 look at the throat of ***Species*** star Natasha Henstridge while running at full speed and observe the extraordinarily extreme strain of the throat muscles surrounding the larynx. See also VIDEO 24.1.

To take another example, a larynx problem that is perhaps of greater consequence in terms of life and death, especially to the elderly, is the swallow reflex. The anatomically complicated and delicate swallow reflex is likely to be adversely affected by the excessive cervical spine curvature that increases with age. When it doesn't work, the food you eat goes into your lungs instead of into your stomach.

Unnatural Structure & Function Increases Susceptibility to Whiplash and Other Accidental Injuries

To get back to the word that started this chapter, "whiplash" injuries usually describe violent accident injuries like car crashes in which the head is jerked backwards suddenly and with significant force.

The unnatural backwardly curved cervical spine is poorly positioned to resist such crash forces. Moreover, the anterior neck muscles are coincidently weakened abnormally.

Both abnormal factors further increase an unnatural tendency to accidental whiplash injury. It should be noted that this unnatural tendency to increase the severity of accidental injury is also generally true of all the adverse functional and structural effects of shoe heels already discussed in previous chapters.

The Risk of Stroke Increased By Cervical Spine Motion That Is Unnatural and Repetitive

The blood supply to the brain passes through a pair of vertebral arteries located inside the cervical spinal column and a pair of carotid arteries located in the front of the neck. The potential is great for any of these arteries, particularly those inside the cervical spine itself, to be increasingly pinched over time by the abnormal backward bending and twisting to the left of the cervical spine.

The routinely abnormal motion of the cervical spine has made it structurally far more delicate than is natural. As a result, accidental forces of a relatively minor magnitude are sufficient to cause temporary or permanent interruption of blood flow to the brain, causing transient ischemic attacks and strokes.

The result of a stroke is temporary and/or permanent damage within a hemisphere of the brain and loss of control and sensation of parts of the body of the opposite side.

Note: for more information on the anatomy of the cervical spine see this **YouTube** video: https://www.youtube.com/watch?v=RNUpMNd_u1U, which is titled "Cervical Spine Anatomy (eOrthopod)" by Randale Sechrest.

25 THE SKULL IS THE SKELETAL STRUCTURE MOST AFFECTED BY HEELS

By far, the most important and most adverse effect on the structure of the human body is that on the skull itself, which is balanced atop the atlas, the topmost bone of the cervical spine.

The skull is at the very end of the spinal whip. As a result, it moves the most, magnifying in all three dimensions the abnormal motions of the spine below it. See front view of a skull in FIGURE 25.1A.

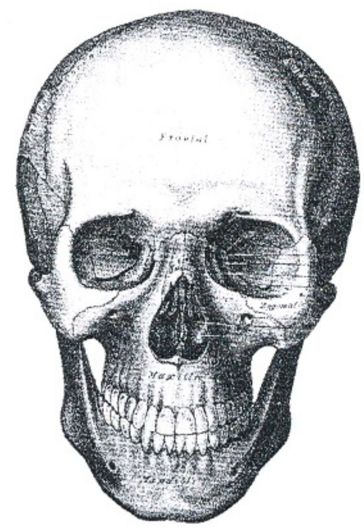


FIGURE 25.1A Skull

Unfortunately, the skull is located in effect at the business end of the spinal whip, where the whip is cracked. As noted above, the shoe-heel induced misalignments located below are greatly amplified at the topmost level of the skull.

The irony is also amplified. As we shall see, the largest number of adverse effects of elevated shoe heels are actually on the part of the human body that is farthest away from the feet.

To begin, as you recall, previous FIGURES 17.2E&F show the neck of a male runner tilted to the right on both legs during midstance, which is the same position of the scoliotic neck shown in FIGURE 23.1 above. This right tilt of the neck (and thus also the head) is highly significant, as we shall begin to see now.

Abnormal Skull Motion Occurs During Running, and Repeats With Every Stride

The extent of the abnormal motions that can occur when running are illustrated in FIGURE 25.1B, which shows a skull being torqued in all three dimensions. If these motions seem impossibly exaggerated, think again. See the muscles supporting the skull in FIGURE 25.1C.

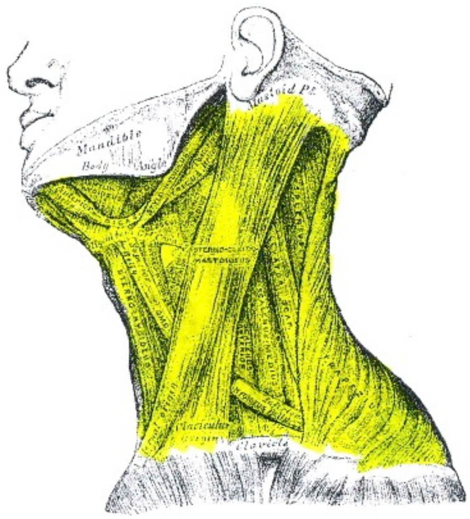


FIGURE 25.1C Neck Muscles

Famous photos of Roger Bannister and Jim Ryun setting world records in the mile both indicate abnormal head motion that is similarly exaggerated, as seen in FIGURES 25.2 and 25.3. While these head motions may seem extreme but also very occasional, I believe they are just strikingly exaggerated examples of highly common abnormal motion of a reduced but still significant and highly routine nature.

Lateral views of Ryun earlier in a race seem to show similarly significant asymmetrical head support between his right and left side support legs, but more subdued and more routine with every step, as shown in FIGURE 25.4. This is particularly noteworthy in the context of Ryun's specific health issues located within his head, which was impaired vision requiring correction with glasses and a hearing disability.

Other Examples of Head and Neck Asymmetrical Motion During Running

Usain Bolt's head tilts significantly more to the left than the right when running, as seen in and VIDEO 25.1. All three female runners in VIDEO 25.2 exhibit asymmetrical head positions while racing, particularly Thomas, third in the line. The motion of seemingly ageless middle distance star Bernard Legat's head is the most unusual, with an obvious hitch in his neck that unnaturally torques his head, as seen in VIDEO 25.3.

The typical leftward tilt of the Bolt's head when running shown above in FIGURE 25.5A alters the permanent structure of the cervical vertebrae of the neck over time, causing them to bow out in compensation to the asymmetrical position and load. As seen in FIGURE 25.5B, this asymmetrical position of the cervical vertebrae bowing out to the right to compensate for leftward tilt thus becomes quite evident even at rest in a stationary position.

Modern Skull Asymmetry Is the Same as the Pelvic and Spine Asymmetry Indicated by Running

As you recall from FIGURE 17.2A, under the high left support leg, the pelvis is tilted down and rotated forward on the right side. Forced by this abnormal position of the pelvis directly supporting it, the thoracic and cervical spines are bent to the right and rotated forward on the right side, like the exaggerated scoliotic position of FIGURE 23.1.

The modern human skull shows the same forward right side asymmetry, so that the shape of the skull is torqued clockwise, as viewed from above. The result is a forward protrusion of the right frontal bone of the skull and a backward protrusion of the left occipital bone.

Abnormal Skull Motion Causes Virtually All of the Common Ailments of the Human Head

Ryan's known ailments lead directly to a very logical and important general conclusion. Namely, that the large number of human deficits located on or in the human skull are due to asymmetrical motion created by the obvious routine abnormal motion of the skull in multiple dimensions. In turn that abnormal skull motion is caused by elevated shoe heels disrupting the natural structure and stable function of the human body below the skull.

For example, a partial list of all too common medical deficits located in the head includes, besides any vision or hearing deficits, including eustachion tube and other infections, asymmetrical nasal passages like deviated septum and other sinus problems including headaches, snoring, facial asymmetry (See VIDEO 25.4), dental problems including jaw bite position problems (like over-bites, under-bites, and cross-bites), as well as teeth asymmetries like crooked, crowded, gapped, or impacted teeth (See typical example in FIGURE 25.6). Even innocuous differences like fuller hair growth on one side of the head compared to the other.

The list goes on, but the short answer is everything in the head that is structurally or functionally asymmetrical is likely due to the human head being tossed around unnaturally at the end of an abnormally formed and supported spinal whip. Being bent backwards and bent sideways and twisted unnaturally, all together these abnormal positions expose the structures within the skull to abnormal, highly repetitive forces of the maximal amplitude normally experienced by the body, all due to elevated shoe heels.

Vision Illustrates the Structural and Functional Problems Within the Abnormally Supported Skull

Just consider vision as a fairly simple example. The most common modern problem is near-sightedness (myopia), which results from an abnormal elongation of the eye.

If the skull is typically bent backwards as noted by the excessive curve of the cervical spine, then the new, more downwardly directed force of gravity is going to increase pressure on the back of the eye. That gradually tends to lengthen it over time (and continues over time), moving the retina at the back of the eye backwards and increasingly out of focus.

If the skull is bent sideways too, then that creates asymmetry between the right and left eyes. Add in twisting motion as well, so the abnormal skull motion is in all three dimensions. The result is asymmetry within either or both eyes (astigmatism), and well as different levels of myopia in each eye. Note the complex and delicate structural arrangement of the muscles controlling the eye, as shown in FIGURE 25.7.

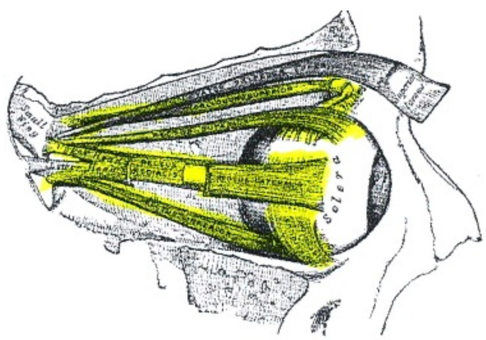


FIGURE 25.7 Eye Muscles

Similar mechanisms are at play for the all the other deficits inside and outside the skull that were listed above. Of course, as usual, there are no known direct causes for any of these listed head-centric problems. By default, the accepted current wisdom is that they all just happen; for example, poor eyesight probably caused by eyestrain from too much reading.

The Nearly Full Size of the Five Year Old's Brain Exaggerates the Instability Problem of the Skull

The weight that must be carried within the skull of a five year old human child is proportionately much greater than a fully grown human like Jim Ryun in the figure shown above. That is because the five-year old child's brain is nearly adult size, even though the child is much smaller.

On a relative basis, this means the child's neck muscles are overloaded compared to an adults, making it relatively much more difficult for the child to stabilize successfully the abnormal motion of his or her skull caused by elevated shoe heels. That would unfortunately increase the likelihood of all the skull-located physical problems discussed above, tending to make them all worse.

Note: for more information on the anatomy of the skull see this **YouTube** video: https://www.youtube.com/watch?v=Nc5IRj3OJhE, which is titled "skull bones" from cattosa3.

26 HUMAN BRAIN STRUCTURE IS CHANGED BY SHOE HEELS

It follows directly from the last chapter on the skull that the brain, by far the largest organ within the skull, would be unnaturally altered by the abnormal motion of the skull. And just like all of the other structures within the skull, the unnatural alterations are caused ultimately by elevated shoe heels,.

If this sounds incredible to you, as it did to me initially, it is reasonable to be skeptical. After all, it does seem far-fetched to think that such an extremely innocuous feature, the very ordinary heels of lowly shoe soles, could change the highly sophisticated structure and enormously complex function of the human brain.

Especially hard to believe since they are separated, as they are, by the entire human body. Still, the logic and evidence from all the preceding chapters inexorably points directly to that otherwise highly unlikely conclusion.

The Structural Change Between the Brain's Right and Left Hemispheres

Most of the human brain, making up the portion that is more recently and most highly evolved, is divided into right and left hemispheres. And as you would expect from the preceding chapters, the two hemispheres are unquestionably asymmetrical, as shown in FIGURE 26.1.

The same hemispherical asymmetry is seen in FIGURE 26.2, which is a bottom view figure showing the arteries at the base of the brain from the classic original 1858 edition of *Gray's Anatomy*.

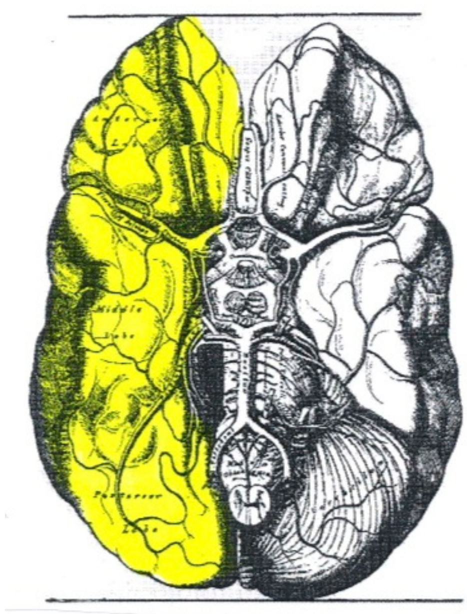


FIGURE 26.2 Right Brain Hemisphere Shifted Forward, Left Hemisphere Backward

Ironically, the horizontal lower surface view of the brain illustrated in FIGURE 26.1 shows the obviously twisted structural effects of the same kind of abnormal rotary or swiveling motion we first saw in the tibial plateau of the modern knee, as compared to the "primitive" knee, as seen in FIGURE 3.4. This twisted position is known as brain torque.

Unfortunately, I found no studies showing a comparable brain from a barefoot, primitive population. But if we did, it is logical to expect the "primitive" brain to be more structurally symmetrical, like the knee joint of the same population.

In addition to the twisted asymmetry between hemispheres, the unnatural modern brain has larger cells with longer range connectivity in the left hemisphere compared to those in the right hemisphere.

Only Some Human Brain Torque Is Innate Due to Innate Right-Handedness, Most Is Not

About two-thirds of human fetuses have a leftward bias, a form of brain torque wherein the left hemisphere protrudes rearwards and the right hemisphere forwards. This suggests that human brain torque has an innate, genetic component. It therefore has been theorized that about 2/3 of the brain asymmetry is inborn due to right-handedness and language (both controlled in the left hemisphere) and the rest cultural.

That may not be correct. As you may recall from chapter 17, the abnormal modern pelvis is right shifted in most cases, so the modern human fetus typically develops within a modern womb that is also right shifted. That potentially causes the right side of the modern fetus to mirror throughout its development in the womb the greater mobility and use of the modern mother's right side.

In summary, I think the existing scientific evidence suggests some degree of human brain torque is naturally due to innate right-handedness, but more may be caused abnormally by elevated shoe heels. I believe that shoe heels may significantly increase or exaggerate a more moderate level of innate asymmetry. More recent genetic studies mentioned below also support the conclusion that in general the human brain torque is not innate.

It should be noted that animal studies indicate that primates do also have some brain hemispherical asymmetry like that of humans, but less so, due presumably at least in part to their smaller brains with less hemispherical development and to quadrupedal locomotion[1].

Like the Skull, Modern Human Brain Asymmetry Follows the Pelvic and Spine Asymmetry Indicated by Running

The modern brain asymmetry parallels exactly the asymmetry of the modern skull noted in the previous chapter. Again, as you recall from FIGURE 17.2A, under the high left support leg, the pelvis is tilted down and rotated forward on the right side. Forced by this abnormal position of the pelvis directly supporting it, the spine is bent to the right and rotated forward on the right side.

