UNNATURAL INSTABILITY

Shoe Soles Have a Very Dangerous But Correctible Stability Defect

The ancient defect appears to cause an estimated 20,000 deaths, 3,200,000 ER visits, 700,000 hospitalizations, and $65 billion in medical costs in the U.S. each year. All are avoidable because the necessary sole design corrections are proven and available for free use in the public domain. They can quickly fix the defect, while increasing sales with redesigned shoes that are far more stable, while much more comfortable too.

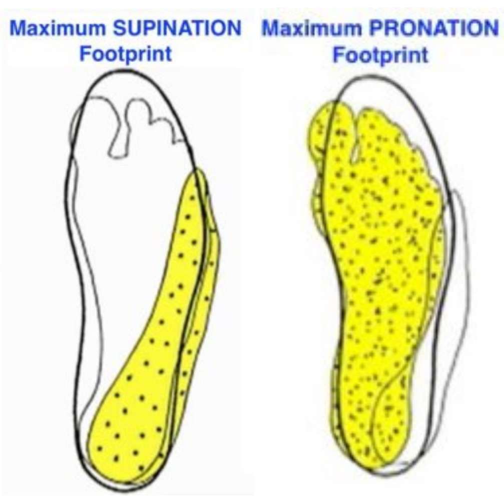
UNSTABLE SHOE

STABLE BAREFOOT

A shoe sole is artificially unstable when tilted outward as far as the subtalar joint naturally allows it to go into a typical ankle spraining position. The entire ankle joint and the bodyweight force transmitted through it pivots on the tiny sliver (the white streak) of a shoe sole edge that contacts the ground. The opposing forces are out of alignment, creating a very powerful destabilizing torque on the tilted ankle, which is supported unnaturally by only the wearer's ligaments and muscle tendons.

In contrast, **a barefoot is naturally stable when rolled into the ankle spraining position**, with opposing forces inline and directly supported by leg, ankle, and heel bones in perfect natural alignment. The bare sole enjoys a wide base of support, especially under the calcaneus or heel bone, as well as under the base and head of the fifth metatarsal bone (all three bones indicated by the large white areas of support).

This artificial lack of stability in shoe soles is due to the foot sole simply rolling over the outside edge of the upper surface of the shoe sole, which causes lateral ankle sprains, breaks, and falls. When the wearer's foot rolls as far as the subtalar joint permits, as shown in **Maximum Supination Footprint** (below, in yellow, superimposed on an upper surface outline of a shoe sole), a large part of the flattened foot sole is unsupported by the shoe sole. The upper of the shoe acts as a physical restraint that keeps the foot from rolling off the shoe sole, but instead the upper causes the shoe sole to tilt uncontrollably, resulting in ankle sprains, breaks and falls with serious injuries.



The same kind of mismatch exists between shoe sole and the **Maximum Pronation Footprint** (also in yellow) of the wearer's foot. The foot tends to roll onto or over the inside (medial) edge of the shoe sole's upper surface, unnaturally destabilizing the shoe sole by causing an inward tilt. When the rolling motion is extreme, tilting the shoe sole inward uncontrollably, the resulting gross instability provides an explanation for the existing epidemic of acute knee injuries, particularly among female athletes, including anterior cruciate ligament (ACL) tears and ruptures.

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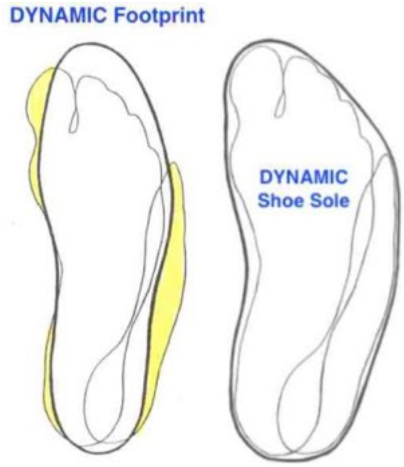
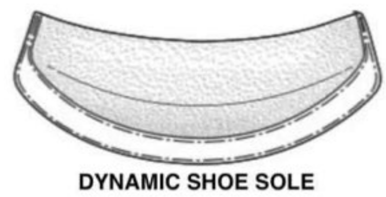


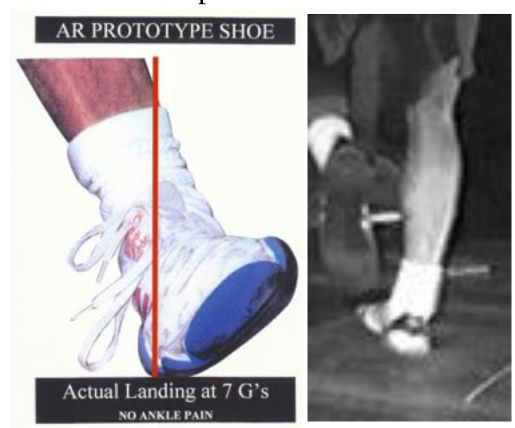
As controlled by the subtalar joint, the full range of normal motion of the foot sole during the extreme motion that often occurs in athletics extends the sides (in yellow) of the **Dynamic Footprint** far outside the sides of structural support provided by a conventional shoe sole.

