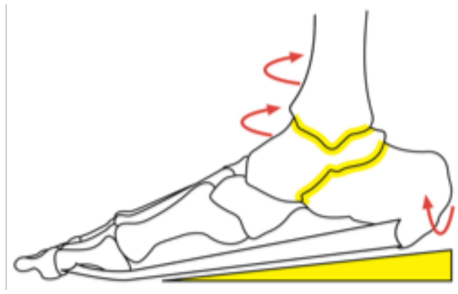
FIRST DRAFT 1/12/20

A MEDICAL CATASTROPHE HIDDEN IN PLAIN SIGHT

OVERLOOKED EVIDENCE AND CONFIRMATION OF AN UNEXPECTED DISCOVERY

Elevated shoe heels automatically tilt down a wearer's foot, thereby plantarflexing the wearer's ankle joint. Based on the work of J. H. Hicks and many other leading researchers – all unchallenged – plantarflexion supinates the **subtalar joint** (the joint between the ankle and heel bones). Although it therefore follows directly that elevated shoe heels must supinate the subtalar joint, since they automatically plantarflex the ankle joint, that artificial coupling between shoe heel and subtalar joint has been entirely overlooked in biomechanical research, including by the most elite athletic footwear company scientists, until I described it, beginning in 2015 in Web-based publications. In 2019, my discovery was summarized in peer-reviewed research published in ***Footwear Science*** titled "Shoe heels cause the subtalar joint to supinate, inverting the calcaneus and ankle joint.



Since shoe heel-induced supination had been unknown, the probable direct effects on human anatomy of its unnatural inversion and external rotation of the ankle joint also had never been explored until I began to publish my initial research in 2015. In taking the first step in correcting that previous oversight in research, I undertook a detailed investigation into the biomechanically logical effects in human anatomy of the heretofore unexamined coupling biomechanism, the elevated shoe heel-induced supination of the subtalar joint. This article is a brief summary of that initial investigation.

In an unexpected way, my investigation of the artificial shoe heel biomechanism summarized here uncovered compelling evidence for overturning the centuries-old basis of human anatomy. Much of what has heretofore been defined as normal human anatomy and what is abnormal (or less highly evolved) are in fact completely reversed. In fact, much of what we think of as normal is actually abnormal. The implications of this basic distinction are profound, since modern medical care is based on correctly singling out the abnormal and understanding its cause in order to treat or prevent it.

THE OVERLOOKED EARLY EVIDENCE SHOWS FOOT SUPINATION IS ARTIFICIAL, NOT GENETIC

A probable direct effect of elevated shoe heels on the human foot was published in 1939 in ***The Lancet***: exemplary footprints are the same between individuals who have never worn shoes despite significant genetic differences **(FIGURE 1A).** In comparison, an exemplary modern human foot (in yellow) subjected to the everyday use of modern shoes is externally rotated about **6°** into a **supination** position **(FIGURE 1B)**. It is important to note that the difference is artificially-induced, not a genetically-based racial difference.

A physical anthropology study from 1931 indicated that an exemplary modern European calcaneus is inverted about **6°** compared to those of two barefoot populations. Note particularly the level lines of the Achilles tendon attachment to the heel bone on all three samples. That attachment line shows the characteristic supination-based structural tilt to the outside in (**D**) European on the right and not in barefoot Africans (**B & C**) on the left. Again, the difference is artificial, not racial.

LATER AND RECENT EVIDENCE SUPPORTS FOOT AND SUBTALAR SUPINATION

These long overlooked effects of the coupling biomechanism strongly suggest that the modern shoes and their most unnatural feature – elevated shoe heels – cause an actual physical deviation in the modern foot. Using a large variety of measurement techniques, many subsequent studies, including the most recent, have provided general support for ankle inversion of **4° – 8°**, but crucially and incorrectly have assumed the inversion to be natural.

For example, roughly **6°** of calcaneal and rearfoot inversion of the calcaneus and foot is observable in a 2019 study using weightbearing cone beam computed tomography in current symptomatic National Basketball Association players. This heel inversion position is so commonly seen at the **Hospital for Special Surgery** in New York that it is officially characterized there as **'… a neutrally aligned hindfoot** and slightly increased foot arch', shown in **Figure 1E** *(Note: due to a recent revision, this Figure and some others are numerically out of order but intentionally so).*

The **4°-8°** of ankle inversion has been so well known for so long that in 1976 Dr. Steven Subotnick convinced the **Brooks** Shoe Company to use a **4°** varus wedge in what became for many years its top-rated Brooks Vantage running shoe (and still in widespread industry use today in the equivalent form of midsole density variations).

As illustrated (with exaggerated angle) on the left in **FIGURE 1D**, the varus wedge puts the subtalar joint into a neutral position so that the calcaneus is aligned with the talus and tibia. Without the varus wedge, as shown on the right in **FIGURE 1D**, the subtalar joint is forced to pronate **4°** unnaturally in order for the calcaneus to align with the level supporting surface below it, and the subtalar joint is thereby left in the inherently unstable position, subject to unnaturally excessive pronation because of the **4°** angle of the bodyweight load acting on it.

Unfortunately, the varus wedge maintains the heel, ankle, and lower leg in an artificial varus position caused by elevated shoe heels, instead of in a naturally stable vertical position, which is the leg position of barefoot runners who have never worn shoes, as we shall soon see.

Ironically, the varus wedge approach has always been used as an add-on with conventional modern athletic shoes with elevated heels. So, both the treatment and its immediate cause are combined into the same basic shoe design! The standard varus wedge is therefore a classic example of treating the symptom – ankle inversion – instead of its actual cause – the elevated shoe heel – which results in a treatment that does not work well.

Besides the **4°-8°** ankle inversion, other studies have noted a correlation between shoe heel height and ankle joint inversion (and/or foot supination). However, they have completely missed the pivotal role of unsuspected shoe heel-induced subtalar joint supination as the cause of the observed ankle inversion, because the motion of the subtalar joint during running has been invisible, until now.

POWERFUL CONFIRMING EVIDENCE FOR SUBTALAR SUPINATION FROM A NEW GOLD STANDARD IN JOINT MOTION MEASUREMENT

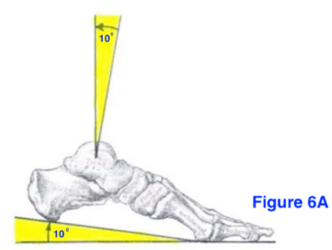
Now, for the first time, truly accurate measurements of the subtalar and ankle joints during running have been made in a study **(Peltz et al., 2014**) that used new gold standard 3D radiographic and computer modeling techniques. The new measurements make all previous measurements using older, less precise techniques obsolete due to their relative inaccuracy, so grossly wrong in fact as to be highly misleading, particularly relative to the subtalar joint. What has long been thought to be a subtalar joint pronation problem is actually a supination problem.

Consequently, the new results are startlingly unexpected, the opposite of the previous scientific understanding, which was that pronation of the subtalar joint and eversion of the ankle joint predominated at peak load during running midstance. Instead, **both subtalar and ankle joints were found to be substantially supinated at midstance during running, with an extraordinary combined total of about <u>8° of inversion and 20° of external rotation at peak load of 3 times bodyweight</u>**. The subtalar joint provides about 5-6° of the inversion and the ankle joint provides about 12° of the external rotation.

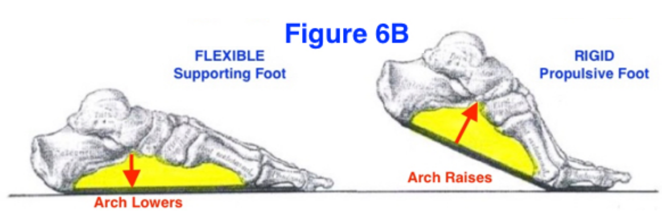
Given this strong evidence firmly based on a gold standard peer-reviewed study confirming my discovery of shoe sole-induced foot supination, what might be its anatomic effects? The best way to understand those effects is first to look more closely at the elevated shoe heel-induced supination of the subtalar joint and how it operates biomechanically.

ELEVATED SHOE HEEL-INDUCED SUBTALAR SUPINATION: HOW IT OPERATES

It is obvious, of course, if the shoe heel moves the foot heel up by, say 10°, the front of the foot is tilted down automatically by 10° into what is called technically a plantarflexed position of the ankle joint **(FIGURE 6A)**.



The hidden effect of the abnormal plantarflexed position is that it activates a well-known **windlass mechanism** of the foot, which normally converts the flexible supporting position of the foot on the ground into a rigid lever to propel the body forward in locomotion **(FIGURE 6B)**. The windlass mechanism automatically



externally rotates the position of the ankle bone (talus) on top of the calcaneus (heel), so that the ankle bone points to the outside.

The elevated shoe heel artificially forces the foot into the unnatural **supinated position** **(**front view of ankle and heel bone in **FIGURE 6C)** when it naturally should be flexibly supportive on the ground. That is an unfortunate and critical change. The automatic shoe heel-induced mechanism unnaturally points both the ankle joint and the lower leg to the outside, instead of straight ahead.

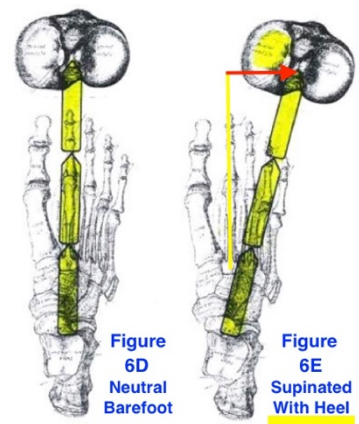
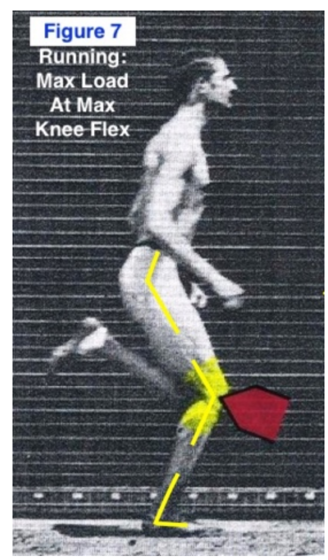


FIGURE 6D shows an overhead view of natural, unshod right foot bones and the natural, non-twisted right knee bone position pointed straight ahead in the flexed-knee midstance running position. The ankle joint is pointed straight ahead and the knee joint is flexed to absorb the maximum repetitive load of 3 times bodyweight, at the maximally loaded midstance position of **FIGURE 7**.