The modern human brain shows the same forward right side asymmetry. As seen in FIGURE 26.1, the right hemisphere of the brain is rotated forward, just like the pelvis, and the left hemisphere is rotated backwards, also just like the pelvis. Technically, this is called Yakovlenian torque.

Moreover, the hemispheres are clearly rotated into what would be each other's natural, symmetrically parallel locations. The forward section of the right hemisphere is shifted past the edge of the forward left hemisphere. And the posterior left hemisphere is clearly shifted all the way into the posterior right hemisphere's natural position, again as seen in FIGURE 26.1.

General Conclusion: Genes Cause Some Brain Asymmetry But Shoe Heels May Account for Most

The fetus studies on brain asymmetry noted above seem to be contradicted by more recent genetic studies. That the observable brain asymmetry is not innate is indicated by two gene expression studies, which did not find hemispherical asymmetry on the population level[2]. If not nature, then nurture, which preceding and following evidence strongly points to the possibility of a shoe heel effect.

The most likely scenario is that in most cases innate right-handedness causes a minor or base level of brain asymmetry. The majority of brain asymmetry may be caused by elevated shoe heels, the effect of which could greatly exaggerate the existing right-handed predisposition to asymmetry.

Male Human Brains Are More Asymmetrical Than Female Brains

As noted previously in Chapters 12 and 13, human males tend to be bow-legged and females tend to be knock-kneed. The female tendency is a two-stage accommodation for higher heels, first bowing out like males and second collapsing into a knock-kneed position more typical of women.   Because the second stage compensates at least in part for the first stage, the resulting shoe heel accommodation can be less overall body asymmetry, depending on the amount of inward collapse.

That overall female accommodation is specifically reflected in the female brain, which generally tends to be more naturally symmetrical than the male brain, with better and presumably more intact connections, and therefore better communication between the left and right hemispheres.

The Known Functional Differences Between the Right and Left Hemispheres of the Modern Brain

Although most brain functions are performed together by both hemispheres, split brain research in the past few decades has revealed that language and mathematical skills are primarily located in the left hemisphere of the modern human brain. The left hemisphere seems to provide sequential analysis of component parts. Generally, the left is specialized for language and logic, as well as internal thought.

In contrast, the right hemisphere is viewed as holistic and parallel in processing. It is better at spatial representations and global processing. Generally, the right is specialized for creativity and intuition, as well as vision and attention.

The rough analogy this research calls to my mind is that the left hemisphere is more like a general purpose processor of a computer and the right hemisphere is more like the specialized graphics co-processor(s).

To carry on with this computer hardware analogy, the general purpose processor of the left hemisphere is also the master or central controller of the computer brain. A leading neuroscience researcher of split brains, Michael Gazzaniga, has named this left hemisphere controller the “interpreter”.

To complete this general picture of the brain, the left brain hemisphere directly controls the (usually dominant) right side of the human body. About 92-93 percent of the modern population is dominant right-handed, and usually right dominant leg also.

What does the Unnatural Brain Twisting Do to the Function of Right and Left Brain Hemispheres?

I could find nothing in the research on the right/left structure or function of the brains of primitive barefoot populations, so there is no way to directly compare them with modern brains to examine the differences.

However, it is possible to logically describe the probable impact of the asymmetric changes present in the hemispheres of the modern brain.

For example, with the left leg load-bearing and pelvis tilted down to the right, as seen in FIGURES 22.1 and 17.2A (left side), the position of the head is going to be twisted to the left and tilted downward to the right like rightward tilt of the thoracic spine. The head would return to normal natural position under the right support leg with level pelvis.

The repetitive pressure that results in the twisted hemispheres would also put the force of gravity on the forward portion of the right hemisphere, in the area of the prefrontal cortex, increasing pressure there. This is because the right side of the head would be lower than the left side. This is like the most typical position of the head in scoliosis, as shown previously in Figure 23.1.

Growth of the Lateral Prefrontal Cortex is Retarded in the Right Hemisphere and Enhanced in the Left Hemisphere

Such abnormally higher peak pressure would tend to retard physically the natural brain development in the lateral prefrontal cortex of the right hemisphere. In contrast, on the left side, the peak pressure would be abnormally reduced, tending to enhance natural brain development in the lateral prefrontal cortex of the left hemisphere.

The larger cell size and greater long-range connectivity of the left hemisphere already noted supports this conclusion. With such enhanced relative development in the left hemisphere, it might play a significantly more dominant role in the abnormal modern brain compared to the natural primitive brain.

This change is potentially extremely consequential, since the affected lateral prefrontal cortex of the human brain is already well known to be its most highly developed portion, wherein the most advanced level of thinking occurs.

The language and mathematical skills primarily located in the left hemisphere would likely be enhanced, albeit abnormally. And at the expense of reduced skills in the right hemisphere. In other words, the abnormal modern brain may well have become more dominantly linear or sequential and analytical than the natural primitive brain.

The Backward Tilted Cervical Spine Weakens the Neck, But Enhances Development of the Prefrontal Cortex

In addition, the excessive cervical spine curvature typical of the modern spine tends to tilt the skull and head backwards abnormally, also as noted before. This weakens the neck and encourages whiplash injuries, making the head and brain much more delicate.

Tilting the head backwards abnormally not only inherently increases the force of gravity pressure on the posterior portion of the brain. It also decreases it in the front portion, in the area of the prefrontal cortex.

The result would be enhanced development of the critically important upper or dorsal prefrontal cortex of both hemispheres and its capacity for the most advance level of reasoning.

The Opposite Effect: Tilting the Head Far Forward In the Elderly May Be a Cause of Dementia

The extremely abnormal curvature of the thoracic spine late in life, the classic dowager's hump, causes the head to tilt forward, eventually progressing to a standing and walking posture wherein the face is pointed straight down, abnormally facing directly at the ground instead of naturally straight ahead. As noted previously in chapter 22, the abnormally extreme curvature of the thoracic spine is caused by elevated shoe heels.

This unnatural position puts substantial abnormal pressure on frontal cortex of the brain, the site of the working or short-term memory. Impairment of short-term memory is of course a classic sign of dementia.

Shoe Heel-Induced Disruption of Normal Cerebral Dominance Is a Cause of Mental Illness

Besides potentially causing dementia, the effect of elevated shoe heel on brain asymmetry may also be logically related to lack of cerebral dominance between the two hemispheres. Studies indicate that such lack of normal dominance is related to stuttering, deficits in academic skills, schizophrenia and mental health difficulties generally.

It is also logical to assume that the effect of shoe heels to disrupt normal brain symmetry has potentially a profound effect on emotion-related forms of mental illness, particularly on disrupting the normal balance of emotions, such as in manic depressive disorders or depression generally.

Putting it in the simplest terms, since the left hemisphere is considered the general focus of positive emotions and the right hemisphere is considered the focus of negative emotions, then preserving the natural balance between the two hemispheres would seem to be critical to maintaining normal mental health. Shoe heel-caused disruption of natural hemispheric symmetry obviously would tend inherently to disturb that normal emotional balance.

The Overall Effect of Abnormal Development on the Unnatural Modern Human Brain

So the net abnormal motion of the head induced by shoe heels is for the head to be tilted backward and twisted to the left while the cervical spine is bent to the right, as shown in Figure 23.1 (albeit in the highly exaggerated form of scoliosis shown in that figure). The net effect of that abnormal motion on the unnatural modern brain is therefore to abnormally enhance the development of the dorsal lateral prefrontal cortex in the left hemisphere, as shown in **VIDEO 26.1**.

The dorsal prefrontal cortex enhancement has occurred in the right hemisphere because of the backward tilting of the skull, but much less due to effect of abnormal twisting to the left and the rightward tilt of the cervical spine.

The dorsolateral prefrontal cortex of the left hemisphere therefore becomes even more dominant as the single, all-powerful CEO of the brain. A CEO with enhanced language and mathematical capability (think high SAT scores) at the highest level of human reasoning, including the unique human capacity to model and plan the future.

Dual Processor Animal Brains Compared to Left Hemisphere Uniprocessor of Modern Human Brains

To revisit the computer analogy, the abnormal modern human brain may be more like a uniprocessor supercomputer located in the left hemisphere. And less like the better-connected dual processor parallel computer (inherently with better robustness and redundancy) it has been throughout its earliest evolution up until the new modern, unnatural version.

Throughout the evolutionary development of vertebrates, including fish, amphibians, reptiles, birds and mammals, the dual hemisphere brain seems to have been optimized predominantly on the central binary problem of animal survival, which is identifying friend or foe.

The left hemisphere is specialized to control routine feeding behavior involving friends and communication. Unsocial and anti-social tendencies are located more in the left.

The right hemisphere controls the visuospatial relationships involved in fight or flight behavior relative to predators or foes and involving intense emotions. Pro-social tendencies including social intelligence and self-control are located more in the right, which also processes threats and mediates fear. This suggests strongly that foes and social interaction are closely interrelated, which means clearly that the threats from animal predator foes evolved in humans, perhaps very quickly, into even greater threats and competition from other humans or groups of humans.

So, summing up, essentially the left hemisphere deals more with friends and the right deals more with foes.

In addition, as previously noted, brain scans indicate that the left hemisphere is associated with positive emotions like joy and happiness, while the right hemisphere with negative emotions like sadness and depression.

In the abnormal asymmetric modern human brain, the friend-oriented positive left hemisphere is enhanced. That provides better communication and advanced cooperation skills that may better support complex, trust-based modern societies.

The foe-oriented negative right hemisphere is degraded in the unnatural modern human brain. This would be helpful in keeping the peace in cooperative societies. Studies indicate that the more violent or warlike a primitive society is, the more left-handers it has, and the dominant left hand is controlled by the foe-oriented negative right hemisphere.

The natural binary brain is better at multitasking and has the additional benefit of increased backup durability in the form of redundancy. The totally ad hoc development and happenstance design of the abnormal modern brain seems to enhance the highest levels of human mental processing. But at the cost of much greater fragility and loss of redundancy.

Author's Note: The preceding analysis in this section is based on studies that appear at times to be possibly overly subjective and at times contradictory. Bear in mind also that most brain functions are performed using both hemispheres, so the primary role of either hemisphere in any given function is a question of degree, not absolute. I will discuss this point in a little more detail at the end of this chapter.

Physical Activity (With Shoe Heels) Increases Brain Hemispheric Asymmetry, Improving Cognitive Function

Recent neuroscience studies indicate that higher level brain function is asymmetrically located in the prefrontal cortex of the left or right hemisphere of younger people, particularly the left dorsolateral prefrontal cortex. In contrast, both hemispheres typically are involved in people over 40, who also tend to have much less physical activity, especially in the form of running. This could be interpreted to mean the activity of the brain is reverting to a more natural, symmetrical state with age. Most neuroscientists refer to this reorganized state as a weakening of brain function.

In a new 2016 study[3] of elderly men by Hideaki Soya, those who were more aerobically fit typically used just the dorsolateral prefrontal cortex of their left brain hemisphere for higher level tasks. Less aerobically fit elderly men used both hemispheres for the same high level tasks. Again, this strongly suggests the physical activity with ubiquitous elevated shoe heels causes brain hemispheric asymmetry and that brain asymmetry apparently is functionally beneficial.

No Such Modern Brain Change Could Be More Odd or More Ironic

Irony has been substantial many times in earlier chapters of this book, but there can be no greater irony than this: elevated shoe heels have clearly had a catastrophically bad effect on the structure and function of every part of the human body - except the brain, the highest functions of which shoe heels may have been accidently enhanced! And all of this has happened strictly by chance, not design.

It cannot get odder than that. In short, a possibly better brain that is barely balanced on a broken body, an abnormal modern body that is far less robust or healthy than a natural primitive body (ignoring, of course, the enormous beneficial effects of modern Western life with extensive access to modern medical care, nutrition, shelter, education, etc).

A Challenge to the Contradictory Outcome of Possibly Better Brain But Broken Body

There is another odd fact to fit into this overall picture, specifically relating to the brain. Researchers have reported that the human brain has shrunk by about 10 percent over the last 5,000 years.

This fits in with a narrative of mankind's transition from hunter-gatherers to farmers based on the theory that farming is a much less cognitively difficult task that allowed the human brain to atrophy measurably.

That narrative piggy-backs on the analogy of the transition of the wolf into the dog, wherein the wolf apparently has been measured to have a slightly larger brain, presumably because hunting in packs is more cognitively challenging than wagging your tail to get a friendly and reliable handout from your human owner.

Actually, the latest research indicates that dogs, among all animals, including even our closest relatives the chimpanzees (with much more highly evolved brains relative to dogs) are supremely adapted to interact effectively with humans. So even the basis for the analogy is questionable. Nor is it unquestionable that farming is less challenging than huntergathering.

Nor is it likely that we have any very reliable information on human brain size 5,000 years ago, only on skull size, which is not at all the same thing. And any minor skull size reduction may be more directly related to the related reduction in jaw and teeth size that occurred in that time frame, although even there the change may be more directly related to the increased use of fire for cooking. Indeed, the entire human body evolved to be less physically robust during this time period.

At any rate, I believe it is also at least possible that a 10 percent shrinkage of the human brain, if it did in fact happen, may have occurred mostly much more recently, like within the last 500 years or so. And, that whatever shrinkage occurred may have been primarily due to being exposed to highly unnatural extremes of motion due to its position at the working end of an abnormal spinal whip caused by elevated shoe heels, as discussed in the previous chapter and this one.

What Functions of the Abnormal Modern Human Brain Have Been Degraded By the Change?

If the abnormal modern human brain has been enhanced, it is reasonable to assume that that positive change may have come at the cost of something else. While there is no direct, structural evidence in the modern brain that I know of, there may be an important but unmeasurable functional difference.

We know, for example, that in ancient Greek culture, Homer's extremely long poems, the Illiad and the Odyssey, were passed down for generations in an oral tradition that relied strictly on the innate memory capacity of the human brain.

Such difficult feats of memory are not common today in the modern Western world. That extraordinary memory capacity might still be perfectly intact, but is simply unused. In the modern world, it has been effectively replaced by the vastly expanded external memory provided, first, by the printing press, and second, now by computers connected to the Internet.

Alternatively, the potential memory capability is present in the modern brain, but it may not develop like the ancient brain due to lack of use. Or, it could be a structural trade-off that involves degrading part of the human brain that necessarily developed as part of the asymmetrical brain enhancement caused by shoe heels.

Can Shoe Heels Directly Cause Brain Injury such as Dementia and Other Psychological Disorders?

We will approach answering this question by digressing purposefully to an analysis of brain concussions and helmet design. The analysis is based on an excellent TED Talk titled *Why Helmets don't prevent concussions – and what might* by David Camarillo, Ph.D. of Stanford University was made April 24, 2016 (at www.ted.com).

Dr. Camarillo points out that helmets are designed to prevent skull fractures, which are caused by direct blows to the head, and current bike and football helmet designs provide pretty good protection. But only against skull fractures.

Brain concussions are quite different. They are caused by indirect or tangential blows to the head that producte violent sideways head motion, a kind of side-to-side whiplash motion.

More significantly, in marked contrast to the very hard skull, the brain is among the softest tissues of the human body, with a consistency much like jello. So protecting it requires an entirely different approach.

In addition, Dr. Camarillo provides good evidence that the conventional understanding of concussion is fundamentally wrong. The problem is not that the outer portions of the brain are damaged by being smashed against the sides of the skill. Rather, it is that the jello-like brain tissue in a critical central portion (shown in red) is being stretched by up to 50% of its normal volume. See FIGURE 26.3. See also **VIDEO 26.2**

It turns out the location of that maximally stretched portion is particularly unfortunate, because it is the precise location of the principal network connection between the right and left hemispheres of the brain (again, at the center shown in red). See FIGURE 26.4.

The physical brain structure located there is the corpus callosum, as shown in the normal brain in FIGURE 26.5. In an abnormal brain subject to repeated concussions, like that of a retired former NFL football player who suffered from chronic traumatic encephalopathy (CTE) shown in FIGURE 26.6, the corpus callosum is severely deteriorated. See also **VIDEO 26.3**.

Repeated Asymmetrical Sideways Head Motion Causes Repetitive Stress Injuries to the Human Brain

It seems logical to conclude that if extreme forces cause excessively violent sideways motion leading to acute injury like concussions and CTE, then highly repetitive abnormal sideways motion like that caused by shoe heels in running (see again VIDEOS 25.1-3) is like to cause repetitive stress injuries to the brain over time. That would be particularly true over a lifetime, the unnatural effects being cumulative.

Moreover, the unnatural effects would be focused on the critically important corpus callosum, which is the principal physical connection between the left and right hemispheres. The shoe heel-induced brain torque discussed earlier (see again FIGURES 26.1-2) would inherently cause the tissue of the corpus callosum between the shifting hemispheres to stretch unnaturally.

There appears to be literally a direct connection here, since the greater the hemispheric asymmetry in males (who tend to have more such asymmetry), the smaller the size of the corpus callosum connecting those hemispheres, and the greater the decrease in inter-hemispheric connectivity.

So it seems reasonable to conclude that there is a strong possibility that the same injury mechanism that is apparent in concussion on an acute basis also adversely affects the brain on a chronic basis due to repetitive stress. This line of thinking suggests the obvious possibility that dementia may generally be a repetitive stress injury to brain tissue caused by shoe heel-induced body and brain asymmetry due to unnatural torques. Even the plaque in the brain tissue of Alzheimer's patients may be due to the unnatural stretching from shoe heel-induced asymmetry.

Previous studies have shown that mechanical forces create unnatural tensile strain that disrupts the ability of cells to develop and continue functioning normally. That disruption has been implicated in causing diseases like osteoporosis, deafness, atherosclerosis, cancer, osteoarthritis, muscular dystrophies, and developmental disorders.[4]

In the brain, with its jello-like consistency the disruption effect is potentially worse than in other parts of the body. The roughly 85 billion neurons in the brain are structurally supported by glial cells and the neurons are connected to other neurons by about 100 trillion branches that terminate in about 100 trillion synapses.

To get some idea of the significant stress made by running on the jello-like structure of the human brain, look at the effect of the running motion on facial muscles, which are firmer than the tissue of the brain. See **VIDEO 26.4**.

The vulnerability of this crucial but relatively fragile structure seems obvious, particularly at the synapse connections. Unnatural cellular stretching is likely to degrade and distort the essential neural connections upon which the functioning of the brain depends.

Helmets Designed to Prevent Concussions as well as Fractures

I don't know what helmet design Dr. Camarillo is cooking up at his Stanford lab, but I developed a concussion prevention helmet about a decade ago that grew out of a shoe sole design based on the barefoot. I had come to the conclusion that the basic approach to conventional shoe sole cushioning design was wrong, because it mostly ignored torsional or tangential forces, which I believed were the main source of widespread running injuries.

So I developed a shoe sole design that incorporated internal slits or sipes (roughly, treads) to create more natural flexibility like the internal structure of the barefoot sole, and to better accommodate torsion and tangential forces. The general concept is sort of like a flexible phone-book with many pages as versus an entirely rigid block of wood. These internal slits or sipes are in contrast to the external slits or sipes used in Nike Free athletic shoes and the many commercial copies thereof.

I thought the internal sipe approach was potentially quite effective and also generally enough to apply to many field besides footwear, so I applied it to helmets and a large variety of other things, include electronic implants, clothes, and wire, among many others. See FIGURE 26.7 for my patented helmet designs.

US008732868B2

(12) **United States Patent**
Ellis

(10) **Patent No.: US 8,732,868 B2**
(45) **Date of Patent: *May 27, 2014**

(54) **HELMET AND/OR A HELMET LINER WITH AT LEAST ONE INTERNAL FLEXIBILITY SIPE WITH AN ATTACHMENT TO CONTROL AND ABSORB THE IMPACT OF TORSIONAL OR SHEAR FORCES**

(71) Applicant: **Frampton E. Ellis**, Jasper, FL (US)

(72) Inventor: **Frampton E. Ellis**, Jasper, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/765,413**

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(65) **Prior Publication Data**

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Related U.S. Application Data

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(Continued)

(51) **Int. Cl.**
A42B 3/00 (2006.01)
A42B 3/10 (2006.01)

(52) **U.S. Cl.**
USPC **2/411**; 2/414

(58) **Field of Classification Search**
USPC .... 2/410–414, 6.8, 415, 425, 16, 20, 21, 2/24, 68, 267, DIG. 3
See application file for complete search history.

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(57) **ABSTRACT**

A helmet and/or helmet liner having one or more internal flexibility sipes for controlling and absorbing the impact of torsional or shear forces, including, for example, at least a first bladder, chamber, or compartment having an inner surface; a second bladder, chamber, or compartment having at least one cavity or void that at least partially encloses at least one gas, and an outer surface located in the first bladder, chamber, or compartment, as viewed in a cross-section, and at least one internal sipe, which is defined by a portion of the inner surface of the first bladder, chamber, or compartment and a portion of the outer surface of the second bladder, chamber, or compartment. The surface portions defining the internal sipe oppose each other and are configured to be movable relative to each other in a sliding motion and have at least one centrally located attachment between the surface portions.

51 Claims, 69 Drawing Sheets

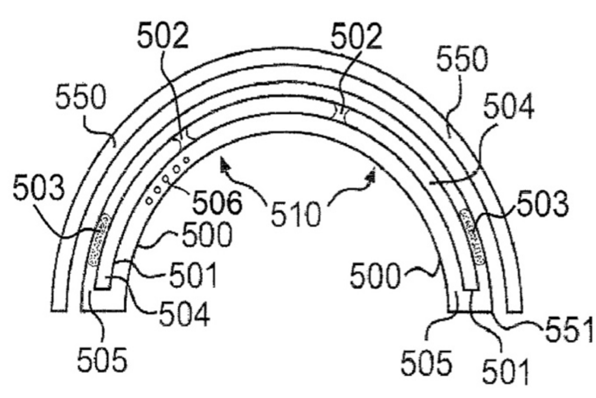

Fig. 26.7 US Patent 8,732,868-p01

General Disclaimer About My Comments on Brain Research

Brain research focuses on the most complicated structure in the universe, the brain, which has over 85 billion neurons and 100 trillion connections between them. Relative to most other fields of science, it is a comparatively young and rapidly evolving science with major developments in technology opening entirely new windows into the many mysteries still existing about how the brain operates.

Much of what is communicated to the public in recent decades in a number of popular books on topics like the left and right brain is considered by experts to be incorrect and/or vastly oversimplified. For example, it has been widely popularized that creativity resides in the right hemisphere, whereas actual research shows that creativity is a product of the whole brain.

The research is also being conducted with an overwhelmingly vast multitude of active researchers. The result is that there is a massive amount of uncoordinated and sometimes contradictory research that is difficult even for experts to assimilate sufficiently to create coherent pictures of the human mind and its most basic functioning. With those difficulties in mind, when in doubt, I have used as my go-to summary text what can probably be considered the Bible of the field, **Cognitive Neuroscience**, by Michael Gazzaniga, Richard Ivry, and George Mangun (2014).

In addition, I freely admit that neuroscience is an area in which I have no particular expertise other than what I have attempted to acquire fairly recently. So I would humbly characterize the preceding information presented on the brain to be well founded based on the information available to me in a relatively extensive search. However, it is inherently more tentative than the other research presented earlier in this book, at least partly due to the necessarily immature state of the brain science. That science is rapidly evolving in a massively uncoordinated way, including with at least one very recent titanic $1 billion fiasco in brain research, as summarized in a **Scientific American** article by Stefan Theil titled, "*Trouble in Mind*"[5].

27 THE RENAISSANCE, THE REFORMATION, THE RISE OF MODERN SCIENCE & TECHNOLOGY, AND ELEVATED SHOE HEELS

If the abnormal modern brain is really better, are there any real world effects that positively demonstrate that improvement? It is not clear how that question might answered in any acceptably definitive way at the present time. Too much new research needs to be done.

But there is an intriguing correlation that can be considered now that suggests the possibility of knowing what a "better modern brain" might mean in terms of real world effects. The Renaissance (14th to 16th Centuries), the Reformation (16th Century), and the introduction of various forms of footwear with elevated heels to Western Europe from the Orient and the Near East[1] - all three happened around the same time.

A number of higher heeled footwear, mainly varieties of platform shoes, began appearing near the start of the 14th Century in Venice, the center of East – West trade. Heeled shoes more similar to modern types appeared in Western Europe from Persian horseman in the late 16th and early 17th Century. Unfortunately, the available information, particularly on extent of usage (especially among higher versus lower classes in society), is extraordinarily limited.

By the late 17th Century, the men of the upper class had widely adopted relatively high heeled shoes, typified in a famous portrait of King Louis XIV of France with relatively high red heels. After the French Revolution at the end of the 18th Century, higher heeled footwear became less popular with men, but more widely adopted then by women.

Actual Historical Use of Elevated Shoe Heels and By Whom is Unclear

Unfortunately, it is essentially impossible from the very sketchy historical record to say exactly what footwear exactly was being worn by whom and when, either generally for classes or for individuals, and for what periods during lifetimes. And doubly impossible to correlate that information with specific important milestones of the Renaissance and Reformation.

For example, the invention of the printing press by Johann Gutenberg in 1455 almost certainly had the greatest single effect of anything on both the Renaissance and Reformation. Whether Johann was wearing footwear with elevated heels prior to and during the time he invented the printing press is unknown. So it is impossible to say whether the transformative printing press was the product of a modern, shoe heel-altered brain or not.

Similarly, Isaac Newton (1642-1727), probably the greatest scientist of the era, is shown in one example wearing elevated heel footwear, but in an 1874 print, so the shoe heels shown there could well be an anachronism. So again, no reliable information.

At this stage, and maybe forever, it is unknowable in any direct way whether elevated heel footwear played a causative role in the creation of modern science and technology, or merely happened coincidently at about the same time.

Still, it is undeniably intriguing that the otherwise completely adverse effects of footwear may have had a leading role, or even the leading role, in creating the modern world.

And, if so, it is obvious that modern science and technology have brought vast general improvements in health care and in standard of living in the modern world. As one unequivocal measure, life expectancy of the general population has increased dramatically compared to five centuries ago.

On that basis, the role played by elevated shoe heels may have been a huge net benefit to human health, despite all of their direct adverse effects discussed in detail in preceding chapters 1-25. And the huge net benefit has provided excellent if not heretofore perfect cover to hide the adverse effects.

Footwear Design and Use in Ancient and Medieval History Even Sketchier But Probably Not Significant

The survivability of footwear over time, especially many centuries, is not good. So even the post-Medieval history of footwear summarized above and based on the research of probably the leading authority on footwear history is inherently sketchy at best, based on relatively very few samples and sources.

Farther back in time, there is even less definite information on footwear design and use. Nevertheless, it is alleged by some sources that high heel use in some forms goes back farther in history. It has been claimed, for example, that some Medieval European wooden-soled patten shoes were ancestors to high heels.

Also alleged is that other forms of high heels appeared in 3500 BC on ancient Egyptian murals being worn by Egyptian men and women of nobility to stand out from the lower classes, especially in ceremonies. In addition, high heels apparently were used by butchers to elevate their feet above the bloody debris of animal carcasses.

Furthermore, in ancient Greece and Rome, platform sandals called buskins were worn, especially by actors to differentiate between classes and characters. In Rome, high heels were used by prostitutes to formally identify themselves as member of the legal sex trade.

To summarize as best we can, apparently there was very limited use of elevated shoe heels in ancient and medieval times, but it is probably safe to say not enough use to have any significant impact on the bodies of most humans at the time.

Effects of the "Better Modern Brain" on Science and Technology in the Twentieth Century

Since we have no reliable information about the use of shoe heels by Gutenberg or Newton, what about now for modern scientists and inventors, when it is fairly reasonable to assume common shoe heel use is relatively universal in the Western world?

To attempt to answer that question, we will return to the example of Albert Einstein, who was mentioned in Chapter 15 and who is the modern era scientist most often compared to Issac Newton.

Although we do not have much information about Einstein's feet and footwear use beyond that mentioned previously, we do have highly detailed information about his brain, which was preserved after his death (against his wishes to be cremated) and carefully studied, including dissection. That is a fairly bizarre tale in itself, summarized briefly in a recent *Scientific American* article titled "Genius in a Jar."[2]

Actual photographs and drawings of Einstein's preserved brain from a 2013 study by Dean Falk et al.[3] indicate clearly that his brain was significantly asymmetrical with regard to the hemispheres, exhibiting the same distinct form of modern brain torques shown previously in FIGURES 26.1 and 26.2.

An extraordinary supporting example seen in **FIGURE 27**: Albert Einstein's brain (top view) was asymmetrical in exactly this way, with unnatural rotary torque squeezing the right hemisphere forward and compressing it relative to the wider left hemisphere (in yellow), which has expanded into a greater maximum diameter. So Einstein's brain clearly had the chief structural characteristics of the "better Modern brain" discussed in the previous chapter.

(Top View, Front of Brain at Bottom)

FIGURE 27.1 Einstein's Brain With Right Hemisphere Squeezed Forward & Compressed Relative to Left Hemisphere

Steven Hawking as a Possible Example of the Theoretical Extreme of the Combination of Asymmetrical Human Body and Brain

Among the greatest scientists of today, probably the closest in both reputation and fame to that of Einstein is Steven Hawking. And like Einstein, Dr. Hawking is a theoretical physicist focused on discovering the most fundamental governing laws of the universe.

Unlike Einstein, and as you probably already know generally, Dr. Hawking has suffered since age 21 in 1963 from a rare, early onset form of amyotrophic lateral sclerosis (ALS or Lou Gehrigs's Disease), also known as motor neuron disease (MND). Despite the nearly insurmountable limitations imposed by his gradual near total paralysis, he has both made pioneering discoveries and authored a record-breaking best seller, *A Brief History of Time*.

What is very interesting about Dr. Hawking's disease is that the physical effect on his body is extreme lateral asymmetry, not at all unlike the extreme lateral asymmetrical effects of scoliosis. See FIGURE 23.1 again and compare with FIGURE 27.3, which shows the asymmetrically twisted body of wheel-chair-bound Dr. Hawking.

Interesting, photos of Dr. Hawkings at Oxford and at Cambridge in the early 1060's show him standing in a consistently asymmetrical posture, with right side shoulder significantly higher than the left side, as seen for example in FIGURE 27.4.

To be clear, I am not asserting that Dr. Hawking's disease was caused by shoe heels, although no cause is known for ALS or MND, so shoe heels cannot necessarily be ruled out as a cause. My point is a different one. It is that whatever the cause of Dr. Hawking's ALS, the overall extreme effect of it on his body is very much like that of scoliosis, which I do assert can be caused by shoe heels.