FIGURE 6E, in contrast, shows the unnatural, maximally loaded, twisted out right knee position caused by an elevated shoe heel when walking and especially running, at the same maximally loaded position of 3 times bodyweight shown in **FIGURE 7**.



The outwardly rotated ankle joint forces the knee to twist to the outside. **FIGURE 6E** also shows that the inside (medial) half of the knee joint abnormally carries most of that maximal load, an amount as great as 80-90% for some individuals, due to the tilting-out of the knee to the side.

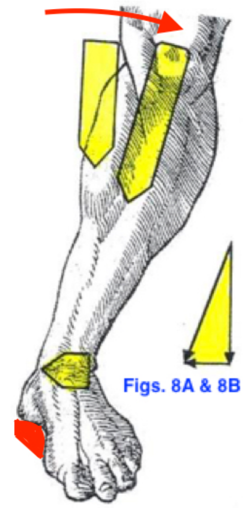
That hidden effect is relatively inconsequential when standing or walking, but, when running, the hidden effect is severely deformative. The reason the hidden shoe heel effect is so consequential when running is that the peak load of about 3 times bodyweight occurs at exactly the worst possible time: when knee, hip, and ankle joints are substantially flexed. **(FIGURE 7)**

MODERN RUNNERS' TWISTED AND TILTED-OUT LEGS ARE ARTIFICIALLY UNSTABLE

FIGURE 8A below shows a front prospective view of the tilted-out runner's leg shown previously in **FIGURE 6B**. Whereas the leg would be naturally stable if vertical, it is unavoidably unstable in the twisted and tilted-out position forced by an **elevated shoe heel**.

In terms of simple classical physics, this angled force vector of body weight carried by the runner's leg resolves into a vertical component vector and a horizontal component vector, as shown in **FIGURE 8B**. The horizontal component is critical, since it unnaturally forces the subtalar joint inward, thereby causing the foot to pronate inward unnaturally. If the runner's leg remained naturally vertical, there would be only a vertical force vector, with no horizontal component vector.

Remarkably, evidence indicates that **never-shod barefoot runners** **do not pronate** with each running stride because they have untilted, vertical legs, like the Bushman, Kim Phuc, and Zola Budd in **FIGURES 3A-C**, as well as the Bantus of South Africa in **FIGURE 1C**. Only runners exposed to longtime use of elevated shoe heels are forced to pronate unnaturally with every running stride!



A natural, vertical leg is inherently in equilibrium. The downward body weight force is balanced by a matching upward ground reaction force. In contrast, the unnatural shoe heel sets up a fundamental structural instability, as shown above in **FIGURES 8A&B**.

The lower leg shown in **Figures 8A & 8B** has an about 8° varus position that is almost constant throughout the stance phase of running. It creates an artificial horizontal force vector component of the ground reaction force (GRF) in the medial direction that powers compensating rearfoot eversion that would not be present in a vertical leg. This medial horizontal force component has been measured recently with a magnitude of slightly more than 2% of the GRF for 25 male runners (Zifchock, Parker, Wan, Neary, Song, and Hillstrom, 2019). The same study includes extraordinary evidence of a lateral horizontal force component with a magnitude of almost 4% of GRF, which is almost twice the magnitude of the medial force component.

There is no explanation for the source of such a lateral horizontal force component except as a direct effect of shoe heel-induced subtalar supination. It appears therefore to provide additional empirical confirmation of that artificial coupling.

The artificial cause: supination. In summary, as shown in **FIGURES 6B**, the elevated shoe heel unnaturally forces the knee to tilt outward in the frontal plane into an abnormal bow-legged position. As a result, the ankle joint is unnaturally de-stabilized. The full body weight load acting on the ankle joint is tilted into an unnatural angle, rather than remaining vertical, which would be naturally stable. This is the **action**.

The unnatural effect: pronation. Simultaneously, in compensation to the abnormal bow-legged position, the ankle is unnaturally forced inward by an unstable horizontal force vector resulting from the tilted lower leg, resulting in unnatural pronation, as shown in **FIGURES 8A&B**. This is the **reaction**.

Simply put, **the artificially supinated foot creates a unnatural horizontal force on the subtalar joint that causes the foot to pronate artificially in reaction.**

Where the action and reaction forces balance in equilibrium for each leg of any given individual is dependent on that individual's sex and personal history of shoe heel use, as well as subtalar joint genetics. Some individuals become supinators, others find a neutral equilibrium, and others become pronators. The simultaneous dual interaction of action and reaction is **strictly biomechanical**. It is an automatic and unavoidable action and reaction, both unnatural and artificially caused by elevated shoe heels.

The repetitive peak joint loading of 3 times bodyweight occurs just when the maximal abnormal knee, hip and ankle joint bending shown in **FIGURE 7** occurs, while also unnaturally rotated to the outside by elevated shoe heels. That directly results in a closed chain of structural misalignments throughout the modern human body, artificially deforming all of it from natural to abnormal.

The unnatural deforming occurs as prescribed by **Wolff's Law**, which requires that bone is remodeled by the maximum loads to which it is subjected. Similarly, the soft tissues of all of the joints – the ligaments, cartilage, tendons, and fascia – also are remodeled by the maximum stresses to which they are subjected by **Davis' Law**.

THE EFFECT OF UNNATURAL SUBTALAR SUPINATION ON THE ANKLE JOINT

The shoe heel-induced inversion of **8°** and external rotation of **20°** the modern ankle joint automatically twists the ankle bone (the bottom of the ankle joint) against the tibia/fibula combination (the top of the ankle joint) . The modern (left) ankle bone shown in **FIGURE 10B & 10C** shows an enlargement caused by the unnatural rotary motion, as well as a resulting lateral side angled enlargement, when compared to a natural ancient barefoot Egyptian (left) ankle bone or Anglo-Saxon (right) ankle bone shown in **FIGURE 10A & 10C1.**
The barefoot ankle operates like a section of a pulley or wheel to efficiently perform its basic simple hinge function.

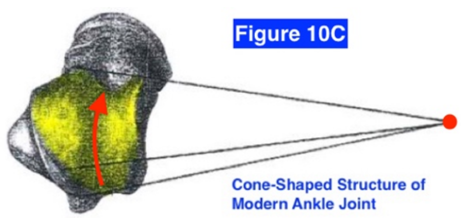
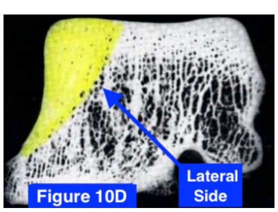
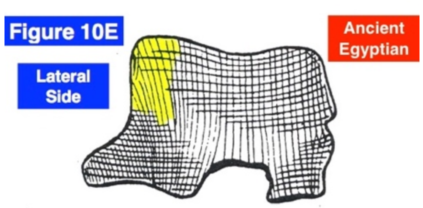


FIGURE 10C shows more definitively the well-known but unnatural rotary structure built into the **modern elevated shoe heel wearing Englishman**'s (left) ankle joint (ankle joint trochlear surfaces highlighted in yellow). The **8°** outward tilted tibia causes the modern (left) ankle's ligaments to loosen on one side of the joint, allowing motion, and tighten on the other side, creating a relatively fixed center of rotation. Based on the governing simple geometry, the lateral side on the modern ankle joint become looser and the medial side becomes more fixed, resulting in the rotary joint structure shown in **FIGURE 10C.**

In marked contrast, the right ankle joint of an **ancient barefoot Anglo-Saxon** of **FIGURE 10C1** shows no rotary structure compared to that of a modern Englishman in **FIGURE 10C**, and has a medial side that is just as long as the lateral side.





Showing the arrangement of the lamellæ in a trans-section through the corpus.

As a result, the anterior **lateral** side of the **modern talus**' trochlear joint surface develops a <u>much more dense</u> network of underlying trabeculae, shown highlighted in yellow in **FIGURE 10D**, in a coronal plane cross-section of the anterior joint surface that is load-bearing in the dorsiflexed ankle joint under peak load during running, as shown in **FIGURE 7.**

In contrast, as shown highlighted in **FIGURE 10E**, **the ancient Egyptian talus shows the <u>opposite</u>** structure – a <u>much less dense</u> trabecular network on the lateral side. In fact, the much greater density in the trabecular network of the **medial** side indicates that the medial side is the dominant load-bearing side of the natural Egyptian talus.

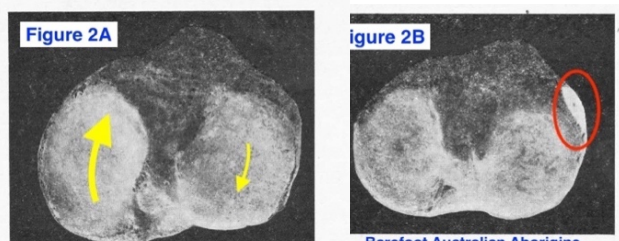
Those significant bone and ligament changes can be remodeled only slowly over a considerable period of time, if at all, and therefore may be the underlying physical reality upon which are based on the 'preferred movement path,' a concept developed by biomechanics scientist Benno Nigg. That path may be structurally locked-in by bone remodeling over a lifetime, so that, for example, the typical shod tibia is externally rotated about 20° relative to the calcaneus throughout running stance, as observed in the Peltz study.

If so, this would largely explain why the popular conversion to barefoot running and minimalist shoes during the past decade has not apparently produced the performance and injury-avoidance advantages expected by most of the runners who experimented with conversion. It would also largely explain the success of Kenyan and Ethiopian runners who grew up running barefoot throughout childhood and adolescence, and therefore probably would have much less bone remodeling even after converting later in life to running in shoes, as do all elite runners today.

THE EFFECT OF THE UNNATURAL SUBTALAR SUPINATION ON THE KNEE JOINT

Since their motion is coupled, the shoe heel-induced inversion of **8°** and external rotation of **20°** the modern ankle joint automatically twists the lower leg unnaturally to the outside about **20°** during running.

The shoe heel-induced **20°** outward twisting of the **modern knee joint** creates an unnatural rotary torsion that is directly built into the abnormal bone structure of the modern tibia **(FIGURE 2A)**, enlarging and weakening either or both knees, promoting arthritis and otherwise avoidable patellar, ligament and meniscus damage.



Shoe-Wearing European
Barefoot Australian Aborigine

In contrast, the rarely injured **natural barefoot knee (FIGURE 2B)** of non-shoe wearers regardless of the diversity of their genetic background has a smaller, simpler structure, with no abnormal rotary motion built into it and with much stronger ligament attachments (iliotibial tract, circled in **red**).