Therefore, the condition of Dr. Hawking's body, and more importantly, his brain can be accepted at least provisionally as a possible case study of the most extreme, end-stage effects of shoe heels on the human body. At least accept it as possibly representing the extreme theoretical case, as understood in the framework of Newtonian science (as interpreted by Kant – and as discussed in later in Chapter 41).

The point I am trying to make is that Dr. Hawking's nearly totally dysfunctional body and his supremely functional brain - both together - may represent the same condition as the end-stage, most extreme net effect of shoe heels on the human body.

At any rate, I have no direct information about the structure of Dr. Hawking's brain, which remains alive and totally functional as I write this. And I do not know if any medical records exist such as brain MRI scans that might provide definitive information on the possible asymmetry of Dr. Hawking's brain.

However, it is clear from the video record that the eyes of Dr. Hawking are highly asymmetrical, with a significantly larger left eye, as seen in FIGURE 27.5. While not conclusive evidence of internal brain structure, it is logical to assume that with typical brain torque (as discussed previously in Chapter 26) the left side would have the larger eye due to reduced frontal pressure on the left side, thus facilitating growth. Conversely, greater pressure on the right side would restrict growth of the right eye.

World War II Hero and Inventor, Alan Turing Was a Different Kind of Genius

Finally, there is the case of Alan Turing, the greatest inventor of the Twentieth Century for his work in laying the foundation for modern computers and artificial intelligence while almost single-handedly altering the course of World War II.

Unfortunately, I have come across no direct information relative to potential asymmetry of his body or brain. Facial portraits from age 16 and 39 both seem to indicate matching eyes, which does not suggest an asymmetrical brain.

Interestingly, Turing was an elite adult runner, well before the running revolution of the 1970's and before modern running shoes, as seen in FIGURE 27.6. This suggests exposure to the effects of shoe heels and running throughout his life.

In contrast to Einstein and Hawking, neither of whom excelled at the highest levels of mathematics and were not childhood prodigies, Turing was first and foremost a mathematical genius, the signs of which were evident at an early age. So Turing may represent a different kind of genius with a different brain structure, one that unfortunately is likely to remain unknown.

Brain Asymmetry and Sex or Sexual Preference Differences

Turing was homosexual, and apparently homosexual men generally have brains with hemispheres that are more symmetrical than heterosexual men (and homosexual women) and therefore more like heterosexual women.[4]

Generally, men have greater difference in size of their left and right hemispheres (the right hemisphere being larger) than women, whose hemispheres are more evenly proportioned.[5] Women also generally have a larger corpus callosum than men.[6] Summarizing, that suggests that generally women have a more naturally structured brain, whereas men generally have a more abnormally structured brain.

28 UNIMAGINABLY HIGHER MEDICAL CARE COSTS

However, the other side of the coin, literally, is the health cost of the medical damage caused by elevated shoe heels. There the news is quite the opposite.

The annual cost of health care in the United States is about $3,000,000,000,000 or $3 trillion. Of that total, about one third is clearly attributed to the direct adverse effects of elevated footwear heels, or about $1 trillion a year in direct costs. This would include, for example, osteoarthritis.

In addition, about $0.5 trillion is due to indirect or difficult to trace adverse medical effects of elevated shoe heels. This would include, for example, greater susceptibility, intensity, or duration of infections due to reduced effectiveness of the immune system caused by malformed and poorly supported internal organs.

The U.S. Health Care Costs for Adverse Medical Effects of Shoe Heels Is $1.5 Trillion Annually

In total, then, about half of all U.S. health care costs, about $1.5 trillion, are attributable to the adverse medical effects of elevated shoe heels. I believe this is actually a conservative estimate.

At this early stage where it is difficult to pin down specifically the component costs accurately, it may be more appropriate to convert to an estimated range, which would be from $1 trillion to $2 trillion. Although that range of error is great, even the low end obviously is a huge number.

Worldwide, the cost of health care is a little over $10 trillion. That total includes for third world countries with lower standards of health care and cost, as well as less use of modern footwear. This is even more of a guess than an estimate, but I think the third world portion is roughly $2.5 trillion of the non-U.S. portion of the total cost.

Worldwide Health Care Costs for Adverse Medical Effects of Shoe Heels is $4.5 Trillion A Year

So the total annual worldwide health care cost for the adverse medical effects of elevated shoe heels is about $4.5 trillion annually, including $1.5 trillion for the U.S. and $3 trillion for non-U.S.

The global footwear market is about $300 million for 2015. That means that, worldwide, the adverse medical effects of footwear with elevated heels is roughly 15 times the cost of the shoes themselves.

So the global health care cost of a $100 pair of shoes is $1,500. In the U. S., with pricier athletic shoes, the cost is probably twice that or even more. This situation is, of course, completely insane!

If the Cause Is Not Eliminated, All You Can Do Is Treat the Effects

The worst thing about these enormous medical costs is that they are all going to treatment of the adverse effects of elevated shoe heels. Besides the massive cost, that is ineffective. Now that the actual cause has been identified, eliminating all those costs through early prevention is the only rational approach. That has to be the goal. Otherwise, "medicine [is just] failed prevention."[1]

29 QUALITY OF LIFE SEVERELY REDUCED

In contrast to cost, it is difficult if not impossible to quantify the reduction in quality of life caused by elevated shoe heels. But at least on a relative basis, it is clearly lower for nearly all, especially for the elderly and disabled.

To the extent that their body has been deformed by elevated heel footwear, all modern humans throughout their entire lives suffer from a reduced quality of life, possibly substantially reduced, compared to what they would have been able to do physically. Put plainly, their bodies would have less wrong with them. Doing anything would be physically easier.

Certainly, for the elderly and disabled, the loss in their quality of life is relatively much greater, since the adverse effects of shoe heels is progressive. At the later stages of life, the adverse effects begin to peak, commonly resulting in very stooped posture and even significant structural problems like "dowagers hump" back and inability to hold up the head when walking.

Indeed, maintaining the capability of ambulating is probably the single most important requirement to maintain health late in life. And the lifelong adverse effect of elevated heels most directly attacks that capability.

Indeed, the effect of age on posture looks to be directly caused by the effects of shoe heels as described in previous chapters. See FIGURE 29.1 and note particularly the typically crossed lower legs, obviously a direct effect of shoe heel-induced supination and resulting knee cant, as introduced in Chapters 2 and 3.

FIGURE 29.2 shows the various rotational changes that occur among the various principal parts of the body that result in natural upright posture degrading into the poor posture typical of the aged. All can be traced directly to the effects of elevated shoe heels.

PART III - The Potential of the Future

30 NEW RESEARCH IS THE HIGHEST PRIORITY!

My research has been long term, in depth, and very careful, but severely limited simply by a gross lack of available information that is publicly available, even with considerable effort, even with the Internet. Added to that, I have had the personal advantage of close periodic proximity to the National Library of Medicine and the Library of Congress. Furthermore, lately I have had fairly frequent assistance from a conscientious intern who was willing and able to go to those libraries to dig up all the critical research studies that are unavailable online, which is nearly all of the most recent (and therefore with the most tightly controlled access), but also including a lot of the older or more esoteric studies.

In sum, at this stage I have pretty much plumbed the depths for what is publicly out there of relevance to this research. By publishing this work I hope to provide a direction for new work by others so as to be informed by them of whatever I may have missed.

Assessment and confirmation of my principal findings and conclusions by qualified experts in relevant fields is the next logical step. They need to consider the wealth of non-public information that is easily available only to them, either in collections they oversee or that they can evaluate in the field without undue difficulty.

For certain, there is a vast amount of useful, perhaps definitive information in existence that was not publicly available to me. To give just one example, in Great Britain there are many collections of skeletal remains from hundreds of Anglo-Saxon and earlier grave sites that could be evaluated by anatomists and physical anthropologists for comparison with bones of modern native Britons. Comparing tibial plateaus, particularly for both legs of the same individual when possible, would be particularly useful.

All over Europe - the Paris Catacombs being another example - there are a vast multitude of other medieval and earlier grave sites that have yielded a large number of collections of intact skeletal material of European descent. Egyptian and other mummies are another obvious potential source, among the many other sources.

That skeletal material can be reasonably presumed to be from those who have not worn elevated heel footwear. Unfortunately, what footwear may have been worn is essentially impossible to know for sure. Some types of footwear in ancient and medieval times such as platform shoes and stilted clogs did have elevated heels, though not in their modern form. Bones survive over time much better than leather or wooden footwear.

Another example focus of research is carefully evaluating any living humans who have remained barefoot during their lives. One possible source is in the South Pacific Islands, where life does not require footwear. I once worked for a native Hawaiian who did not wear shoes until he went to college at Northwestern University, where footwear was mandatory in the Chicago winters. Modern medical technologies like MRI provide an excellent, detailed and safe window in the inner structure of living human bodies that did not exist until relatively recently.

31 WHAT IS THE NEXT STEP?

Given the severe damage to the human body done by elevated shoe heels, what can be done the fix the existing damage to the very large population of those who have already used conventional footwear since childhood? Is fixing existing damage even possible, and if so, how, and how quickly, and how much, and what are the costs?

On a more positive note, without question it would seem that we can avoid future damage for children starting at birth by simply avoiding elevated shoe heels. I also have effective shoe sole designs that neutrally preserve the biomechanics of the barefoot for the young. All existing "barefoot" and "minimalist" footwear commercially available now is problematic in one way or another. All can be improved in fundamental ways.

But if we implement a pure, corrected barefoot approach to footwear, do we not then lose the apparently critical enhancement to the human brain created by elevated shoe heels? For that I have no certain answer. More research and testing must be done first.

These are all extremely important questions. As probably the only person currently who might know the answer to any of those questions, I can say, regretfully but unequivocally, that I cannot answer any of those questions with a satisfactory level of certainty.

It Is Not Clear How to Fix Shoe Soles to Limit Or Fix Existing Structural Damage

I have tried for many years with limited technical means to fix the basic problem at the source, namely, the shoe sole. As I have said earlier, eliminating the shoe sole entirely and going barefoot is definitely not a good general option, if you already have existing damage, as most do. Going barefoot usually even makes the damage worse.

For many years I have played around with rebuilding or modifying shoes, shoe inserts, and insoles, both prescribed and over the counter, and gotten nowhere. I actually have many shoeboxes filled with inserts that I custom made for myself to test treatment solutions for my own specific asymmetry problems. As far as I could tell, none worked.

I eventually gave up, although I still can't resist trying out ideas from time to time, but nothing has ever worked. And I have always known the reason for the consistent failure, more or less.

Far Too Many Variables to Control

The reason is that there are just far too many variables in terms of what you can do to the both the right and left shoe soles or insoles or inserts. And the sensitivity of my ad hoc measurement of improvement or lack thereof was not delicate enough to measure minor incremental differences.

Although my methods were pretty crude, the same essential problem exists in the best-equipped biomechanics labs today. There are too many variables to control for and they are are too difficult to measure accurately except in very limited ways.   Because of this, the general situation is that too few test subjects are used in the tests and too few trials are run for each test subject.

However, recent advances in a very popular new technology have provided a whole new approach that appears to solve all of these interminable problems. If fixing the existing damage by shoe heels to human bodies is possible – a big if – this new approach should be able to find the way.

And if it is possible to fix or avoid body damage while at the same time still maintain the brain enhancement provided by shoe heels discussed in Chapter 27, this new approach should also be able to find the way.

In addition, there is some other hope of a solution to the difficult questions with which this chapter began. After all, many individuals have minimal damage despite wearing conventional modern elevated shoe heels. Identifying their unique accommodation, such as lower main longitudinal arches, may provide a fruitful approach that can be implemented in shoe sole design.

32 CONFIGURABLE SOLE STRUCTURES CONTROLLED BY USER'S SMARTPHONE AND/OR THE CLOUD

The smartphone is poised to revolutionize medical care. A super powerful personal computer located on or near your body almost 24/7 that connects to the Internet and with motion and other sensors directly on your body provides a previously unheard of potential for health care monitoring and direct, realtime treatment.

The overall picture of this relatively imminent medical future was laid out in detail in 2015 in a book by Dr. Eric Topol titled, "**The Patient Will See You Now**". The title emphasizes his view that in that future the patient will have far more control of his own personal health care than is the case now.

The smartphone will also revolutionize medical care in a way unforeseen by Dr. Topol. The smartphone has the capability to answer the difficult questions raised in the last chapter, if they can be answered.

In short, the smartphone is the key component in a system that can actively monitor sensors in your shoe soles and on parts of your body like the small of your back (roughly, your body's center of gravity) and your head. The smartphone can then use that information to evaluate and control electronically configurable structures in your footwear, correcting and optimizing in real time your body's personal biomechanics while running or walking or just standing around.

To put this into proper context, the capabilities and potential benefits just described of this invention combining smartphone and configurable footwear soles goes very far beyond anything that can be done today for you or anyone else in even the most sophisticated and best equipped footwear biomechanics lab anywhere.

Moreover, the smartphone can connect to a web-based cloud computer system that can compare your data with that of others using the same system, which could easily become a database of millions of users. Big data techniques can then be used on all that data to find important correlations for you and others physically like you that would be impossible to spot any other way.

Reliable solutions to structural and/or functional problems that many other runners or patients have already had that are the same as your problems can be downloaded from the cloud to your smartphone. The smartphone can then use the solution to configure your footwear soles.

The whole process of the cloud/smartphone/footwear system would be ongoing continuously. It thereby continually optimizes corrections to existing damage you may have from elevated shoe soles.

The Invention Solution Has Already Been Issued in the Form of U. S. Patents

Of course, I am an inventor. It occurred to me several years ago that the only possible solution to the catastrophic human damage from shoe heels that I was uncovering was this unique kind of smartphone approach.

So I filed U. S. and international patent applications, and received my first U. S. Patent on this technology, Number US 9,030,335, on May 12, 2015. The title of the patent is "**Smartphone App-Controlled Configuration of Footwear Soles Using Sensors in the Smartphone and the Soles.**" See Figure 32.1 below. It is also available on the Internet at my website: **anatomicresearch.com** or at the USPTO website.

US009030335B2

(12) **United States Patent**
Ellis

(10) **Patent No.: US 9,030,335 B2**
(45) **Date of Patent: May 12, 2015**

(54) **SMARTPHONES APP-CONTROLLED CONFIGURATION OF FOOTWEAR SOLES USING SENSORS IN THE SMARTPHONE AND THE SOLES**

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(72) Inventor: **Frampton E. Ellis**, Jasper, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/859,859**

(22) Filed: **Apr. 10, 2013**

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Related U.S. Application Data

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CPC ***G05B 15/02*** (2013.01); ***A43B 13/181*** (2013.01); ***A43B 13/40*** (2013.01); ***A43B 1/0054*** (2013.01);
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(58) **Field of Classification Search**

USPC 340/870.07; 36/29
See application file for complete search history.

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(57) **ABSTRACT**

A smartphone app that causes a smartphone device to actively control a configuration of footwear structural elements located in a footwear sole or removable inner sole insert of a user of the smartphone device, and one or more sensors located in either one or both of the sole or the removable inner sole insert the user's footwear and a sensor including a gyroscope and/or an accelerometer in the smartphone device; and the footwear structural elements being configured for computer control by the smartphone device when the smartphone app is operating on the smartphone device; and wherein instructions of the smartphone app, when executed, cause the smartphone device to, first, process measurement data received from the footwear and smartphone sensors and, second, use the processed measurement data to alter a configuration of the footwear structural elements based on the output from processing measurement data.

27 Claims, 40 Drawing Sheets

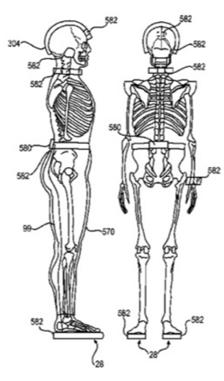

Fig. 32.1 US Patent 9,030,335-p01

I was completely taken by surprise about a month later when my business partner's wife told me that in a web search she had, strictly by chance, run across a highly laudatory **YouTube** video complete with animation on my brand new patent. The patent was singled out from many thousands of other patents for unusual praise. You can see it by Googling the title, "**Smart Shoe – finally humanity invents the shoe that it deserves**" or you can go directly to the link: **https://www.youtube.com/watch?v=CjBhghWDMoM.**

In the short time since then, I have already received five more U. S. patents on specific aspects of the new technology, such as for a smartphone app and for using a web-based cloud. Those five additional new patents are Patent Numbers US 9,063,529, US 9,100,495, US 9,160,836, US 9,207,660, and US 9,375,047* – all available at my Anatomic Research website: **anatomicresearch.com** or at the USPTO website.

Tuning Both the Body and the Brain Optimally

This new technology holds the potential for finding the best solution in real time for correcting the major anatomical misalignment in your body. That in itself is impossible with any other existing technology. But this new invention may be able to do even more.

At the same time it tunes the performance of your body, it similarly holds the same potential for tuning the performance of your brain. Specifically, for example, tuning the enhancement of the development of the dorsolateral prefrontal cortex of the left hemisphere of your brain.

It may be able to do what otherwise would seemingly be impossible. It may be able to find the best possible compromise between otherwise contradictory goals. That is, it may be able to correct the major misalignments of your body while still maintaining the full enhancement of your brain's left hemisphere dorsolateral prefrontal cortex. Or at least the best optimization compromise, or range of compromises, that exists between the contradictory goals.

Solving the Biggest Single Obstacle to Producing Reliable Biomechanical Research

Over the last decade particularly, the quality of biomedical research has been called into serious question. Many studies have been proven untrustworthy if not invalid. Think in terms of the grossly wrong but supposedly science-based facts that led to the substitution of sugar for fat since the 1970's, as well as promoting the use of trans fats. These troubling issues are well described in two new books[1].

The biggest single problem is that the studies have too few test subjects and that the subjects are not randomly selected. This problem is particularly acute in biomechanics research, especially in running studies. Many studies have as few as a dozen or a few dozen subjects.

And absolutely none at all are randomly selected from the general population, but rather from the relatively much smaller population of active runners – thereby avoiding studying the biomechanical issues that prevent most from running.

As a consequence, even the very best, most highly awarded studies, like the Willwacher et al. Nike Award-winning study cited in Chapters 2 & 3, include a relatively small sample of highly selective subjects: only a few hundred active runners limited to a relatively narrow middle age group, tested under very limited test conditions and testing times.

As noted earlier, limiting test subjects within this middle age group to active runners non-randomly probably excludes at least 95% of the population in this age group. And critically important age groups like children and adolescents are entirely exluded from the study.

In contrast, the smartphone based approach described above would theoretically allow an unlimited number of test subject to be tested 24/7, including critical test parameters like head motion that are not even tracked now. There would be no overt selection criteria whatsoever.

This is a huge quantum leap in access to essential information and the ability to process it efficiently, especially from a cost perspective. (To that is added the additional capability of using that information to actively configure shoe soles in real time.)

Through the use of the smartphone invention, the currently insurmountable problems of too few subjects and lack of random selection would be replaced by initially many thousands, then hundreds of thousands, then millions, then hundreds of millions, and finally billions of test subjects - all randomly selected. Even those in poverty can be statistically well represented with ease and even cost-effectively included by charity and government subsidy.

Improving Conventional Biomechanical Research Right Now

The age group that is currently ignored in formal studies and should instead be the primary focus is children, nearly all of whom are active runners throughout their daily lives. So actual randomized studies are possible that accurately represent the entire population of children, not just a tiny slice.

Moreover, the youngest are the direct source for provide incalculatibly valuable insight into the structure and function of human bodies of all races and sexes that have not yet be adulterated by footwear. Their growth can be tracked throughout their childhood and adolescence, providing accurate information that does not currently exist.

The entire age groups of children and adolescents should be the subjects of intense formal biomechanical study. They should provide direct insight into what happens when things start to go wrong biomechanically during the critical growth phase of life. And all of their longest future lives of any age group can be affected.

* My U. S. patents, including U. S. Patents numbered US 9,030,335, US 9,063,529, US 9,100,495, US 9,160,836, US 9,207,660, and US 9,375,047 noted above, are all herein incorporated by reference in their entirety.

33 A NON-PROFIT ANATOMIC RESEARCH INSTITUTE

I am well along in my relatively successful invention career already. And I am optimistic as to future income from sales of this and other books, primarily on topics relating to some other significant problems of existing modern footwear, as well as many other options.

So I think I can afford to be fairly altruistic concerning the patents I described in the last chapter, as well as my now rather large portfolio of other footwear patents, many of which are of a closely related nature. Most relate to better performing, truly barefoot-like footwear soles and also to computer control of configurable structures within footwear soles, like air bladders, compartments, and chambers.

A Non-Profit Anatomic Research Institute Holding My Patents

My plan is to establish a non-profit Anatomic Research Institute and transfer all my footwear patents to that Institute. They all will then be available for non-exclusive licensing to any footwear company.

I do not plan to charge licensing fees, but I do expect to receive substantial supporting donations from highly profitable footwear companies to fund the effort of the Institute to coordinate the best footwear, medical, and other solutions to the serious medical damage caused by existing footwear products.

I believe they will contribute at a reasonable level because it is firmly in their best interests to do so. With an irony that will not be lost on their customers, shoe companies can expect enormous potential financial benefits by marketing demonstrably better products needed to fix the major problems their previous products created.

It is also in their interests in terms of avoiding problems that could arise from an inadequate or non-credible and self-serving efforts limited to the private sector. That would likely prompt an over-reaction in the government sector, such as footwear being declared medical devices by the FDA. In the absence of effective, proactive effort by the industry, the FDA could make a compelling case to do so (despite, of course, having itself no existing experts or expertise to regulate footwear in any way relevant to the issues raised in this book).

More than anything else, the entire footwear industry is going to need to establish a new fundamental basis for trust by the public that the industry knows what they are doing with their products in the future. This book indicates that their past track record at best is total ignorance of their primary product's most basic problem, so believing in solutions that they come up with on their own are not likely to be well received by the public or by government regulators.

Expert Medical Leadership is Missing and Required

I plan to recruit a CEO from the medical community to lead the Anatomic Research Institute. I am already well aware of who are the leading researchers in medicine, biomechanics, physical anthropology, podiatrics, and other related fields because I have been using their research studies extensively. I plan to recruit them as consultants or staff members depending on their personal circumstances.

A small group of the best of them will form a board of advisers that will also include a few representatives from the footwear industry. The board of advisers and I will provide overall research direction.

The foremost missing factor from the research equation right now is relevant medical expertise, which is completely lacking in the footwear industry. My primary goal for the Anatomic Research Institute is to add that critical medical foundation to the effort to find effective solutions.

Not Just A Pointless Moonshot - A Major Medical Research Effort To Achieve Effective Treatment, Cures & Prevention

I believe what is required now is a **major** medical research effort, one of unprecedented scope. Although the term "moonshot" is inappropriately overused, what is required is a moonshot scale effort that gets off the ground quickly. Compared to the actual Apollo moonshot, the tangible payoff on Earth would be far greater, as well as both much cheaper and faster.

What is required is as follows: First, the major issues I have raised as to our current probable misunderstanding of human anatomy must be resolved as quickly as possible.

Second, the damage caused by elevated shoe heels needs to be accurately assessed for every part of the human body.

Third, the most effective medical and other treatment plans must be devised.

Fourth, since every age group is affected more or less by the adverse effects that progress with age, the treatment plans must be tailored for specific age groups.

Besides adding a crucial medical focus, an approximately equal priority for the new research institute is to drastically increase the support and participation of biomechanics scientists. As a group, they have the most relevant expertise necessary to implement successful solutions, particularly involving footwear and motion. Almost all of them currently subsist at academic institutions with very limited funding and little outside support from the footwear companies.

It strikes me as extraordinarily odd that there are probably about 100 neuroscientists currently for each biomechanics scientist. Yet those few biomechanics scientists may have far greater impact on improving the actual functioning of the brains of living humans over the next decade or two. I'm not arguing for fewer neuroscientists, only for many more scientists with expertise in biomechanics and lower extremity human anatomy.

At any rate, my personal goal and that of the Institute will be research and development only. The development will go only so far as creating prototype soles with the cooperation of the industry. Those prototypes would then serve as the simplest possible basic standards that can be safely copied and used within the industry to build actual products for market. Associated with the prototype soles would be a limited testing program.

The Basic Tool: Smartphone & Cloud Control of Configurable Structures in Footwear Soles

I believe the most likely and best footwear solution will come from using the smartphone and cloud-connected footwear soles with configurable structures that are microprocessor-controlled, as discussed in the previous chapter.

They will provide all the data on an individual wearer basis needed to solve the problem for each individual, and they can then also implement the best solution available at any given time for large populations of millions of individuals. And over time, the solutions can continuously improve as the big databases improve.

There is tremendous potential in collecting this individual data and matching it up with other individual medical data, including widespread individual genetic testing in the future. The result of using all this combined data on individual health care is likely to be revolutionary. And, aggregating it in the cloud with the “big data” from millions of other individuals where artificial intelligence and deep learning techniques can be used is likely to be truly revolutionary.

Lack of Privacy and Security of Highly Personal Data in Smartphones & the Cloud: An Insurmountable Problem?

There is however a major roadblock to this highly promising approach. There exists no way to safely create and store this extremely personal data, not currently and not in the immediate future.

The continual theft of huge databases from both businesses and government provides constant proof of this never-ending problem. Your smartphone and personal computer similarly lack reliable protection, as do all other computers, including the cloud.

The seemingly insurmountable problem is that reliable cybersecurity does not currently exist and is not even theoretically possible using existing methods. But a basic change at the most fundamental level of hardware architecture can provide a foolproof solution to this otherwise intractable problem, as we will discuss in the next chapter.

34 INTERNAL HARDWARE PROTECTION IS REQUIRED TO PROTECT PRIVACY AND SECURITY OF SMARTPHONES AND THE CLOUD

Unfortunately, the existing situation for privacy in the cyberworld of smartphones and clouds is terrible and constantly getting even worse. Simply put, there is no reliable security or privacy in cyberspace. Cybersecurity has become so bad that it now poses an extraordinarily grave threat to the U.S. economy and our national defense, as well as to each of us as individuals.

That presents a very big obstacle to implementing the important new solution to the elevated shoe heel problem, as described in chapter 32, which is configurable shoe sole structures controlled by smartphones and/or the cloud.

That invention absolutely requires reliable security to protect the privacy of all of your sensitive personal data stored in the smartphone and the cloud. Eventually that data would optimally include genetic and other medical information to provide a new and higher level of health care, so this a general problem that potentially includes all aspects of your health care.

However, no comprehensive solution to the cyberspace security/privacy threat has been found, much less implemented. Nor can there ever be such a solution, so long as the existing methods used are software based, as they virtually all are now..

A new hardware-secure architecture for computers is required that, for the first time, provides true security and privacy for computers like smartphones and the cloud that are connected to the Internet.

To be as blunt and emphatic as possible, reliable security and privacy is not even theoretically possible with the existing, very old architecture of computers.

The Existing Basic Computer Architecture Has Been Made Obsolete By the Internet

The existing Von Neumann architecture for computers was designed in 1945, several decades before networks were invented. It has no reliable internal defense against Internet malware. Only software defenses are available internally, which inherently can be defeated by software malware, sooner or later.

The only reliable existing alternative is to disconnect the computer from the Internet. But Internet connection is absolutely mandatory in today's world. A smartphone without a signal is nearly useless.

So, unfortunately, Internet connection requires that computer external defenses like firewalls be porous, thereby always potentially allowing in malware, which can go potentially anywhere inside your smartphone and do anything once inside.

The best that can ever be hoped for with existing Von Neumann architecture is an endless, continual battle between internal software defenses and offensive Internet malware software. But sooner or later you lose. And usually you don't find out until later that you lost.

Currently, the Computer's Defenses Always Lose Eventually

The offense currently has an unbeatable advantage. In the end, the defense always loses, because it has to be perfect every time in every battle. Otherwise the defense loses the war. The offensive malware software only has to win one small battle, even a minor skirmish, to win the entire war.

Just like a biological virus, one tiny software virus can kill. It can take control of your computer and its files, and/or steal and/or change files, and you will likely not even know it has happened. But unlike biology, computer hardware can be designed to provide an absolutely invulnerable internal defense against any and all software.

It just takes a basic design change. A fundamentally new computer architecture has been invented that provides an internal hardware defense against Internet malware software.

A Secure Control Bus and/or Simple Internal Hardware Barriers Are Required To Provide True Security and Privacy

The new architecture provides an inner protected area with a master controlling microprocessor that controls the entire computer through a secure control bus that is not connected to the Internet.

The inner protected area can be disconnected from the Internet by an extraordinarily simple but impermeable hardware barrier. It therefore can be completely invulnerable to Internet malware software.

The new hardware-secure computer architecture manages to do what is seemingly impossible currently. It is simultaneously both Internet connected and Internet disconnected.

It thereby provides the fail-safe security and absolute privacy that are impossible now with current methods that are doomed to fail, sooner or later.

The new secure architecture can be used in any Internet-connected computer, from the simplest to the most complex, from the Internet of Things (IoT) devices to smartphones to clouds and supercomputer arrays. It can be configured to completely lock down the operating system or any applications or any files of any computer, while still allowing open access to the Internet from the rest of the computer.

Additional information on this new secure computer architecture is available on my website: www.GloNetComp.com.

Like the Footwear Space, Cyberspace Has Had An Unidentified Fundamental Cause of Its Lack of Security and Privacy

Ironically, the current situation in cyberspace is just like that in the footwear space. In both, the true fundamental cause of a multitude of diverse and seemingly unrelated problems has gone completely unrecognized.

As a result, only the symptoms are treated and only in reaction to each new disease after it breaks out and becomes an epidemic. The result is endless, expensive treatment of symptoms that amount to no more than ad hoc patches in a rapidly weakening dike. In the end there is nothing but a prayer that the dike does not break before it can actually be repaired.

What is actually needed, of course, is at least a cure. The most effective answer is prevention. However, prevention and cure requires correct diagnosis of the actual underlying cause, so it can be directly addressed and overcome with effective prevention and/or cure.

That cause is the lack of internal hardware defenses to software attacks in the form of malware. Hardware can provide a simple but absolutely effective barrier that software never can.

A Silicon-Based Computer System Is Not Like a Carbon-Based Biological System

At least with regard to threats from the Internet, cyberspace is unlike a biological environment. In biological environments, viruses use any means possible to gain entry into cells and grow there in an endless "wetware" war that is like the software war in computers against malware like viruses.