Similar tibia samples from **barefoot Caucasian populations in India (FIGURE 2C)**, show the same simple, non-rotary articular surface structure as the barefoot Australian Aborigine of (**FIGURE 2B**).

In addition, an **ancient Roman** tibia **(FIGURE 2D)** shows the same simple, non-rotary surface structure as the barefoot Australian and Indians.

The asymmetrically twisted and malformed menisci highlight the abnormality of the modern knee and its cartilage. The medial meniscus is pushed far forward and the lateral meniscus backward **(FIGURE 2E)**, unlike those of a barefoot knee. The outward tilted tibia causes the knee ligaments to loosen on one side of the joint, allowing motion, and tighten on the other side, creating a relatively fixed center of rotation.

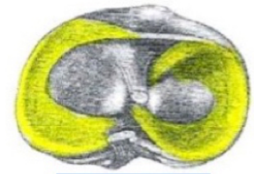


Figure 2E
Modern Knee Joint

THE OVERALL EFFECT OF THE UNNATURAL SUPINATION ON THE HUMAN BODY

It is already well-established in evolutionary terms that the human body was born to run. In terms of the evolution-in-reverse in operation today, the artificial conversion of the modern human body from natural to abnormal, with a twisted and deformed bone structure built by aberrant rotary torsion, occurs during running with elevated shoe heels. Astonishingly, the effect of the **8°** outward tilt and **20°** outward twist of the ankle cascades throughout the entire modern human body, slowly deforming and destabilizing every part of it.

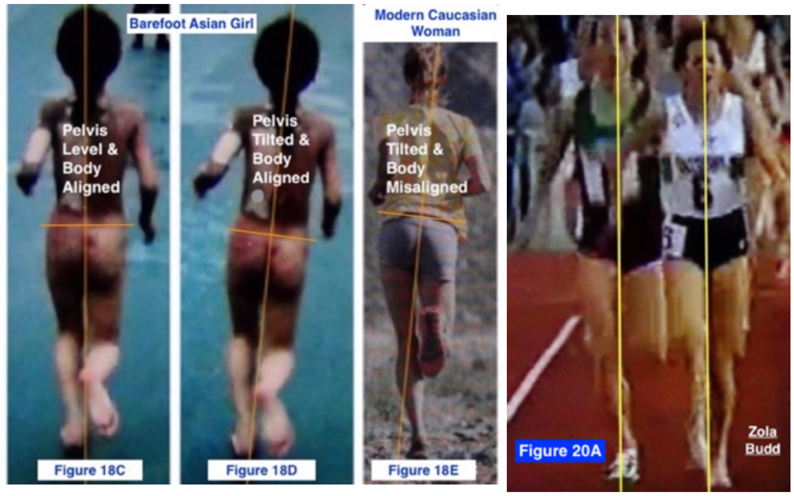
As previously noted, that is because the artificial tilt and twist occurs during running, when the highest repetitive forces in the human body are experienced. That pounding, highly repetitive load of about 3 times bodyweight controls bone growth and joint formation during the critical childhood and adolescence growth phases, a time when running occurs frequently – all as dictated by Wolff's Law on bone growth.

An **African Bushman (FIGURE 3A)** who grew up barefoot has a typical **natural body structure**: symmetrical with straight legs and level pelvis when running, with no leg crossover and well-defined spine, as well as minimal supination or pronation. Other photographic evidence indicates that **Asians** and **Caucasians** who had not worn conventional modern shoes**,** such as **Kim Phuc** as a child **(FIGURE 18C&D)** and **Zola Budd** as a young adult **(FIGURE 20A)**, have the same typical natural body structure.

In contrast, the typical modern body of a **shod Finnish marathoner (FIGURE 3B)**, who doubtless grew up wearing modern shoes, is **unnaturally deformed: his legs and torso are both tilted and twisted away from a vertical centerline.**

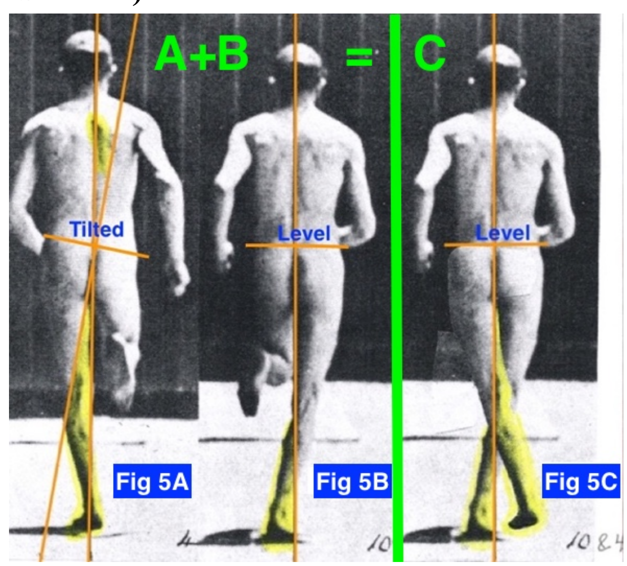
His support leg is bent-out into a bow-legged position by his shoe heel-induced supinated feet, and he has a twisted pelvis and bent-out spine with shallow definition, with unnatural thoracic torsion abnormally distorting the chest and subjecting the heart to unusual repetitive pressure, thereby promoting heart disease. The neck and head of the **Finn** are tilted-**in** to counterbalance his tilted-**out** spine, so it is even possible to speculate that, just like the modern knee, the modern human brain itself is tilted and twisted in an artificial structural reaction to unnatural rotary torsion caused by shoe heels.

Even the most elite modern athletes, like **Roger Bannister** breaking the 4-minute mile barrier **(FIGURE 4)**, demonstrate the same misaligned and deformed body structure under the duress of maximum effort, in contrast to upright and aligned structure of the **barefoot Bushman** of **FIGURE 3A** and of **Kim Phuc (FIGURE 18C&D)** or **Zola Budd (FIGURE 20A)** (both shown beside modern Western shoe-wearing female runners).



THE EFFECT OF ARTIFICIAL SUBTALAR JOINT SUPPINATION ON THE HIP JOINT

During running, at the point of maximum load of about 3 times body weight, the effect of modern shoe-supinated feet is to automatically tilt both left and right legs unnaturally inward, crossing over the centerline of the body. **(FIGURES 5 A+B)**



Consequently, **a modern runner's pelvis is forced to <u>tilt down</u> abnormally (FIGURE 5A)** on at least one side to prevent the feet and legs from crossing over the body's centerline and thereby colliding directly into each other. Otherwise, if a modern runner's **pelvis is <u>artificially kept leveled</u> (FIGURE 5C), instead of tilted**, his maximally flexed and loaded legs become so criss-crossed that running would be impossible.

That theoretical level pelvis position **(FIGURE 5C)** shows the true relative position of the hip joints between both the pelvis and the legs <u>at peak load</u> when running, the position in which those lower extremity joints are all unnaturally deformed by that peak load.

The absurdly unnatural crossed-leg position deforms the bone structure of the hip joints, bending it into an abnormally adducted position, which weakens the hip and restricts its natural range of motion, promoting fractures. The neck of the femur is also unnaturally deformed and weakened, bending into an abnormal position in both the frontal and transverse planes. The pelvis itself is deformed because of the unnatural outward horizontal force component at the hip joint created by the abnormal bent-in position of the legs, making the pelvis wider and flatter, thereby reducing the birth canal width.

Again, supporting evidence comes from published and unpublished data from a prize-winning study by Dr. Steven Willwacher. The standing hip angle for 222 test male and female test subjects was **2° to 3° of outward tilt** (abduction) of the leg.

However, at the very beginning of the stance phase of running, the initial hip angle immediately became **8° to 10° of inward tilt** (adduction). This is an amazing change, the total the hip angle increasing by a full **11° to 12° of inward tilt**, a dramatically abrupt difference in the transition from standing to running on the support leg.

Even more extraordinary is the fact that **at peak load midstance, the hip inward tilt (adduction) angle for females climbed to 17° and to 14° for males**. From standing to peak load, the total hip angle inward tilt or adduction change when running is **19°** for females and **17°** for males. In stark contrast, for the typical never-shod barefoot runners shown in **FIGURES 3A-C**, the support leg is almost **vertical!** The huge angular difference would seem to indicate that modern hips are abnormally structured, thereby explaining why hip fractures are so common in modern medicine.

An obvious question arises. What causes both legs to be bent-**in** so far from their natural vertical position? The answer, which at first sounds more confusing than helpful, is that both legs actually are being bent-**out** unnaturally by both ankle joints, as we have seen earlier.

The observed bent-**in** position of both legs is because both legs are anchored to the body at the hip joint, but obviously are not anchored at the ground, so the counterintuitive answer is: the legs – that are abnormally bent-**out** by the moveable ankles – are **in direct reaction** forcibly bent-**in** by the relatively unmovable hip joints (which are fixed in the frontal plane by the inertia of the torso's mass).

THE EXTREME RIGHT/LEFT ASYMMETRY OF THE MODERN HUMAN BODY

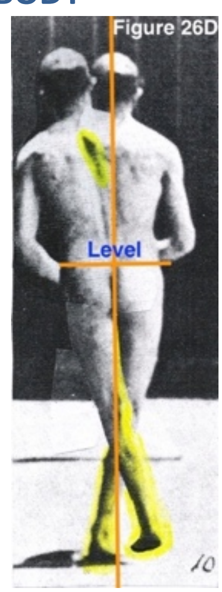


FIGURE 5C & 26D shows the asymmetrical position of the right and left legs in the **FIGURE 7** position of peak load of 3 times bodyweight at midstance. In the past, virtually all biomechanical studies of the lower extremity during running tested only one leg (and usually only one or two parts of the leg), but a precedent-breaking 2017 study by Radzak at al. specifically collected data on both right and left legs to evaluate asymmetry during running. The differences found were astounding.

The range of motion for the average **left** ankle of runners was everted (roughly like pronation) about **32°** and inverted (like supination) only about **3°**. In contrast, the **right** ankle everted about **16°** and inverted about **12°**. Most runners, in other words, when running do nothing except pronate with their left foot, but pronate and supinate almost equally with their right foot. That is an extraordinary imbalance, and yet one that was already evident over three decades ago in a study by Peter Cavanagh, a leading pioneer of modern running research.