Silicon systems are fundamentally different in a critical way. Simple silicon hardware can be located within any computer in order to absolutely deny any entry whatsoever to protected parts of the computer from all viruses or other malware coming from the Internet. The protected part of the computer can be designed to control the unprotected, Internet-connected part of the computer. It's essentially as simple as that.

With internal hardware protection, a computer can be set at any desired level of security, from absolutely locked-down to relatively loose. The looseness is essentially determined by how much control is permitted the human operator. However, even a relatively loosely configured computer with internal hardware protection is still far tighter than existing systems with only software protection internally.

There can be multiple levels of security in multiple protected parts of the computer. For example, with today's ever growing number of cores on a microprocessor, it is both easy and economical for a computer's microprocessor to have many cores, each running at one of several or many different levels of security.

In summary, computer security and privacy can be made reliably as strong as needed, but only with a hardware-based approach involving a new basic architecture to be used in all new computers, from the largest to the smallest. It's not that difficult to do.

Again, A Comprehensive Solution Has Already Been Invented and Issued in the Form of U. S. Patents

As I have aready made abundantly clear, I am an inventor. As long ago as late 1996, I became increasingly concerned about security and privacy in computers connected by the Internet. My intuition initially was that existing defenses like conventional external firewalls and software were inherently weak and ineffective. So I developed an entirely different approach based instead on internal hardware firewalls.

I filed U. S. and international patent applications, and received my first U. S. Patent on this basic technology, number US 6,167,428, on December 26, 2000. Since then I have been awarded about forty additional U. S. patents on variations and additional inventions related to this hardware protection-based computer architecture technology. Many of the earliest issued patents have terms that will expire by 2018 and the claimed inventions will become part of the public domain, available for free use by anyone.

One example from my most recently issued U. S. patents, number US 9,009,809*, which issued April 14, 2015, is titled "Computer or Microchip with a Secure System BIOS and a Secure Control Bus Connecting a Central Controller to Many Network-Connected Microprocessors and Volatile RAM." See FIGURE 34.1. Along with my other related patents, it is also available on the Internet at https://www.globalnetworkcomputers.com.

* My U. S. Patents, including U. S. Patents numbered US 6,167,428 and 9,009,809 noted above, are all herein incorporated by reference in their entirety.at my computer technology website: https://www.globalnetworkcomputers.com or at the USPTO website.

US009009809B2

(12) **United States Patent**
Ellis

(10) **Patent No.: US 9,009,809 B2**
(45) **Date of Patent: *Apr. 14, 2015**

(54) **COMPUTER OR MICROCHIP WITH A SECURE SYSTEM BIOS AND A SECURE CONTROL BUS CONNECTING A CENTRAL CONTROLLER TO MANY NETWORK-CONNECTED MICROPROCESSORS AND VOLATILE RAM**

(71) Applicant: **Frampton E. Ellis**, Jasper, FL (US)

(72) Inventor: **Frampton E. Ellis**, Jasper, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/333,759**

(22) Filed: **Jul. 17, 2014**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 13/815,814, filed on Mar. 15, 2013, now Pat. No. 8,898,768, which is a continuation of application No. 13/398,403, filed on Feb. 16, 2012, now Pat. No. 8,429,735, and a

(Continued)

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(Continued)

(52) **U.S. Cl.**
CPC ***H04L 63/02*** (2013.01); ***G06F 11/2043*** (2013.01); ***G06F 21/71*** (2013.01); ***G06F 21/50*** (2013.01); ***G06F 21/85*** (2013.01); ***H04L 63/0209*** (2013.01)

(58) **Field of Classification Search**
CPC H04L 63/02; H04L 63/0209; G06F 21/85; G06F 21/50; G06F 11/2043; G06F 21/71
USPC 726/11, 22, 30; 713/153, 154, 194
See application file for complete search history.

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(57) **ABSTRACT**

A computer or microchip including a system BIOS located in flash memory which is located in a portion of the computer or microchip protected by an inner hardware-based access barrier or firewall, a central controller of the computer or microchip having a connection by a secure control bus with other parts of the computer or microchip, and a volatile random access memory located in a portion of the computer or microchip that has a connection for a network. The secure control bus is isolated from input from the network, and provides and ensures direct preemptive control by the central controller over the volatile random access memory, the control including transmission to or erasure of data and/or code in the volatile random access memory and control of a connection between the central controller, the volatile random access memory and at least one microprocessor having a connection for the network.

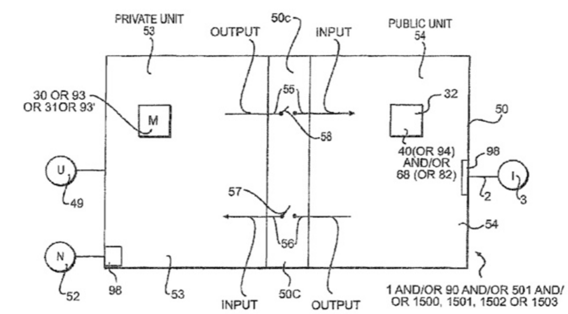

Fig. 34.1 US Patent 9,009,809-p01

35 OVERVIEW OF THE NATURALLY FORMED HUMAN BODY

The unnatural forces acting on the human body equipped with elevated shoe heels have an overall effect on the basic proportions of the abnormal human body. This is an unproven hypothetical conclusion, but supported by the logic outlined in previous chapters.

First, the foot. Like native African populations of early last century, flat-footedness and high arched feet (especially clubfeet) are very rare. Nearly all feet are in a neutral, upright position, with much less pronation/supination during locomotion.

The unnatural alignment of the lower limbs caused by elevated shoe heels increases forces unnaturally on bones, restraining growth according to Wolff's Law. The result is proportionately shorter legs.

The misalignment of the abnormally widened pelvis causes weakened abdominals, gluteus maximus, and hamstrings, and thereby generally weakens the trunk, the core of the human body. That decreases forces on the spine and encourages its growth, again in accordance with Wolff's Law. The result is a proportionately longer spine and trunk, relative to arms and legs.

The effect on the cervical spine is particularly noticeable, resulting in a longer neck. The weakened trunk also provides an unstable, misaligned base of support for the arms and legs, resulting in shorter arms and narrower shoulders proportionately, as well as shorter legs.

An Overview of the Natural Human Body, Without Modern Malformation Defects

The natural human body, unaffected by abnormally elevated shoe heels, should demonstrate proportional characteristics that are the opposite of those described above for the abnormal human body equipped with modern footwear.

Therefore, by the same logic used above, compared to the abnormal human body as we currently know it, the natural human body would have proportionately longer lower and upper limbs, as well as a shorter trunk and spine.

The pelvis would be less wide and less flattened, and the shoulders wider. Because muscles and joints would no longer be misaligned with its naturally correct physical form and structure, all of the muscles of the body would be better developed and the whole body much stronger.

The joints would be more geometrically regular, such as a more spherical head of the femur in the hip joint, and less variation between individuals. There would be less variation between sexes and races.

Naturally Correct Function Follows Naturally Correct Form

The reciprocal of the famous design aphorism, “form follows function”, is “function follows form”, which is just as true. Actually, the enhanced reciprocal aphorism should be “natural function follows natural form”.

With a naturally correct form, function becomes naturally correct as well, instead of abnormal and prone to disease and injury. So there should be a major general increase in health and quality of human life.

While this improvement should be dramatic at all stages of life, the difference is likely to be most remarkable in the elderly. The last stage of human life should improve to generally good health and a quite satisfactory quality of life, instead of years of severely handicapped existence involving substantial pain and suffering.

This is very important since life expectancy is likely to increase based on other improvements in medical care, as well as based on natural form and function.

An Increase in Life Expectancy for Men to Equal That of Women?

As noted earlier, the differences between men and women have been substantially exaggerated in an unnatural way by elevated shoe heels. One of the most important of those differences has been in life expectancy, which has increased from a couple of years a century ago to about seven years now.

The extra years lived on average by women has been attributed to basic differences between the X and Y chromosomes, but that seems unlikely, since it obviously does not account for the big increase for women compared to men in the last few generations.

It therefore seems more likely that this difference in life span is an abnormal effect of elevated shoe heels. After all, men and women are most typically affected in opposite ways, with their pelvises rotating in opposite directions backward or forward and their knees being bent in opposite directions, toward knock-kneed or bow-legged positions.

Therefore, preventing this difference by avoiding elevated shoe heels from earliest childhood and finding effective ways to compensate for it when it is already present, both actions taken together should result in roughly equivalent average like spans for men and women. And at a higher level for both, since abnormalities would be prevented or compensated for in both sexes.

36 CAN SHOE HEELS EVEN CAUSE CANCER?

When I initially drafted this chapter, I stated that it was needless to say that there have not been any prior studies testing the premise that shoe heels cause cancer, at least none known to me. It turns out only the very last part of that sentence was correct, because I recently came across a July 27, 2016, Yahoo article titled “Can High Heels Give You Cancer?” Although that question seems almost absurd on its face, the surprising answer given in that article was a yes.

The article quotes cancer specialist David Agus, M.D., a professor of medicine and engineering at the University of Southern California, from his recent book, *A Short Guide to a Long Life*[1]. Dr. Agus points out that there is a clear connection between inflammation and cancer, and that uncomfortable high heel shoes can trigger lowlevel inflammation that raises your risk of cancer. Regular use of high heels leads to pain and inflammation on a repetitive basis that can interfere with the body's overall ability to repair DNA in order to avoid cancer.

Other than this association by Dr. Agus, no other direct connection with cancer and shoe heels (especially heels that are not overly high) seem immediately obvious, much less a causative one. That is despite the mass of evidence already presented on the widespread destruction wrought on the human body's structure and function by shoe heels,

Actually, perhaps surprisingly, the connection between shoe heels and cancer is fairly direct. Elevated shoe heels have made major structural and functional changes in the modern human body that make it simply much more difficult to move than is natural. Modern human motion has been made slower and less efficient, with much more discomfort and actual pain from gradually worsening overuse injuries like arthritis and/or acute injuries like ankle sprains.

By default most of us end up moving less and less, and that reduction in physical activity burns fewer calories, resulting in a widespread and growing national epidemic of obesity.

In Recent Years It Has Become Well Known that Obesity and Cancer Are Closely Connected

As of 2008, over 68 percent of U. S. adults were overweight or obese, as were 17 percent of children and teens (compared to only 10 percent of children and teens roughly a dozen years earlier).

Obesity is associated with an increased risk of the following cancers: esophageal, pancreatic, colorectal, breast (after menopause), endometrial (uterus lining), kidney, thyroid, and gallbladder. In addition, obesity may also lead to increased cancer-related mortality[2]

How exactly obesity causes cancer is not yet definitively known.[3] It is currently thought that effect of the excess adipose tissue (fat) combined with endocrine system alterations in the obese both cause tumors to develop and grow. Also, the excess fat results in inflammation that enhances the capability of cancer cells to spread or metastatize.

Reduced Physical Activity and Cancer

Even without excess weight or obesity, the reduction in physical activity of modern humans caused by elevated shoe heels also is associated with cancer. Recent studies indicate that 50 percent of Americans lack sufficient physical activity, exposing them to increased risk of colon, prostate, lung, uterus lining, and breast cancer.[4]

A recent systemic study reviewed 45 studies that had examined the relationship of physical activity and cancer survivability. It found evidence in 27 observational studies that physical activity was associated with reduced breast cancer and colon cancer mortality.[5]

Another recent study has indicated that being unfit or losing cardiovascular fitness overtime is associated with mortality from cancer in men.[6] In addition, new study indicates that running protects mice from cancer.[7]

In addition to the increased cancer risk, lack of sufficient physical activity increases the risk of high blood pressure, diabetes, death from heart disease, and premature death, as well as resulting in less healthy bones, muscles, and joints and lower psychological well-being.[4]

Is the Malformed and Malfunctioning Modern Human Body More Susceptible to Cancer?

The answer to this question would generally be yes, since for example a malfunctioning immune system is considered to be at least one cause of some types of cancer. But the question here is much more specific. Does the unnatural modern human function that follows from the unnatural structural form caused by shoe heels include an abnormal vulnerability to cancers of any type?

Cancer is a very complicated field of medicine, one in which I am certainly no expert. Nevertheless, I believe it is likely that the general state of abnormal system functioning within the modern human body caused by elevated shoe heels does logically. That is because of the modern human body's general malfunctioning includes vulnerabilities to cancer that would not otherwise be present if such body systems were in a natural form and thereby enabled to function naturally.

Cancer and Asymmetry May Be Related

My research in this area has just recently begun, but an interesting angle has quickly presented itself. There was recently broadcast on television in 2015 an excellent PBS series by Ken Burns on "**Cancer: The Emperor of All Maladies"**, which provides a three part in-depth history of attempts to treat the disease.

Near the beginning of the series, it covered a 1950's case study of identical twin boy toddlers, one of whom contracted leukemia and died. What caught my eye was a photograph (see FIGURE 36.1) of the two together that appeared to indicate that the body of the twin who died had apparent asymmetries and the other twin, who is still alive many decades later today, did not.

Since the twins were identical, they had no genetic differences, so there cannot have been a genetic cause to the cancer. The only difference between the twins notable in the case study televised was the apparent physical asymmetry. That asymmetry probably went unnoticed at the time and what caused it is unknown. My educated guess is that was due to abnormal fetal development within an unnaturally supported and shaped womb positioned by an asymmetrical pelvis that was abnormally rotated, tilted, and twisted by elevated shoe heels.

What seemed significant to me is that physical asymmetry was uniquely present with cancer. If elevated shoe heels cause physical asymmetry as I have shown, then it is logical to think that such abnormal form does lead rather inexorably to abnormal function, which certainly raises the strong possibility of abnormal vulnerability to cancer relating to a malfunctioning immune system, for example.

It therefore seems likely that a direct linkage between elevated shoe heels and cancer will be found, if we do but look carefully. If and when such a linkage is found, then the steps we will be taking to reduce human structural asymmetry anyway will also serve to reduce the vulnerability to cancer as well.

Brain Cancer and Brain Hemispheric Asymmetry Appear to Be Linked

A new study appearing in **Nature**[8] includes a horizontal cross-section of a brain with a malignant brain tumor, a glioblastomas, located in the right hemisphere (see FIGURE 36.2). The right hemisphere shows clearly an asymmetrically larger development of the brain compared to the left hemisphere, even excluding the extra volume of the tumor that is present.

The suggests that the abnormally greater growth one of the brain's hemispheres, such as due to the effects of shoe heels to position the head asymmetrically, as previously discussed, may develop into the uncontrolled growth of the cancer tumor. This would result from the natural growth constraints of brain cells being exceeded by excessive unnatural cell division. In other words, shoe heels spur unnaturally excessive growth in one hemisphere and that excessive growth continues, spiraling out of control.

More specifically, the abnormally greater pressure caused by the asymmetrically greater growth of the right brain hemisphere of Figure 36.2 constrained within the rigid skull may also unnaturally force together some of the 10,000 loops of DNA that are tightly packaged in each brain cell, causing some of the loops to merge abnormally. As noted in the **Nature** study, that unnatural merger appears to activate a PDGFRA gene that is normally turned off, thereby causing the cell to divide continuously, launching a cancer.

Leukemia, colon cancers, bladder cancers, liver cancers, and sarcomas are all formed with this abnormal merged DNA loop characteristic of the glioblastomas type of brain cancer. Like the brain's constraint by the skull, the growth of red blood cells within bone marrow in leukemia is severely constrained by the rigid structure of the bone, which is abnormally formed by shoe heels.

Colon cancer, bladder cancer, and liver cancer may also be initiated by unnaturally excessive pressure and/or tension caused by their unnatural position within the pelvis, which has been abnormally rotated, tilted, and twisted asymmetrically by shoe heels. Sarcomas are malignant tumors arising from connective tissues, which are also abnormally and asymmetrically altered in a similar manner by shoe heels.

37 WAS THE HUMAN BODY POORLY DESIGNED BY EVOLUTION?

The obvious design weaknesses of the modern human body are both numerous and well known. Evolution is essentially blamed for all of them. The basic rational is that evolution works to maximize reproduction, not health. The result is therefore that the modern human body inherently has many jury-rigged, non-optimal compromises that directly cause many health problems.

The prime example usually given is the human lower or lumbar back, which causes widespread pain and suffering allegedly due to its incomplete development during our relatively recent evolutionary transition from quadrupeds to upright bipeds.

The Scars of Human Evolution

This general point of view was first articulated by Wilton M. Krogman, a forensic anthropologist and physical anthropologist from the University of Pennsylvania. In 1951 he published a study titled "***The Scars of Human Evolution***" in which he stated that "We humans are such a hodgepodge and makeshift that the real wonder resides in the fact that we get along as well as we do."[1]

He blames most of the problem on our evolutionary shift from quadrupeds to vertically upright bipeds with complicated S-shaped spines, leading to an inherently unstable lower back, as well as hernias, varicose veins, and hemorrhoids. He singled out feet for special criticism: "Our fallen arches, our bunions, our calluses and our foot miseries generally hark back to the fact that our feet are not yet healed by adaptation and evolutionary selection into really efficient units."[1]

Recently, in 2013, the American Association for the Advancement of Science convened a commemorative meeting on "The Scars of Human Evolution." At the meeting Bruce Latimer of Case Western Reserve University noted that only the human species "...regularly suffers from fractured hips, bunions, hernias, fallen arches, torn menisci, shin splints, herniated disks, fractured vertebrae, spondylolysis, scoliosis, and kyphosis." (paraphrased by Ann Gibbons of *Science* Magazine)[1] Similar points were made by Jeremy DeSila from Boston University and by Don Johanson, the famous discoverer of the Lucy fossil.

In addition, Jeremy Taylor blames the evolution of bipedalism for three unique difficulties of modern humans: osteoporosis, pregnancy and childbirth, and scoliosis.[2] At the AAAS meeting on "The Scars of Evolution", anthropologist Karen Rosenberg noted that the widespread modern need for Cesarean sections literally leaves many such evolutionary scars on women.[2]

Medical Researchers Blame Evolution Too

The blaming of evolution by anthropologists for the faulty design of modern humans has been accepted as the correct explanation by medical researchers as well. A good example of this is "The Unstable Ankle" published in 2001 by Meir Nyska and Gideon Mann. My own research on the human ankle demonstrates unequivocally that the wellknown instability of the ankle is due entirely to the unnatural and inherently faulty design of conventional shoe soles that fail to naturally support the ankle.

The Fundamental Mismatch

Which takes us directly back to the main point. As Jeremy Taylor himself notes "much disease arises from the mismatch of our bodies to modern environments."[3] The most important mismatch by far is of the human body to modern elevated shoe heels, as noted at length in previous chapters. Simply put, in the absence of the artificial environment of elevated shoe heels, the human body would be free of all of the important defects that were attributed above to evolution.

That is not however to say that, properly understood, evolution is not very important to the best practices in medicine. An important new field of evolutionary medicine was created in 1994 with the publication of the book, "***Why We Get Sick***" by Randolph Nesse and George Williams. They point out that evolutionary factors are critical in a large number of diseases and their treatment, and that "Medicine without evolution is like engineering without physics." For example, principles of evolution are at the very heart of the problem with the ever-growing resistance of microbes to antibiotics.

The Guiding Force in an Animal's Evolution is the Capability to Move in Its Local Environment

In a book published in 2016 by Matt Wilkinson titled "***Restless Creatures: The Story of Life in Ten Movements***" the basic point is made that locomotion lies at the very heart of every animal's evolution, absolutely controlling its body shape and function to optimize locomotion within its native environment.

This principle is so basic that Wilkinson notes that the brain and associated sensory organs like eyes and ears were originally nothing more than a guidance system to coordinate the movement of the body of an animal from one place to another. In terms of energy expended, the human brain works hardest when we exercise the hardest, not when we are solving difficult math problems. That is likely why a recent study by Richard Maddock at the University of California at Davis Medical Center indicates exercise is beneficial to brain health, relieving symptoms of depression and anxiety.

Thus, the bodies of fish were made to swim, those of birds to fly, and humans were quite literally born to run. Evolution explicitly reformed our bodies to run on two legs, which none of apes from which we directly evolved can do.

Nothing is more basic: the shape of our bodies is optimized to run. Our bodies develop and grow in reaction to the forces they encounter, especially in childhood. The greatest forces our bodies encounter then on a highly repetitive basis are, by a factor of two or three, those forces experienced while running as a child and young adolescent.

38 HIDDEN HUMAN PHYSICAL POTENTIAL IS VAST

The misalignment of human joints and malformation of human bones and joint, all caused by elevated shoe heels, severely reduces the effective strength of human muscles, particularly the major muscle groups. The specific weakening of the abdominals, gluteus maximus, and hamstrings were discussed earlier in Chapters 8-10.

In the simplest physics terms, the geometrically simple natural levers of the modern human body have been changed into abnormally complex and asymmetrical levers that both produce much less leverage and stunt the natural, self-reinforcing growth of muscle. The resulting levers of the modern human body are inherently weak relative to their natural potential and fail to become very much stronger with use.

Our Closest Animal Relatives, Chimpanzees, Are About 2.5 Times As Strong as Modern Men

The overall reduction in strength of the modern human body compared to our evolutionary forebears is quite significant. Our closest primate relatives, the chimpanzees (pan troglodytes), have been estimated to be roughly three to five times as strong as a modern man. This huge difference is despite having very nearly the same set of genes, varying from us by only a few percent.

The wellknown primate researcher Jane Goodall has estimated that an adult male chimpanzee in the wild "would be at least six times stronger than a normal [human] male", based on her field observations.

Other tests with captive chimpanzees using a dynamometer came up with a figure slightly less than four times stronger than an average college student and about 2.5 times greater than an exceptional human subject (top 1 percent).

The most definitive study was a US Air Force study that tested a chimpanzee out-pulling a human weight-lifter by 2.5 times on a relative body weight basis. Besides much superior strength, the chimpanzees also demonstrated much superior muscle endurance[1].

Another more recent study compared bonobo apes (pan paniscus) to modern man in jumping tests with the bonobo performance roughly twice that of humans[1].

The current research consensus seems to be that ape muscle is intrinsically superior to human muscle (in Goodall's view and that of most other researchers). But of course the real answer is not likely that chimpanzees have "magic" muscles compared to us.

Rather it is that we as modern humans are unnaturally weak, due to the abnormal malformation of the muscles, bones, and joints of our bodies caused by the unnaturally destructive effect of elevated shoe heels.

The good news is that without exposure to shoe heels, even the average human body is likely to be far stronger and robust in every way than today's modern human body.

Note: for more information on untapped human physical potential see this **YouTube** video: https://www.youtube.com/watch?v=tkc_eHTItTg titled "WATCH WHAT THIS MAN DOES NEXT (NOT HUMAN?) from REALITYWORLDVIDZ.

39 PREPARE TO BE SURPRISED

As I have said repeatedly in previous chapters, most of what we need to know about the anatomical and medical problems created by elevated shoe heels remains to be discovered. Existing research studies are very limited.

As a consequence, it is likely that we will repeatedly be surprised by what we find, particularly with regard to the surprising solutions that may be out there waiting to be discovered. Some preconceived notions are likely to fall by the wayside and some commonsense assumptions will likely be completely contradicted by what we find. That is to say scientific discovery often works.

We do know now from history that there have been some unusual individual cases in the past that we do not have sufficient knowledge now to explain. They may ultimately provide totally unexpected approaches to extraordinarily advantageous outcomes that are complete surprises, even the opposite of what is expected. I will recount a few historical cases that I know of as of now.

The Romantic Poet Lord Byron

One of England's greatest poets had from earliest childhood what was referred to as right clubfoot (although this exact diagnosis may well be incorrect). It caused a noticeable limp. Despite this significant handicap, he was a very powerful swimmer, an effective boxer, and a bisexual with a sufficiently extensive list of sexual conquests to be socially exiled from England.

The Great American Female Sprinter, Wilma Rudolph

The standout athlete of the 1960 Rome Olympics, the first to be televised, Wilma had polio at age four. She had to wear a brace on her left leg and foot (which was twisted) until age nine, and an orthopedic shoe for two more years.

Despite having to endure all this, Wilma in totally dominant fashion won gold medals in the 100 meter and 200 meter sprints, as well as the 4x100 meter relay.

Olympic Figure Skating Star Kristi Yamaguchi

Kristi was born with clubfeet and had plaster casts on her feet from the first couple of months until age one. Then she wore corrective shoes connected by a brace until age two. Despite this, she won gold medals at the 1992 Winter Olympics and World Championships.

Womens Soccer Superstar Mia Hamm

Mia was born with a clubfoot and wore corrective shoes as a young child. Despite this, she became arguably the greatest American female soccer star, leading the U.S. team to gold medals in both the 1996 and 2004 Olympics.

Hall of Fame NFL Quarterback Troy Aikman

Despite being born with a clubfoot, Troy led his Dallas team to three Super Bowl wins.

40 WHAT SHOULD YOU DO NOW?

First of all and most importantly, do not panic! It would be a big mistake for you to try to make any sudden, major changes, either in the shoes you wear or other aspects of your current lifestyle. As I have mentioned previously, for example, suddenly transitioning to barefeet or very low heel shoes from much higher heeled shoes is very likely an injury mechanism in and of itself.

Just keep doing whatever you think is already working for you. Take it slow and easy for now.

I will make a few recommendations in this chapter for the first kind of new steps I think you should take. My emphasis and yours should be safety, first and foremost. Your personal creed should be the same as the physician's creed, “First Do No Harm”. Trust me, there are many, many ways you can make things worse for yourself. Please don't outsmart yourself.

I have to be very conservative right now about what I recommend to you. I want to be sure that I do not help you to harm yourself. There are no silver bullets to use here (vampires, if they existed, might be easier to deal with than shoe heels). I am acutely aware that most of the science that needs to be done to provide safe and reliable answers for all of us has not yet been done. That leads directly to my first recommendation for you.

(1) Stay Connected to Be Updated With More Definite Recommendations for You, as Research Evolves in the Future

One of my primary goals for the non-profit Anatomic Research Institute mentioned earlier is to communicate reliable information about the latest on the ongoing research on treatment and prevention to the public. In short, to provide trustworthy recommendations to you on a continuing basis.

So, at least for now, you can visit my website at **http://www.anatomicresearch.com** and sign up for email updates. All of this is very much a work in progress currently, but in the future I will likely be setting up social media and other fairly obvious lines of communication to make staying connected easier.

I will be posting video online demonstrating what I think are safe and effective stretches and exercises for you to counteract the adverse effects of that elevated shoe heels have probably had on you. That leads directly to my second recommendation for you.

(2) Focus for Now on Weight Training Exercises and Stretches That Counteract the Adverse Effects of Shoe Heels

It is going to take a while to sort footwear out relative to the elevated heel problem. You should not expect anything for a year or two at best in terms of widely available commercial products. At worst, it could be many years, or perhaps not in your lifetime, at least in terms of new footwear designs that fix your problems, as versus simply not making them worse.

Weight training of even an informal type is important, since shoe heels have tended to weaken you and make you asymmetrical, particularly including your upper body. For cardiac heath, you need to have balanced upper body strength. Building up your "core" strength is critical. Most important is to focus on your abdominals, glutes, and hamstrings.

Stretching, even simple stretches, are more important than you might think. I believe one of the most important is bending over carefully and touching your toes, or coming as close as your can without straining). That bending forward motion counteracts the backward rotation of the pelvis that elevated shoe heels cause, as previously discussed. See FIGURE 40.1. Besides the lumbar spine, you need to stretch your thoracic and cervical spines carefully too.

I will posting a great deal more on the Web in the future with much more specific information on the best exercises and stretches and how to safely perform them, so again, stay in touch. I have some new exercises and some different ways of performing some older ones, but I need more time to test with varied populations, including the elderly, who need the help the most but are much more frail than the general population thereby raising extra safety concerns.

I also will be posting information on how to better assess your personal asymmetry profile in order to tailor exercises and stretches specifically to counteract it adverse effects on your body.

(3) Alternate Running and Other Aerobic Exercises

I know it may be very difficult to do if you are an avid runner, but run less, to avoid becoming a former runner. Run only every other day, with weight training on the days between.

When you run, alternate with periods of walking. Instead of jogging at a relatively slow speed for your entire workout, try alternating between running faster and then walking. That's better for your heart too.

Also, do aerobic sports or exercises that involve lateral or side-to-side motion, like basketball or soccer or dancing, not just straight ahead repetitive motion. But be very careful in trying anything new by transitioning slowly, listening to any painful feedback from your body. Racquet sports like tennis that typically involve swinging with one arm only, or golf with its twisting swing motion, probably increase whatever asymmetry problems you may have.

By the way, I think grunting loudly when hitting the ball in tennis is probably advantageous in stabilizing the chest and protecting the heart, even if it is terribly obnoxious. Hopefully, an effective alternative can be developed, like tensing the diaphragm as if to grunt, but holding your breath instead until after the ball is hit.

You can also try sports and exercises that don't involve natural human locomotion, like swimming and riding a bike. My personal experience is, however, that doing so will not counteract or correct your asymmetries, just not make them worse.

Two exercises that I can think of may be helpful: rollerblading or iceskating and the skating form of cross-country skiing, particularly as used in racing. They are unusual because they rely on an outward to the side, skating motion of your legs that is similar to the front end misalignment discussed in chapter 11, rather than straight ahead motion required by running and walking. In a way, then, they are non-normal locomotion motions that happen to be better adapted for the abnormal structure of the modern human body.

(4) Work Hard On Your Posture

The overall effect of elevated shoe heels on your body is to force it over into a generally slumped forward position, which typically is called poor posture. In an excellent article in **The New York Times** titled "**Posture Affects Standing..**." Jane Brody states that

> Poor posture can have ill effects that radiate throughout the body, causing back and neck pain, muscle fatigue, breathing limitations, arthritic joints, digestive problems and mood disturbances. ...We live in a gravitational field, and when our bodies are out of line with the vertical, certain muscles will have to work harder than others to keep us upright. This can result in fatigue and discomfort….

To counteract this shoe heel-caused problem, you need to strengthen your core, abdominals, glutes, and hamstrings, as well as back extensors. You also need to avoid bad postural habits. Britain's National Heath Service has an excellent online resource for doing both that is cited in the Times article, or you can search directly for "**Common posture mistakes and fixes – Live Well – NHS Choices**"

(5) Shoes and Barefeet

As pointed out in Chapter 18, switching between the use of shoe heels and bare feet, especially in rigorous sports and exercise, is itself a likely source of injury. Especially so in the not uncommon example of running barefoot and then wearing conventionally heeled shoes immediately before and after.