Even so, right/left imbalance is missed in virtually all existing peer-reviewed running studies, even the best, which not only fail to measure simultaneously all the joints of both legs, but also omit all the other major parts of the human body, like the pelvis, spine (lumbar, thoracic, and cervical), and head, so the obvious structural problems of the Finnish marathoner of **FIGURE 3B** are never measured in a biomechanics lab. As a result, all existing peer reviewed running studies could almost be characterized as a parody of the blind men describing an elephant based on each man separately touching only the elephant's trunk or ear or leg or tail and thus having wildly different ideas of what must be an elephant.

OTHER CRITICAL OMISSIONS IN EXISTING PEER-REVIEWED RUNNING STUDIES

Moreover, none of the existing studies have taken into account the artificial effect of shoe heel-induced subtalar joint supination. Without controlling for that important variable, test results have become incomprehensible, and have resulted in contradictory results that cannot be resolved, like the unexplained "decoupling" issue of tibia and ankle joint motion during running, for example. However, if the missing effect of artificial subtalar joint supination is taken into account, the decoupling problem can be logically explained.

Unfortunately, neither of these is the greatest problem with existing peer-reviewed running studies. Incredibly, none of them meet the single most basic requirement of scientific validity: randomly selected test subjects. Instead, most select a small number of recreational or competitive runners who have not been injured for a significant period, like three or six months – which is a highly select group that is not at all characteristic of the general population of such active runners, which itself is a highly select group not at all characteristic of the general modern population, the vast majority of which are not active runners.

Worse still, only modern runners who have habitually worn shoes throughout their lives have been tested in modern biomechanical labs, so only human bodies that likely have been permanently affected by shoe heel-induced supination are ever evaluated. Not a single never-shod barefoot runner has ever been measured in the critical frontal and horizontal planes to measure their joint motion, particularly that of subtalar and ankle joints.

In addition to those glaring omissions, most peer-reviewed studies that test runners wearing footwear do not even identify that footwear, which of course varies widely in sole structure and material that would be expected to affect test results. In the exceptional cases where the tested footwear is identified, only the shoe model is identified, occasionally with one particular structural or material characteristic identified, but ignoring all others.

So, the critically important testing variables of shoe sole structure and material are entirely overlooked. Given that the foot and ankle form the foundation of the entire human body above it, this is a striking omission! Compare that omission to architecture, where the structure and material of foundations are treated as absolutely critical.

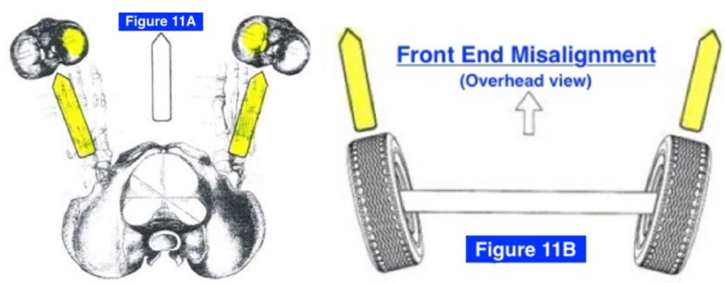
A related comparison is even more glaring. Over 60 architectural programs exist in U. S. universities alone and almost 700 worldwide. There are not a single such academic program on footwear structure and materials anywhere. Entirely missing also is any footwear sole equivalent to the credentialing, licensing, building codes, and inspection that carefully controls every architectural structure, from modest houses to the tallest skyscapers.

The fundamental issue underlying all of these problems is an appalling lack of biomechanical research funding. Relative to each dollar invested in other important fields of science like astronomy, particle physics or brain research, for example, less than a penny is spent on biomechanics research. Not a single biomechanics lab currently exists anywhere (not even in the largest footwear companies) with anything like what is necessary to produce valid running studies sufficient to take even the first steps necessary to address the anatomical and medical catastrophe caused by elevated shoe heels.

The athletic footwear companies have focused their resources on marketing performance and elite athletes, not injury avoidance, and spend almost nothing on basic research. Moreover, any role they might potentially play in basic research is subject to an unavoidable conflict of interest. Almost all of the research they currently do is directly related to product development and is done secret.

THE UNNATURAL FRONT END MISALIGNMENT OF THE HIP JOINTS

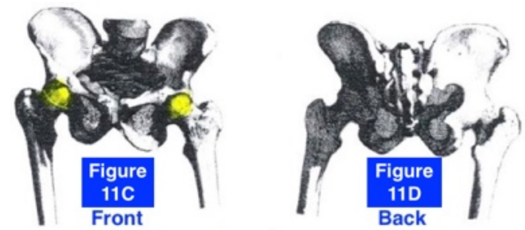
Besides tilting each leg to the outside in the frontal plane, as shown previously in **FIGURES 8A&B**, the shoe heel-induced subtalar joint supination externally rotates the ankle bone 20° in the horizontal plane, and that unnatural ankle misalignment causes both legs to be pointed to the outside, inside of straight ahead, as shown in an overhead view in **FIGURE 11A**. The knee of the right leg is at an extraordinary angle of about 40° from the knee of the left leg, instead of being parallel to it.



This outward rotation (and an 8° outward tilt) is directly analogous to the front end misalignment of an automobile **(FIGURE 11B)**, which quickly results in breakdown or accident. Only the incredible robustness of the human body, honed by the untold years of evolutionary improvement of bipedal locomotion evident even in the famous 3.2 million year old Lucy fossil, is capable of masking the misalignment problem by making the human body breakdown so gradual and spread throughout the entire body that its cause appears to be natural aging.

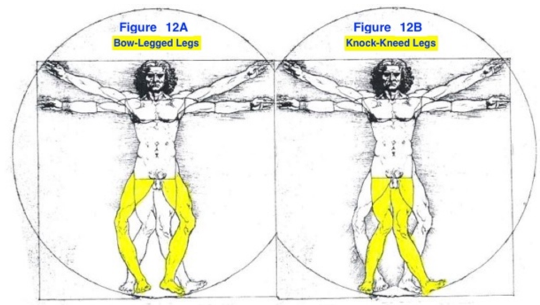
Nevertheless, the abnormal breakdown is substantial over time, with the worst effect being the drastic increase in right/left asymmetry discussed earlier that is necessary simply to more the human body forward in a relatively straight line, rather than see-sawing left and right like an ice skater. As Cavanagh found, one leg becomes dominantly propulsive, while the other becomes dominantly supportive, each with different ranges of ankle, knee, and hip joint motion.

The effect of the front end misalignment on the hip joints is seen in the excessive exposure of the femoral heads, which are outwardly rotated almost out of the hip sockets when standing, shown in a front view in **FIGURE 11C**, demonstrating how unnatural their position is relative to the rear view shown in **FIGURE 11D**, where the femoral heads are completely covered and located abnormally deep within the hip sockets. The result is a highly fragile modern hip joint, prone to unnatural fracture and osteoarthritis. It should be noted that the human body is optimized to deal with peak running loads, so in the **FIGURE 7** position, the femoral heads are better seated in their sockets.



UNNATURALLY EXAGGERATED DIFFERENCES BETWEEN MALE AND FEMALE

Modern **male feet tend to become fixed in the supination position** in reaction to elevated shoe heels. Most modern **men tend to become bow-legged**, as shown above in **FIGURE 12A**, often with a noticeable knee bending motion to the outside when flexed during locomotion. This abnormal condition, called varus knee thrust, weakens their legs.



Although females also tend to supinate first in reaction to generally higher heels, modern **female feet are then generally forced into excessive pronation**, in reaction to the greater imbalance of forces generated by the higher elevated shoe heels. Most **females tend to become the opposite, knock-kneed**, as shown in **FIGURE 12B**. Women primarily experience this opposite effect because of their frequent use of much higher heels, their wider pelvis (due to relatively shorter thigh bones), and their greater joint flexibility – all of which cause their legs to rotate inward under peak load.

THE ILLIOTIBIAL TRACT ROTATES THE MALE PELVIS BACKWARDS AND FEMALE PELVIS FORWARDS

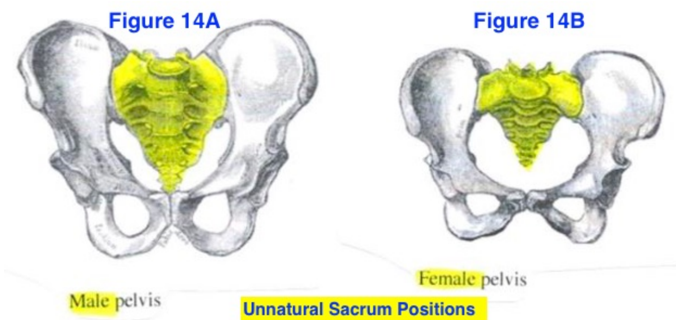
The iliotibial tract is a long ligament connecting the iliac crest of the pelvis to the top of the tibia. It plays a little known but critical role in unnaturally exaggerating the difference between male and female body structures. When the foot supinates, the iliotibial tract forces the pelvis to rotate backwards (in the sagittal plane) when the tibia rotates outward in reaction to the foot supination, including the characteristic supinated foot position of modern males caused by moderately elevated shoe heels.

Conversely, when the foot pronates, the illiotibial tract forces the pelvis to rotate forward (in the sagittal plane) when the tibia rotates inward in reaction to the foot pronation, including the characteristic pronated foot position of modern females caused by higher elevated shoe heels.

The modern **male pelvis** is typically flattened and automatically **rotated backward**, as shown in **FIGURE 13B**, because of its mechanical connection to the outward twisted knee by the critical illiotibial tract. That rotation flattens the male lower back and male butt, and softens the belly, as well as abnormally increasing the thoracic and cervical spinal curves.

The modern **female pelvis** is also typically first flattened in the same way, but then the female pelvis **rotated forward** in additional compensation, as shown above in **FIGURE 13C**. This rotation results in an excessive rounding of the female lower back and butt, as well as thoracic and cervical spinal curves, and makes pregnancy and childbirth unnaturally difficult.

THE SACRUM BASE OF THE LUMBAR SPINE IS TILTED UNNATURALLY BACKWARD IN MALES AND FORWARD IN FEMALES



In **FIGURES 14 A&B**, the sacrum (in yellow) is the base that supports and positions the spine and therefore all parts of the body above the pelvis. The sacrum is rotated abnormally backwards in the modern male figure (on left in **FIGURE 13B**) and abnormally forward in the modern female (on right in **FIGURE 13C**). The sacrum of each gender is in a different and unnatural position to provide direct support the spine above it. Asymmetrical bilateral tilting shown in **FIGURES 5A-C & 26D** also alters the natural structure of the modern pelvis.

The unnaturally different supporting positions of the sacrum force the curvature of the spine typically to decrease in modern **men**, shown in **FIGURE 15B**, and make the abnormal modern male spine inherently less flexible.

In modern **women**, in contrast, the abnormal curvature of the spine is typically increased, as shown in **FIGURE 15A**, and make it structurally more flexible. Note the drastically different sacroiliac joints (in yellow), which join the sacrum to the ilium of the pelvis. The sacroiliac joints are infamous as sites of intractable (and unnatural) pain.

In addition, the unnatural asymmetrical mismatch in pelvic position and abnormal pelvic functional ability reduce sexual performance, satisfaction, and fertility for both modern males and females. **FIGURE 15C** illustrates an extreme example of the effect of pelvic asymmetry on modern male genitalia. Equivalent female asymmetries exist as well, although in an inherently subtler way, and of course the female breasts are often less than perfectly matched.

THE BIRTH CANAL OF THE FEMALE PELVIS IS FLATTENED DANGEROUSLY

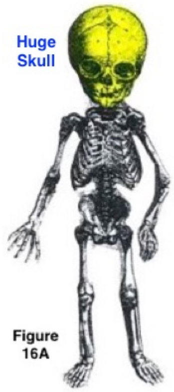
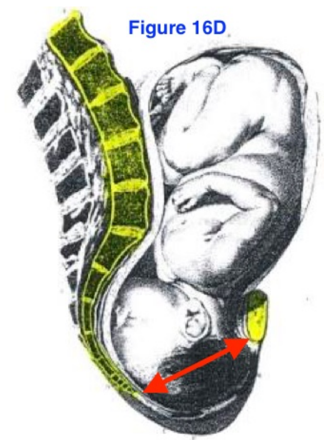


Figure 16A

In human childbirth, the primary cause of maternal distress is the size and shape of the **baby's head** relative to the modern mother's pelvic opening. 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 that it makes the skeleton look as if it must belong to a space alien with an enormous brain (**FIGURE 16A)**.

The **female pelvic brim** and the fetus's relatively huge skull are about the same size. In humans, therefore, the fit is much tighter than in other primates. Mother and fetus are also mismatched in shape. The fetus must enter the birth canal sideways, and then make a difficult 90° turn, all because of the **unnaturally flattened, misshapen brim and pelvis** of the modern mother **(FIGURE 16C).**

Figure 16D


The head of the fetus has somewhat flexible sutures within the bone of the skull that help the fetus squeeze through the birth canal, as seen in **FIGURE 16D**. That inherently difficult birth passage, however, exposes the fetus's brain to enormous trauma. The fetus brain is subjected to real danger with potentially permanent consequences.

The unnatural asymmetry of the mother's body, moreover, can affect the fetus's placement in the womb during its nine-month development period, as shown in **FIGURE 16E**. The most typical position of the fetus within the womb is unnaturally asymmetrical, for example, abnormally affecting its development, both before and after birth.

The word "pelvis" is Latin for basin, as shown in **FIGURE 16F**. In the human body, that basin is piled high with our internal organs, as seen in **FIGURE 16G**.

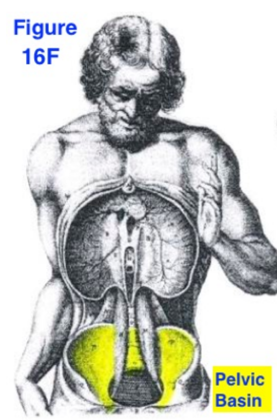
Figure 16F


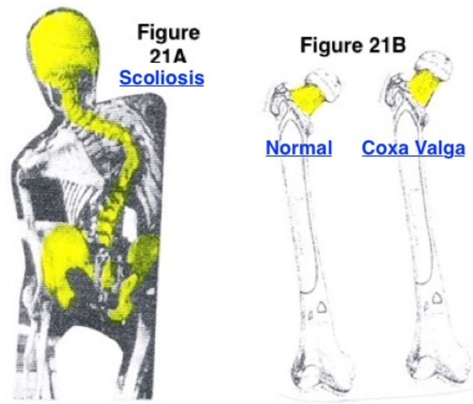
Figure 16G


When humans tilt that basin into an abnormal backwards or forwards orientation, it would logically 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, hemorrhoids, and incontinence are likely direct effects of the abnormal position of the digestive system. Sexual organs are similarly displaced and thereby subject to unnatural dysfunction.

This unnatural pelvic tilt is likely to affect adversely all of the other internal systems either contained by and/or supported by the pelvis. The other major and minor organs have a multitude of interconnections and interactions that are amazingly complicated and often quite delicate. The function of the interdependent systems of these organs is likely to be degraded in approximate proportion to the degree of abnormal pelvic tilting.

THE TWISTED SPINE OF THE MODERN RUNNER: A MILD VERSION OF SCOLIOSIS

The functionally twisted skeletal structure of the modern runner shown above in **FIGURES 3B, 5C & 26D** shows the early stages of the same kind of structural deformities that are found in a more exaggerated form in a disease called scoliosis, shown in the photograph of **FIGURE 21A**.



Scoliosis, in fact, provides an extreme case for what passes as "normal" in the abnormal modern human body. The twisting effect of shoe heels creates in most modern bodies a moderate version of unnatural asymmetrical spine twisting as scoliois. The twisted spine is so common as to be "normal" in adolescents, with about half having a 5% to 10% thoracic curve even when young and only 19% of non-scoliotic children had level shoulders. The widespread epidemic of back pain is the direct result of an unnaturally asymmetric spine. This condition affecting nearly 30% of all U.S. adults each year

In addition, scoliosis is associated with the femur neck inclination known as coxa valga. Coxa valga is a condition in which the angle of the femur neck is greater than 125 degrees, seen on the coxa valga femur in **FIGURE 21B**. Coxa valga is associated with hip adduction. Scoliosis is linked to hip adduction too, like the abnormally exaggerated hip adduction in running shown in **FIGURES 5A-C**.

UNNATURAL PELVIC TILT IS THE ONLY SOLUTION TO THE IMMOBILITY PROBLEM CAUSED BY SEVERE LEG CROSSOVER

The bizarre X-shaped legs situation shown in the **FIGURES 5C & 26D** photographs directly above is summarized in the drawings of **FIGURE 18A**. The mechanical action of shoe heels tilts inward both legs so acutely that they actually cross over each other (as shown in line drawing on the **left** of **FIGURE 18A**). For the human body to move forward without tripping over its own legs, at least one side of the pelvis must tilt down, so the feet no longer cross over (as shown in line drawing on the **right** of **FIGURE 18A**). The functionally short leg is loadbearing and the longer leg is non-loadbearing. This abnormal pelvic tilting enables forward motion and makes the legs more vertical.

In the photographs of **FIGURES 5A&B**, the running male demonstrates this typical pelvic compensation. To move forward, the runner's left pelvis tilts down, and this pelvic tilt effectively reduces the inward tilt of his left leg. The runner's right leg tilts in more and crosses over, under his center of gravity, while his pelvis remains level. This runner illustrates the most common male resolution to the major structural misalignment.

These correlations suggest the strong possibility that running with shoe heels is the underlying cause of scoliosis for those predisposed to the illness, predominately women, whose hips generally adduct more in conjunction with greater pelvic tilt, as shown in **FIGURE 18B**. The result is abnormal hips more prone to fracture.

Finally, the blind are not able to run and do not typically get scoliosis (or at least did not during the period before guide runners became an option).

THE TWISTED POSTURE OF MODERN RUNNERS LOOKS LIKE THE ELDERLY

Although severe scoliosis is relatively rare, aging effects posture in a similar way because of the long-term damaging effects of shoe heels. See FIGURES 22 A&B and note particularly the typically crossed legs shown in FIGURES 5C & 26D that are obviously a direct effect of shoe heel-induced supination and the resulting knee cant that was discussed earlier relative to FIGURES 8A & 3B.

MOST GENETIC DIFFERENCES ARE MINOR BUT EXAGGERATED BY SHOE HEELS

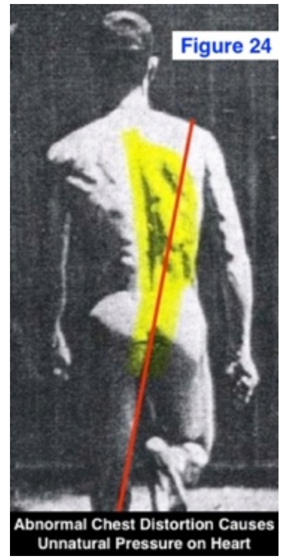
In the unique example below, the same individual Caucasian male demonstrates that a simple surgical **realignment** of his legs from **knock-kneed** with well-developed vastus lateralis thigh muscle **FIGURE 23A** (an alignment more typically found in those of African descent with lower longitudinal foot arches or pronated feet) to **bow-legged** with reliance on vastus medialis thigh muscle **FIGURE 23B** (an alignment more typically found in those of Caucasian descent with higher longitudinal foot arches or supinated feet).

The only true genetic difference between the two is an otherwise inconsequential difference in foot longitudinal arch height, but that otherwise almost undetectable genetic distinction is made unnaturally exaggerated by elevated shoe heels.

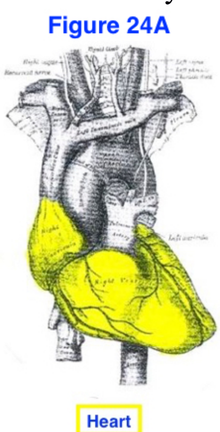
THE FIRST STAGE OF HEART DISEASE?

Running gives an early start to the misalignment deformities that we develop more fully in old age. The torsional distortions in the chest area are often substantial, as seen in **FIGURE 24**, and they likely create unnatural pressure on the modern heart and eventually heart disease. Similarly, the stooped chest posture of the elderly, as seen in **FIGURE 22B**, and the increased thoracic spinal curves of men and women, as seen in **FIGURES 13B&C**, also are unnatural distortions that produce abnormally increased pressure on the modern heart.

The distortions in bone and muscle appear to be much greater on the right side. The focus of the distortions on the right side may generally protect the left side-oriented heart. Because the pelvis is tilts down substantially to the right, the spine is actually curved far to the left side relative to the pelvis, as seen in **FIGURE 24**. Previous **FIGURES 3B & 5A** show the same unnatural chest distortion and pelvic tilt. Like **FIGURE 24**, it demonstrates substantial pelvic tilt, which increases the extent of overall structural abnormality, particularly in the thoracic region.