Instead, for now, I think the best you can do is to try to moderate the adverse effects of elevated shoe heels. To do that, you should avoid your highest heel shoes, both athletic and street shoes. You might even try moccasins or slippers with low heels instead of barefeet or flip-flops.

The basic idea is to try to reduce the amount of change or transition between different heel heights by converging toward the middle in terms of heel heights.

I think this approach is particularly important for women with special regard to high heels, especially spikes. I think you have to come down gradually from these higher heels, especially if you are a serious athlete. I believe high heels are a really serious health problem for women. So many women have such a strong desire to wear them, apparently for sexual allure more than anything else, according to surveys.

Strictly from the point of view of sexual allure, I can only say that, as a guy, I personally would vote instead for other, more direct and healthy approaches to increasing such allure, if one feels compelled to do so. Healthier potential alternatives might include clothing that is more shear and/or more revealing and/or enhancing (Spanx, etc.) and/or, as a last resort, more absent (meaning articles of underwear such as slips or bras). Just suggestions, from a medical point of view.

41 IS MEDICINE NOT A REAL SCIENCE BECAUSE IT IS INCORRECTLY BASED ON ABNORMAL MODERN HUMAN ANATOMY?

There is no question that modern medicine has provided enormous health benefits. However, that it is a real science in the classic sense like Newtonian physics raises different questions.

Whether or not modern medicine is a real science with definite laws that can predict real world outcomes with certainty was discussed in a 2015 book titled "**The Laws of Medicine**" by Siddhartha Mukherjee. (The book and an associated TED Talk are available at www.TED.com.)

Without doubt modern medicine uses all the most advanced, highly sophisticated tools made available by the latest advances in technology and science to provide highly effective and ever improving treatment of diseases and injuries.

But medicine differs in a number of major ways from the gold standard of science, Newtonian physics. The most obvious of these differences is complexity.

The Inherent Overwhelming Complexity of the Human Body Is a Daunting Problem

While Newtonian physics describes, for example, the relatively simple motion of the planets of the solar system and falling bodies therein, medicine has as its subject the human body. Just a tiny part of that body is the human brain, often said to be the most complicated structure in the known universe, with over 85 billion neurons and 100 trillion connections between them, as noted earlier.

Moreover, in addition to the brain, the human body includes all the rest of the nervous system, the circulatory system, the skeletal, joint, and fascia system, the muscular system, the digestive system, the urinary system, the lymphatic system, the sensory system, the pulmonary system, the immune system, and the reproductive system. The anatomical structures of these systems alone are fantastically complex on both a macro level and a micro level.

And of course further complexity is created by the many organs within each system of the human body, which both function together and also interact constantly with many organs within many of the other systems.

Finally, there is the fundamental difficulty of measurement, such as measuring the motion of highly irregular and non-rigid human shapes, instead of the geometrically regular and solid ones of classic physics.

So, the inherent overwhelming complexity of the human body is obviously a daunting problem for medicine as a science compared to classical Newtonian physics.

Another Fundamental Problem Has Existed Until Now, Unknown and Virtually Insurmountable

Until now, the massively adverse effect of elevated shoe heels on the human body has not been recognized. So every experiment involving the human body has been conducted without that huge variable being taken into account and controlled for. As a direct consequence, the experimental results and their utility for treatment or prevention have been significantly reduced.

This fundamental problem is best understood in comparison to classical Newton physics. Its basic structure, as popularized by the German philosopher Immanuel Kant, is based on a two state analysis: the first state being pure and the second being practical.

The first or pure state is an abstract, theoretical state wherein, for example, the effect of the pure force of gravity is calculated is if a body was falling alone in a vacuum.

The practical state is where the variable effects of the actual friction of air on the falling body (based measurements of the altitude, temperature, humidity, and/or wind at a certain geographic location and time), for example, are added in to the theoretical effect of pure gravity to produce a useful end result that matches motion actually experienced in the real world.

Thus, in classical Newton physics, a combination of pure gravity and practical friction together yield an accurate, predictable understanding of falling bodies in the real world.

Until Now, an Unnatural State of Disease Has Been Mistakenly Accepted in Medicine as the Pure or Theoretically Ideal State

The adverse effect of elevated shoe heels, being heretofore unknown, has allowed a fundamentally false conception of the human body to be inadvertently accepted in modern Western medicine. An abnormal state has unknowingly been accepted as a normal state. What is unnatural has been mistaken generally for natural.

Put simply, modern medicine cannot function as a real science if it is not aiming at the correct target, which is the good health of the natural human body. Putting it more negatively, if modern medicine understands diseased conditions to be normal, it cannot possibly proactively produce cures or prevention, only the reactive treatment of symptoms.

The natural, normal state of the human body is the only true pure or theoretically ideal state of a real science like classical Newtonian physics. Currently, in modern medicine, that natural state is virtually unknown, because the deep and widespread adverse effects of elevated shoe heels have not been known.

For modern medicine to function effectively like a real science those unnatural effects must be known, and with far greater accuracy than I have been able to provide in this brief book, which is nothing more than a first step in the right direction.

Most of the real work remains to be done to discover with sufficient accuracy the true natural structure and function of the human body. That knowledge will provide a clear direction leading directly to the cure and prevention of a multitude of important diseases. The alternative is mostly continued directionless treatment of symptoms, however sophisticated and expensive. See FIGURE 41.1.

Is Biomechanics Not a Real Science Because It Is Incorrectly Based On Abnormal Modern Human Anatomy?

Most of the discussion above relative to the field of medicine applies to biomechanics as well, particularly that every experiment involving the human body has been conducted without the huge variable of the massively adverse effect of elevated shoe heels being taken into account and controlled for. There a few additional points specific to current biomechanics research generally.

Due to the inherent difficulty and cost of measuring the extraordinarily complex human body in motion, most biomechanics studies are extremely limited in scope, with very narrow goals and little coordination. There are usually a very small number of test subjects and the manner in which they are chosen often unknowingly affects the statistical validity of the conclusions.

Aside from the heel issue, far too little attention is paid to the specific structure of footwear, which is used in most biomechanics studies. Generally footwear is supplied by test subjects and is essentially completely unknown. Even when footwear is supplied to test subjects, the most that is ever reported is the shoe makes and models. Even if one structural component is identified and/or studied, other important components are not. There are usually unresolved transition issues when barefoot test subjects are used.

Generally speaking, I would say that far too little recognition is given to that indisputable fact that footwear is the de facto artificial structural foundation of the modern human body. Their interaction must be accurately accounted for in order to achieve valid and meaningful biomechanics research results.

Relative to the important role it could and should play in the future of modern human health and quality of life, the field of biomechanics is very severely underfunded compared, for example, to neuroscience. The footwear industry is particularly remiss in this regard.

I firmly believe that the field of biomechanics will be wholly transformed by the future Internet of Things, as specifically outlined previously in some detail in Chapter 34 relative to smartphone and/or cloud control of configurable shoe sole structures.

42 CONCLUSION

Compared to other repetitive stress injuries like carpel tunnel syndrome, elevated shoe heels produce what must be, by far, the ultimate repetitive stress injury. And the injury is not localized, but rather can extend to any part or many parts of the human body, as we have seen. Missteps and other accidents transform many of those repetitive overuse injuries into acute injuries like the way that the weak and misshapen modern Western knee is unnaturally prone to ACL tears.

The Main Take-Away

In many parts of this book I have had to rely on very spotty research in my attempt to trace the effects of elevated shoe heels on the modern human body. At this stage, the picture of the pristine, natural human body is very incomplete. Much future work by professionals in many fields needs to be done, including much more extensive collaborations between those in associated fields, in order to confirm and expand my initial effort here.

My basic analysis of the effects of shoe heels are the best I could do for now. But I fully expect that some parts of it will be revised, perhaps even substantially. Some parts may be completely contradicted by factual evidence that does not exist now or that I somehow missed.

So the effects I have described at length in preceding chapters should be viewed as tentative. However, and let me be as emphatic as I can about this, although some of the effects I have outlined will likely be revised in the future, the fundamental disruption of the natural anatomic mechanisms of the foot and ankle artificially caused by elevated shoe heels will not be revised or contradicted. It is now an established fact.

More specifically, that perverse disruption is by shoe heels on the natural biomechanical operation of the subtalar ankle joint as activated by the windlass mechanism of the plantar fascia (all carefully described in chapter 2). It is biomechanically automatic and fully supported by a multitude of peer reviewed scientific studies carefully cited in this book. That unnatural disruption is directly based on factual evidence as good as any that exists in anatomy and biomechanics currently. Therefore, that most fundamental part of my analysis – its basic foundation - will not change in any substantial way in the future.

In addition, the critical role that running in shoes with heels has to substantially alter the natural development of the human body will also not change significantly in the future. Nor will, more specifically, the importance of the maximally loaded, bent-knee position of the leg during the midstance phase of the running stride, as described in chapter 3. Moreover, it is beyond any reasonable doubt, based on the very large number of peer reviewed references I have cited there, that elevated shoe heels directly and automatically create a bow-legged position that is the basic cause of osteoarthritis of the knee. The sheer volume of existing evidence is overwhelming.

Where Does That Leave Us?

Knowing now that elevated shoe heels are the root cause of so much modern human disease allows for the simple prevention of most of those diseases, but only for those born now or recently. The parents of those newborns can just ensure that elevated shoe heels are avoided during their childhood. Furthermore, every national government can and should ban the production or importation of any children shoes with elevated heels. Very gradually over time the problem will then fade away. So future prevention is fairly simple.

Unfortunately, finding cures or even new, more effectively targeted medical treatments may be very difficult for the generations of humanity already living today. Except for the youngest, most modern humans have already been significantly affected adversely by the lifetime use of elevated shoe heels. Certainly for now and the relatively immediate future, modern medicine will continue to be practiced in the same ways it is already evolving today, which certainly already includes extremely rapid technical progress in many areas.

For now and the next year or two, the best hope for effectively counteracting the adverse effect of shoe heels will be the very targeted but simple exercises and stretches discussed in chapter 40. Those will be revised and improved on an ongoing basis as they are formally tested across varying populations.

In addition, the basic design of footwear can be easily and vastly improved in the next few years, compared to nearly all of today's footwear, which is fundamentally flawed in terms of simply maintaining the obviously superior natural stability and comfort of the sole of the barefoot. That issue will be briefly discussed in the next, final chapter, the Postscript.

Finally, I believe the best hope for effective treatment or cure for the adverse effects of elevated shoe heels for all of us captive guinea pigs are the configurable shoe sole structures electronically controlled by smartphones and/or the cloud, as previously discussed in chapter 32. It will probably take several years to develop satisfactory prototypes and a few more years to get into widespread production. It could be quicker if the project is seriously treated as a moonshot, as I believe it should.

A Personal Note

This book, not so very far from a first draft, is the best I can or probably should do for now. At times the vast scope, complexity, and potential significance of the project has almost completely overwhelmed me. Although it is far from the finished product I would like for it to be, I believe it is time now to get the book out as quickly as possible, published online in the early Beta Version 1.0 form as it now is, for thorough review and reaction now by medical and biomechanical professionals with much greater detailed expertise than me. A lot of fresh analysis, as well as new lab and field work to provide real answers to the many questions raised by this book, should be done as soon as possible.

The need for that work is truly urgent. The current state of affairs in human anatomy, and all the medical care based directly on it, is that we simply do not now accurately know what is a normal healthy human body, not its natural shape nor its natural function. That is, we have never knowingly studied the natural human body unadulterated by the adverse effects of elevated shoe heels.

Creating a New Scientific Field of Research: Theoretical Human Anatomy

In the spirit of classical Newtonian physics, a new scientific field focused on what I would call **Theoretical Human Anatomy** needs to be established,. It is necessary in order to achieve the goal of discovering, for the first time ever, the true shape and function of the healthy natural human body – specifically, a body wholly undeformed by unnatural environmental influences such as elevated shoe heels. Although somewhat ad hoc right now, this book is my best personal attempt to jumpstart that critical new field, and as broadly as possible invite others to help this guinea pig in its establishment.

43POSTSCRIPT

It is unfortunately an easily provable fact that the elevated shoe heel is only the first of two very fundamental and unnatural problems in the structure of conventional shoe soles.

The other really basic problem is that shoe soles are structurally nothing like the soles of your feet. In concept and design, shoe soles are much more like portable cookie-cutter sections of cushiony ground that are attached to the shoe uppers that are much more naturally shaped to go around your feet.

As a result, conventional shoe soles are relatively flat, narrow, and rigid. The natural soles of your feet are much rounder, much wider, and much more flexible. As you might guess, this fundamental design mismatch causes major performance and stability problems for modern shoes that are entirely unnatural. Put bluntly, the stability of modern athletic shoes is embarrassingly bad, even those used by superstar athletes. SEE FIGURE 43.1

The fundamental design problem of conventional modern footwear is quite old, going back to at least the time of the Roman Empire, but is still present in nearly all modern shoes, including nearly all athletic shoes. Modern shoes are made with the latest materials and the most modern manufacturing technologies. However, their basic sole structural design is several thousand years old and essentially unchanged today in any important structural way.

The most glaring result of their unnatural stability problem is ankle sprains, which are by far the most common sports injury. They are also the most common cause of visits to hospital emergency rooms (although most ankle sprains are never treated there or seen by any medical professional).

It is easy to prove that the human ankle joint, even though structurally weakened by elevated shoe heels as shown in chapter 5, is nearly impossible to sprain when the foot is bare. You can see this exceptional natural stability for yourself quite easily. BUT DO NOT TRY THIS IF YOU HAVE ANKLE PROBLEMS OR ARE DISABLED OR FRAIL OR OTHERWISE IMPAIRED!

Just take off a shoe and, while standing upright and keeping most of your weight on your other foot, carefully roll your barefoot to the outside. That is the position in which most ankle sprains occur. Your barefoot and ankle will feel naturally stable.

In contrast, if you were to roll your foot to the outside in a conventional shoe, your foot would quickly become highly unstable and would roll over unnaturally out of control if you put much weight on it, spraining or fracturing your ankle. BUT DO NOT DO THIS. YOU WILL FALL AND HURT YOURSELF BADLY! Instead, just put the shoe you took off onto a table top and tilt it to the outside. You can easily see for yourself how the conventional shoe sole teeter-tooters unstably on edge, completely unlike your footsole.

So you can see that a conventional shoe sole is actually required to sprain even the relatively deformed modern human ankle. The conventional modern shoe sole functions as a completely unnatural lever that rolls your foot over to the side.

This second shoe sole problem, the lack of natural barefoot stability, will be the subject on my next book. It will also deal more specifically with the natural shoe sole design principles necessary to fix the mismatch problem. For now, you can get an overly detailed and complex preview of those design principles in my issued patents at my website, www.anatomicresearch.com. (Sorry about their lack of easy readability, mostly inherent in patents which are first and foremost technical documents, but that is why I plan to summarize and translate them into more easily understood language in the next book.)

ENDNOTES

See separate document on Website

LIST OF DRAFT FIGURES & VIDEO

See separate document on Website

BIBLIOGRAPHY

See separate document on Website