As a result, the abnormal torque and excessive pressure may focus directly on the modern heart, creating abnormally high pressure on the heart, with its highly complex and delicate plumbing network of valves and arteries, as seen in **FIGURE 24A**. That pressure unnaturally distorts and stresses the modern heart, especially at the midstance in the running stride when the body is subjected to a peak multiple of body weight.



A recent study has indicated that men who can do many pushups are protected against heart disease, apparently because the well-developed chest muscles required to do so counteract the asymmetrical breakdown seen in **Figure 24**.

THE TILTED AND TWISTED MODERN HEAD

The body part most unexpectedly affected by elevated shoe heels could be the human organ farthest away from the heels: the human head. The motion of the head while running with shoe heels exaggerates all the abnormally asymmetrical motions of the unnatural body beneath it.

In effect, the skull is tip of a skeletal whip in which the subtalar joint is the handle controlling abnormal motion. The natural stability system of the human neck – its highly complex structure of muscles, tendons, and ligaments, including its unique nuchal ligament – are overpowered by the excessive instability of the supporting body below it.

Instead of normal jiggling head motion that can be naturally dampened, the modern head is forced into gyrations that cannot be voluntarily controlled. Instead of a natural position, which would be vertical and forward-facing, the modern skull and the brain within it are twisted abnormally even in the most elite modern athletes in all three planes of motion **(FIGURE 26A)**.

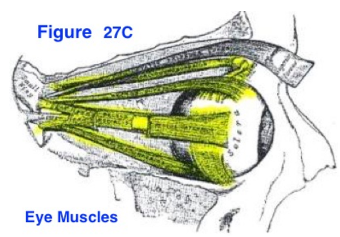
Famous photos of Jim Ryun **(FIGURE 26B)** and Roger Bannister **(FIGURE 26C)** setting world records in the mile both indicate abnormal, intensely twisted head motion. While these head motions may be extreme but only the occasional result of intense effort, they are actually just exaggerated examples of continuous everyday abnormal motion that has become embedded over time. In somewhat reduced form, the unnatural tilting and twisting motion recurs repetitively on a routine basis throughout modern human life, especially in the early, formative years.

As **FIGURE 27B** demonstrates, the asymmetrical position of the modern cervical vertebrae - bowing out to the right to compensate for the leftward tilt of the thoracic spine - becomes quite evident even when the body remains at rest in a stationary position. In addition, arterial hyper-development on the right side appears to be abnormal, potentially indicative of eventual future stroke. And **FIGURE 27B** is just a typical example taken at random of modern neck structure.

VISION & OTHER PROBLEMS IN THE TILTED AND TWISTED HEAD

Vision issues may help us understand the unnatural deficiencies inside the modern skull. The most common modern vision problem is near-sightedness (myopia), a condition results from an abnormal elongation of the eye. The modern skull is typically bent backwards by the unnaturally excessive curve of the cervical spine. As a result, the force of gravity is directed more toward the rear of the skull, which will increase pressure on the back of the eye. That unnatural pressure over time gradually tends to lengthen the eye (and continues over time), thus moving the retina at the back of the eye backwards and rendering it increasingly out of focus.

If the skull is also bent sideways, then that distortion creates asymmetry between the right and left eyes. Any other unnatural twisting motion will create the abnormal skull motion is in all three dimensions. The result is asymmetry within either or both eyes (astigmatism), and as well as different levels of myopia in each eye. Note the complex and delicate structural arrangement of the muscles controlling the eye shown in **FIGURE 27C**.



Similar mechanisms underlie all the other deficits inside and outside the skull. These adverse effects may involve the size and shape of the sinuses and associated problems such as a deviated septum, the malalignment of teeth, the malalignment of the jaw with the skull, and various hearing difficulties. There are, of course, no known direct causes for any of these listed head-centric problems. By default, the accepted current wisdom is that these deficiencies just happen; we are told, for example, that excessive reading causes poor eyesight, or that a congenital defect causes the deficiency.

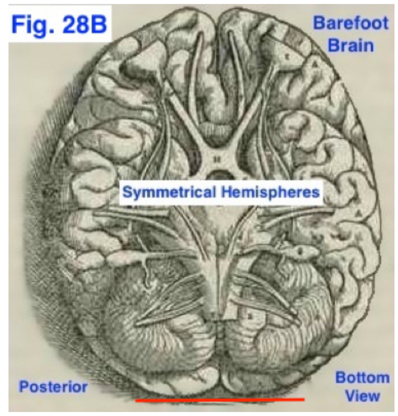
THE MODERN BRAIN IS TWISTED LIKE THE MODERN KNEE

Base on the foregoing, it is even possible to speculate that elevated shoe heels have rendered the modern brain more bilaterally asymmetrical. Modern neuroscience had firmly established in that the modern human brain has a shape and structure that is **asymmetrical, with the right hemisphere shifted forward and the left hemisphere shifted backward**. This modern brain asymmetry is indicative of the very same unnatural rotary torque that is built into the modern knee joint, as previously seen in **FIGURE 9A**.

The well-known structure of the **modern human brain** is shown in **FIGURE 28A.** The modern human brain is twisted, showing an abnormal built-in structural reaction to unnatural rotary torsion in the shifted positions of the right and left hemispheres, as shown in a bottom view, with the right hemisphere shifted forward.

So, it is possible that the right hemisphere brain shift is either caused by elevated shoe heels or the shift is increased by them. However, if the shoe heel-based evidence already presented is ignored, it might be reasonable to assume that this brain shift is solely or at least partly due to the predominance of right-handedness. However, the only evidence available now does not support this explanation. Instead, the few pre-modern brain drawings in existence show highly symmetrical brains, albeit with a slight hemispherical shift in the opposite direction from modern brains.

In contrast to the modern brain shown in **FIGURE 28A**, **FIGURE 28B** is a drawing, from 1543 by Andreas **Vesalius**, which shows a bottom view of a **pre-modern, natural brain** that developed before the general use of elevated shoe heels. Unlike the modern human brain, Vesalius' drawing shows a natural barefoot brain with symmetrical hemispheres with no major shifting or rotary torsion, just a tiny, opposite shift forward of the left hemisphere, not the right. Other early brain drawings by Christopher Wren in 1664 and A.L.F. Foville in 1844 (likely without elevated heels) show similar structures.



STOKES OCCUR IN THE COMPRESSED HEMISPHERE

Stroke is characterized by a portion of the brain which has died due to an abnormally reduced blood flow to it. As is evident in **FIGURE 33** which is a CT scan of a stroke patient, the stroke has occurred in a brain with marked asymmetry between the frontal lobes of the right and left cerebral hemispheres (shown in **green**), in which their twisted positions evidence significant clockwise rotary torsion. The frontal lobes control the most complex intellectual processes of the brain.

Moreover, the portion of the brain tissue that has died (shown in **orange/red** on the left of **FIGURE 33**) is in the frontal lobe of the right hemisphere that has been pushed forward and compressed, probably subject to higher than normal pressure from abnormal clockwise torsion on a repetitive basis. The width of the affected right hemisphere is less than that of the unaffected left hemisphere, again suggestive of regular exposure to higher than natural compressive forces.

It is highly possible, obviously, that increased relative pressure on any portion of the brain would likely have an adverse effect on the flow of blood sufficient to avoid brain stroke. The higher than natural compressive forces that are present in hemispherically asymmetrical brains would produce that increased relative pressure.
It is therefore reasonable to speculate that elevated shoe heels increase the occurrence and severity of brain strokes by increasing brain hemispheric asymmetry, as demonstrated previously.

Artificially twisted brain hemispheres may play a role in other mental diseases. Dementia, including Alzheimer's Disease and chronic traumatic encephalopathy (CTE) caused by repeated concussions (such as in American football), schizophrenia, addiction, anxiety, depression, obsession, multiple sclerosis, and Parkinson's disease all may be caused or worsened by the artificial twisting of the modern brain due to elevated heels. Perhaps even the Yips.

ALBERT EINSTEIN'S ASYMMETRICALLY BRILLIANT BRAIN

At least in some individuals, the possibility exists that this unnatural twisted asymmetrical structure of the the modern brain inadvertently enhanced its highest level of mental functions, language and logic. The evidence suggests that the asymmetrical brain change includes an important increase in the size of the **left hemisphere's dorsolateral prefrontal cortex**, the specific part of the brain that handles its most complex mental functions.

The brain of Albert Einstein provides an extraordinary example of the possible value of brain bilateral asymmetry. As shown in a top view in **FIGURE 28E**, **Einstein's brain was bilaterally asymmetrical**, with unnatural counterclockwise rotary torque squeezing the right hemisphere forward and compressing it relative to the wider left hemisphere (in yellow).

The left hemisphere has expanded into a greater maximum diameter (crossing over brain centerline), allowing for an increase in size of the left hemisphere's critical dorsolateral prefrontal cortex – again, the location of the brain's highest intellectual functions.

Of course, the accuracy of any of the previously referenced centuries-old brain drawings remains unknown. However, Einstein's modern brain is carefully drawn from the published photograph shown in **FIGURE 28E'** and is highly accurate. As is clear in the photograph, even component parts of his brain (in yellow) are substantially shifted between right and left hemispheres.

However, unlike the Einstein brain, there are no conclusive photographic or physical anatomical evidence for the pre-modern, natural brain. Therefore, the definitive anatomical structure of the pre-modern, natural human brain remains uncertain. However, modern technology, however, including MRI and other scanning techniques, as well as standard gross anatomy lab techniques, could be easily used to obtain such evidence by examining living and deceased members of the few remaining "barefoot" populations that have never worn shoes or elevated shoe heels.

IS IT POSSIBLE THAT ELEVATED SHOE HEELS IGNITED THE RENAISSANCE AND REFORMATION, AS WELL AS THE RISE OF MODERN SCIENCE AND TECHNOLOGY?

The substantial physical asymmetries of Einstein (and Steven Hawkings) suggest a possible correlation between modern brain asymmetry and exceptional intellectual ability, at least in some outstanding individuals. Remarkably, the historical period during which elevated shoe heels were introduced into use in Western Europe is the same period in which arose the beginning of modern science and technology that created the modern world. That might not be a coincidence.

Elevated shoe heels may have - in a totally inadvertent way - provided a brain enhancement to at least some individual modern humans that ignited the revolutionary explosion of technological invention and progress that occurred then (possibly by enlarging the dominant left hemisphere, allowing for the accidental development of it as a more powerful and specialized uniprocessor instead of a parallel processing twin of the right hemisphere). Although the direct causation seems almost unimaginable, a logical possibility of it clearly exists, given the timing correlation. Sir Isaac Newton, for example, is shown wearing elevated shoe heels, but that might be an anachronism. Clear evidence is lacking for now. Nevertheless, it is possible that elevated shoe heels gave birth to the modern geek.

ELEVATED SHOE HEELS CAUSE A GROSS MISMATCH DISEASE

Humans evolved barefoot, but in the modern world they are **mismatched** by that evolution with a critical part of their modern physical environment – elevated shoe heels. The result is the physical evolution-in-reverse of modern *Homo Sapiens*.

The few remaining barefoot hunter-gatherers still in existence are almost immune to most of the noninfectious diseases that kill or disable modern humans, as Dr. Daniel Lieberman notes in his book, ***The Story of the Human Body***. Liebermann notes that the limited study data available indicates that barefoot middle-aged and elderly hunter-gatherers (who typically live to an age between 68 and 72) remain remarkably healthy:

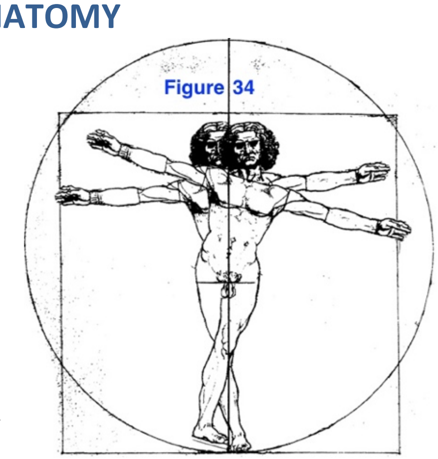
> ...[they] rarely if ever get type 2 diabetes, coronary heart disease, hypertension, osteoporosis, breast cancer, asthma, and liver disease. They also don't appear to suffer much from gout, myopia, cavities, hearing loss, collapsed arches, and other common ailments. …they are healthy compared to many older Americans today **despite never having received any medical care**. [emphasis added]

This remarkable conclusion echoes that from over three decades ago in a study by a Canadian researcher and physician, Dr. Steven Robbins, and a colleague. His study surveyed the available literature on the injury history of barefoot populations.

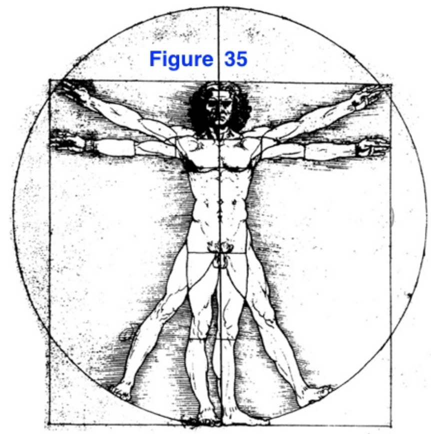
What Dr. Robbins found was that those barefoot populations representing genetically diverse human populations had far fewer overuse injuries than were typical of modern shoe-wearing populations. Even more attention-grabbing was that this was far fewer injuries despite far higher activity levels on a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

A CORRECTED PARADIGM FOR MODERN HUMAN ANATOMY

The heel mechanism has fundamentally changed the modern human body from symmetrical and robust to the asymmetrically deformed and fragile body shown in **FIGURE 34**. The tilted and twisted modern body has abnormally bent-in legs that forcibly tilt an unstable, twisted pelvis. The result is an unnaturally bent-out spine and tilted-in head that is formed in the peak load running position during childhood growth, shown in **FIGURE 26D**, in which the bone and joint structure of the modern human body is deformed unnaturally by elevated shoe heels, in accordance with Wolff's and Davis's Laws.



The study of modern human anatomy must adopt a **new paradigm** of the human body. That new paradigm must be based on the understanding that the true natural structure and function of the **barefoot human body** is the natural norm – the bilaterally symmetrical, theoretically ideal body, shown in **FIGURE 35**, that existed before elevated shoe heels came into widespread use. The existing anatomical paradigm - the modern human body deformed by shoe heels – must be redefined as an abnormal diseased state. The evidence uncovered in this investigation clearly points directly to a completely new and different understanding of what is normal in human anatomy, despite the conventional wisdom that gross human anatomy is the most settled of all the sciences.



The entire modern body is structurally destabilized and functionally impaired. Once those asymmetrical deformities are initially developed in childhood and adolescence during running with elevated shoe heels, they become locked into the bone and joint structure of adults, as shown in the knee example **(FIGURE 2A)**. These deformities become worse over time with continued running as adults, of course, but also become worse for older adults who only walk, even though walking did not create the original deformities. Once formed, the deformities continue to increase inexorably throughout adult life. They become fully evident in the unnaturally stooped posture of the elderly, for whom walking or standing is often difficult or impossible.

THE FINANCIAL AND HEALTH COSTS OF A HUGE UNGUIDED EXPERIMENT INVOLVING BILLIONS OF INVOLUNTARY HUMAN TEST SUBJECTS

Given the link between shoe heels and the anatomical damage they inflict biomechanically on virtually every part of the modern human body, the initial estimate of the associated medical costs for the pervasive damage caused by elevated shoe heels in the United States alone appears to be as high as $1.5 trillion each year. Although these financial costs are shocking, the effect of elevated shoe heels on our general health and well-being is even more costly. In the course of our lifetime – but especially as we age – shoe heels drastically degrade our overall health and quality of life.

There really is no way to describe the untenable situation that we, as modern shoe-wearers, are all trapped in now, except to say that all of us have been little more than **Guinea Pigs** throughout our lives and remain so today. At least for now, we are all inadvertently trapped, involuntarily enrolled in a huge, unguided experiment in reverse-evolution that first began for each of us as a fetus in our modern mother's asymmetrical womb (unnaturally formed and functioning), then continued when we took our first infant steps in baby shoes, and continues uninterrupted today. Each day our bodies become more deformed and farther away from their true natural state. For now, we know little about how to stop or even slow that inexorable progression.

THE BEST WAY TO OVERCOME THE UNNATURAL MEDICAL CATASTROPHE

Simply going barefoot is not the answer. For those with significant physical deformity who are most in need, the artificial shoe heels have become an essential structural prop for them, and removing it leads to a further physical collapse into bilateral asymmetry. There are no known simple, general answers now.

It is therefore urgent that we, for the first time, focus on the true cause – elevated shoe heels – of this global mass epidemic of modern human deformity, with its untold level of cost and misery, and that we focus on finding effective treatment for the direct effects of that cause, rather than blindly continuing the mere treatment of its multitude of seemingly unrelated symptoms.

The best way to solve the critical medical problem described in this article is with a major non-profit foundation dedicated to basic research and development, and strictly independent of any direct commercial conflicts of interest, such as those that would be expected to arise unavoidably with footwear companies. It should be led by medical, anatomical, and biomechanical specialists, all completely independent of the footwear industry, so as to provide trustworthy research based on an independent point of view.

Some form of government regulation is likely to be necessary in the future, but not until the research has progressed sufficiently to define an effective governmental role, such as taxing footwear companies to fund independent basic research. For now, it is anticipated that profitable footwear companies would make the substantial voluntary contributions to the non-profit research foundation necessary to maintain good relations with the public. All parties are likely to benefit substantially from finding the best solutions as soon as possible.

In summary, the modern human body has been substantially deformed – artificially by footwear, rather than preordained by genetics – resulting in unnaturally exaggerated anatomic differences between genetically diverse human populations and also between genders. This apparently happened by happenstance through the routine work of cobblers and their modern equivalent, all entirely ignorant of the enormous anatomical consequences of elevated shoe heels.

How the everyday shoe manages to create such widespread deformity in every part of the modern human body is the focus of my new book. What little is known and the research effort urgently needed now are outlined there. A first draft of both the abridged book and the complete book are available at my website, **www.AnatomicResearch.com.**

RESEARCH NOTE:

I should also include here a note about the extent of my research effort related to the heretofore ignored issue of shoe heel-induced subtalar joint supination. I have conducted over a period of many years a comprehensive analysis of all related peer-reviewed research I could locate in many different disciplines like biomechanics, anatomy, orthopedics, podiatry, physical anthropology, archeology, and many others, including a number of articles available only at the Library of Congress and the National Library of Medicine, not online. The **Endnotes** of my unabridged book now totals over 75 pages, mostly listing the many peer-reviewed articles I reviewed and concluded were relevant to this investigation, and specifically noting the exact pages and/or specific figures that were considered most relevant. Far more articles were reviewed and deemed not sufficiently relevant to include in the Endnotes.

LIST OF FIGURES:

Human Body, available online at www.Bartleby.com/107/. Fig. 2B is from unknown web source.

Figure 6B Based on Figure 290 of the ***1918 Edition of Gray's Anatomy*** *and a*dapted from Hicks, J.H. (1961) The three weight-bearing mechanisms of the foot. In: Evans, F.G., ed. ***Biomechanical Studies of the Musculo-Skeletal System***. Springfield, IL: Charles C. Thomas. Also from Kelikian, Armen (2011). ***Sarafian's Anatomy of the Foot and Ankle***, page 620. Philadelphia: Wolters Kluwer.

Figure 6C Adapted from Figure 10 of Kirby, K., Loendorf, A., and Gregorio, R. (1988) Anterior Axial Projection of the Foot. ***Journal of the American Podiatric Medical Association*****,** 78 (4), 159-170, which is from Root, M.L., Orien, W.P., and Weed, J.H. (1977). ***Normal and Abnormal Function of the Foot***, Clinical Biomechanics Corporation, Los Angeles and on Figures 16 and 20, pages 61 and 67, from Sgarlatto, T. E. (Ed.) (1971). ***A Compendium of Podiatric Biomechanics***. San Francisco: California College of Podiatric Medicine.

Figure 6D&E Comparison between barefoot and heeled shoe of the path of the ankle joint (talar trochlear) when rotated externally to the outside by shoe heel-induced supination of the subtalar joint, based on Figures 244 and 258 of the ***1918 Edition of Gray's Anatomy***.

Figure 7 Figure 3.2 based on Plate 18 Man Running, Frame 10 side view, from Muybridge, Eadweard (1887). ***The Human Figure in Motion.*** New York: Dover Publications, Inc. (1955).

Figures 8A&B Perspective view of body weight forces during running on the lower leg tilted to the outside, based on a part of a figure from ***De dissectione partium corporis humani libri tres*** by Charles Estienne. Paris, 1545. Simple graph of the force vectors of Fig. 8A.

Figure 9 Modified **Leonardo De Vinci** sketch known as "***The Vitruvian Man***" (c. 1485), showing the abnormal, unnatural general cross-over structural position of modern legs and hip joints, as well as showing the effect of the unstable pelvis, which results in a bent-out spine and tilted-in head.

Figure 10A&B Comparative upper surfaces of the talus (ankle joint) of an Egyptian and a European, Figure 61, page 114, of Jones, Frederic Wood (1949*).* ***Structure and Function as Seen in the Foot.*** London: Bailliere, Tindall and Cox.

Figure 10C Cone-shaped trochear surface of modern ankle bone, the talus, modified from an upper view of the talus in the ***1918 Edition of Gray's Anatomy.***

Figure 10C1 The trochlear surface of an ancient Anglo-Saxon talus, from Cameron, J. (1934). ***The Skeleton of British Neolithic Man*****.** Williams & Norgate, Ltd., Fig. 29 and Plates XXX & XXXI.

Figure 10D Frontal plane cross sections of the ankle bone (talus) showing trabecular over-development of lateral side, Figs. 23.28-29 from page 273 of Michael C. Hall (1966). ***The Architecture of Bone.*** Springfield, Illinois: Charles C Thomas.

Figure 10E Frontal plane cross sections of the ankle bone (talus) showing trabecular under-development of lateral side, from Figure 34 of R. B. Seymour Sewell (1906). A Study of the Astragalus. In the ***Journal of Anatomy and Physiology*** 42:152-161, particularly Fig. 34 on page 160.

Figure 11A Basic misalignment of lower extremity joints, showing the right and left knee joints of right and left legs rotated unnaturally to outside by elevated shoe heels/subtaler joint interaction, away from the direction of forward locomotion indicated by the pelvis, as seen in a horizontal plane view*, modified from* upper views of the foot, tibial plateau, and pelvis in the ***1918 Edition of Gray's Anatomy***.

Figure 11B Overhead view of major misalignment of front-end wheels (original).

Figure 11C Front view of modern hip joint bones, from original plates (circa 1747) on page 29 and 31 from ***Albinus on Anatomy*** (1979) by Robert Beverly Hale and Terence Coyle. New York: Dover Publications, Inc.

Figure 11D Rear view of modern hip joint bones, from page 31 also from ***Albinus on Anatomy*** (1979).

Figure 12A&B Modified Leonardo De Vinci sketch known as "***The Vitruvian Man***", showing the two abnormal, unnatural general structural positions of modern legs and hip joints: bow-legged legs and knock-kneed legs.

Figure 13A Front view of the illiotibial tract based on a figure from unknown source (being searched).

Figure 13 B&C The Figure shows (B) Sway back most typical of males and (C) Kyphosis most typical of females, from Google figure search.

Figure 14A&B Male and female pelvises comparison, from Figure 241 and 242 of the classic 1918 Edition of ***Henry Gray's Anatomy of the Human Body***.
Figure 15A&B Side view of typical human spines, from Dynamic to Static, based on Figure 8, page 61, from Kapandji, I. A. (1974). ***The Physiology of the Joints (Volume 3): The Trunk and Vertebral Column (Second Edition)***. Edinburgh: Churchill Livingstone.
Figure 15C Eadweard Muybridge standing naked by a chair, frontal view, from the second frame on the title page of Muybridge, Eadweard (1887). ***The Human Figure in Motion***. New York: Dover Publications, Inc. (1955).
Figure 16A Skeleton of a typical full-term fetus showing its disproportionate very large relative size of head, front view, by Ontleding des menschelyken lichaams (1690). ***In Human Anatomy: A visual History from the Renaissance to the Digital Age***, page 135. (2006) Rifkin, Benjamin A. and Ackerman, Michael J. New York: Abrams.
Figure 16B Pelvic openings in selected primate species including human, Figure 5-2, page 93, from Trevathan, Wenda (2010). ***Ancient Bodies, Modern Lives***. Oxford: University Press.
Figure 16C Four main types of pelvises, from Figure 24, page 75, of Francis, Carl C. (1952). ***The Human Pelvis***. St. Louis: The C. V. Mosby Company.
Figure 16D Fetus during labor, from figure by William Smellie (1754) A Sett of Anatomical Tables, from page 203, in ***Human Anatomy: A Visual History from the Renaissance to the Digital Age***, page 203. (2006) Rifkin, Benjamin A. and Ackerman, Michael J. New York: Abrams.
Figure 16E Typical asymmetrical prenatal position of human fetus in the womb, right ear facing outward, from Figure 4.36, page 158, of Gazzaniga, Michael S. et al. (2014). ***Cognitive Neuroscience: The Biology of the Mind (4th Ed***.). New York: W. W. Norton & Company.
Figure 16F Pelvis as a basin for viscera, from figure by Giulio Cesare Casseri (1627) De humani corporis favrica libri decem. Page 118 in ***Human Anatomy: A visual History from the Renaissance to the Digital Age***, page 135. (2006) Rifkin, Benjamin A. and Ackerman, Michael J. New York: Abrams.
Figure 16G Viscera spilling out, unsupported by pelvic basin, Plate 57 of Andreas Vesalius from the First Edition of the ***De Humani Corporis Fabrica*** (1543), page 165 of The Illustrations from the Works of Andreas Vesalius of Brussels by Saunders, J. B. deC. M. and O'Malley, Charles D. (1950) New York: Dover Publications, Inc.
Figure 18A Hip Adduction Deformity from Figure 440 from Samuel L Turek, ***Orthopaedics: Principles and Their Application***. Philadelphia: J. B. Lippincott Company, 1967.
Figure 18B Corresponding still photos of left and right legs at midstance of woman walking in high heels, from a video clip of a Depend advertisement from September 2016.
Figure 18C-E Figures 17.12 C-D are still photos from a video of Kim Phuk by Nick Ut of Associated Press, shown running from a napalm bombing in **PBS The Vietnam War**, A Film by Ken Burns & Lynn Novick, 2017, Florentine Films and WETA, Washington, D.C. Figure 17.12E is from a website advertisement of unknown source.
Figure 20 A front view still photo frame from a **YouTube** video clip of Zola Budd 'world record' 2000 metres **https://www.youtube.com/watch?v=FGSjpUIGbZs** Uploaded on Dec 10, 2010.
Figure 21A Heavily cropped and highlighted photograph taken from an old 19th Century archive still photo of the office of Rudolf Virchow (b. 1821, d. 1902), a pioneer in the study of leukemia, used in **PBS** Ken Burns Presents ***Cancer: The Emperor of All Maladies*** (2015). A film by Barak Goodman
Figure 21B Comparison of normal and coxa valga femoral neck-shaft angles, based on modified femur front view drawings from the classic 1918 Edition of ***Henry Gray's Anatomy of the Human Body***.
Figures 22A&B Comparison of skeletons with naturally erect posture and poor posture, from Mary Bond's ***The New Rules of Posture: How to Sit, Stand, and Move*** (2006) Healing Arts Press; the drawings are modified from originals by Brenna Maloney and Patterson Clark of ***The Washington Post***. See at: http://www.washingtonpost.com/wp-dyn/content/graphic/2007/04/16/GR2007041600761.html
Figure 23A Knock-kneed caucasian male with well-developed vastus lateralis, Figure 9.7 of I. S. Smillie

(1974). *Diseases of the Knee Joint.* Edinburgh: Churchill Livingstone.

Figure 23B Same male surgically made bow-legged, with relatively wasted vastus lateralis, Figure 9.10 of Smillie (1974) of preceding figure reference.

Figure 24 Frame 2 rear view, Plate 21, Man Running at midstance, in Muybridge, Eadweard (1887). ***The Human Figure in Motion***. New York: Dover Publications, Inc. (1955).

Figure 24A The heart and complex network of surrounding arteries and veins, from Figure 505 from the classic 1918 Edition of ***Henry Gray's Anatomy of the Human Body***.

Figure 26A Neck torsion and skull positions, Figures 64 and 65, page 219, from Kapandji, I. A. (1974). ***The Physiology of the Joints (Volume 3): The Trunk and Vertebral Column (Second Edition)***. Edinburgh: Churchill Livingstone.

Figure 26B Jim Ryun's head and neck position at the end of a race. Ryun's Run. In ***Runner's World,*** September 2003, page 79.

Figure 26C Roger Banister's head and neck position at the finish line of his successful attempt to break the four-minute mile on May 6, 1954, from an **AP** Photo File.

Figure 26D Composite of previous Frames 4 and 10 like Figure 17.2A above with pelvis leveled in order to show the true relative position of the flexed legs at the maximum load-bearing at midstance position and showing the effect of the unstable pelvis, resulting in a bent-out spine and tilted head. Plate 23 Man Running, from Muybridge, Eadweard (1887). **The Human Figure in Motion**. New York: Dover Publications, Inc. (1955).

Figure 27B An Xray example of typical cervical vertebrae asymmetry from unknown web source.

Figure 27C Side view of the eye muscles, from Figure 885 in the classic 1918 Edition of ***Henry Gray's Anatomy of the Human Body***.

Figure 28A Figure 4.5 from page 126 of Gazzaniga, Michael S. et al. (2014). ***Cognitive Neuroscience: The Biology of the Mind (4th Ed.).*** New York: W. W. Norton & Company. The torsional-shift anatomical asymmetries between the right and left hemispheres are shown in a bottom view.

Figure 28B The Base of the Brain from Vesalius, Andreas (1543). ***De Humani Corporis Fabrica Libri Septem***, Basel. From Wikipedia Commons. See also Saunders, JB de CM. and O'Malley, Charles D. (1973). ***The illustrations from the works of Andreas Vesalius of Brussels***. New York: Dover.

Figure 28E&E' Top view of Einstein's brain, showing asymmetrical hemispheres with the right shifted forward, from Figure 1 of Dean Falk, Frederick E. Lepore, and Adrianne Noe (2013). The cerebral cortex of Albert Einstein. **Brain** 136: page 1306.

Figure 33 A CT scan of the brain of a stroke patient, from "A Stroke Treatment Mired in Controversy" in the ***Science Times*** of ***The New York Times***, March 27, 2018, page D1.

Figure 34 Modified Leonardo De Vinci sketch known as "***The Vitruvian Man***" (c. 1485), showing the *abnormal, unnatural general cross-over structural position of modern legs and hip joints, as well as* showing the effect of the unstable pelvis, which results in a bent-out spine and tilted-in head.

Figure 35 Unmodified Leonardo De Vinci sketch known as "***The Vitruvian Man***" (c. 1485), Accademia, Venice.

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