To be as stable as the barefoot, the sides of a **Dynamic Shoe Sole** must extend as far as the foot's dynamic footprint to provide naturally safe locomotion.



In addition, instead of being flat, the extra width of the Dynamic Shoe Sole must be curved up around the sides of the **rounded** sole of the foot to avoid creating unnatural destabilizing levers. The shoe sole must also be sufficiently **flexible** to flatten under a bodyweight load, as does the rounded barefoot sole. Finally, the dynamic shoe sole must have a **uniform thickness** in frontal plane cross-sections to maintain natural barefoot lateral stability, as seen in the example heel cross-section.

This is not a theoretical design. An **Anatomic Research Prototype shoe** incorporating these features was constructed in 1993 and tested at the biomechanics lab at U. Mass at Amherst. It proved capable of **stable single foot landings in the maximum supination position typical of lateral ankle sprains at peak forces as high as 4 to 7 G's without ankle pain**.



That unique lab test was obviously impossible to perform in conventional shoes due to very high risk of serious injury, but a similar standing test indicated an ankle pain threshold in conventional shoes of as little as 0.25 G in the maximum supination position.

The patented technology was exclusively licensed to Adidas from 1994 to 2003, but its development then did not reach the full potential demonstrated by the AR Prototype. However, independent development by Anatomic Research has continued since then, as shown in this fully stable factory pre-production ***ARIG slide sole***. The utility patents covering the structural elements of this proven barefoot-based stability technology have expired, so those elements are now free and relatively easy to use by the footwear industry.

The simplest possible example of such use among limitless potential redesigns is the most classic basketball shoe, the Converse ***All Star***. It has been modified by a ***Photoshop*** simulated integration of the ***ARIG slide*** sole structure into the ***All Star*** shoe upper. The result shows little change to the basic look of the classic shoe. The sole sides go from vertical to tilted out about 20°. The sole sides are less angled than the flared sides of soles of running shoes that were introduced in the 1970's, but are now a part of a totally different internal sole structure, one that is finally stable after thousands of years.

Ankle sprains are clearly are unnatural and avoidable, but remain the most common cause of both athletic injuries and hospital ER visits. None of the sprains are preventable in conventional shoe soles, even when the best existing commercial shoe and ankle anti-sprain technologies are used. If there could be any doubt, this reality is clearly demonstrated by superstar **NBA 2014 MVP Stephen Curry**, who is shown here wearing his signature performance basketball shoe and a state-of-the-art ankle brace on his nevertheless badly sprained right ankle, unfortunately with his foot bent at a sickening right angle to his lower leg.

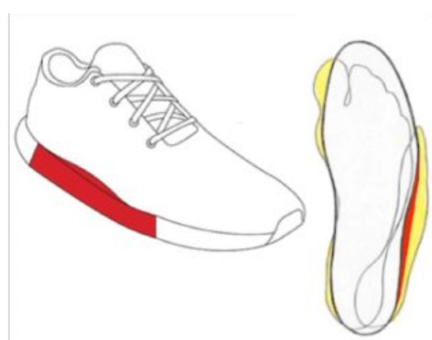
Artificially unstable conventional shoes cause unnatural ankle sprains and breaks, which cause falls, often with serious injuries. According to the **CDC**, accidental falls resulted in 40,000 deaths, 6.5 million Emergency Department visits, and 1.4 million hospitalizations in the U.S. in 2019. The total annual U.S. medical cost of the accidental falls was about **$130 billion**, which is far higher than the estimated total annual branded athletic footwear sales worldwide of about **$83 billion**.

Assume that only half of those falls are caused by the instability of footwear soles – a conservative estimate given the major stability defect evident in existing sole design. If so, the roughly **$65 billion** in total annual U.S. medical costs of those potentially avoidable falls each year far exceeds the annual total of U.S. branded athletic footwear sales of about **$31 billion**.

Unmistakably, this is a serious national medical problem of a magnitude at least equivalent to the 9/11 event – but actually far worse, since it recurs every year. Cumulatively, over the last two decades it totals almost as many deaths as caused by the opioid crisis. Fortunately, it has a proven and effective solution. Moreover, the relative financial cost of a one-time general design and manufacturing correction within the footwear industry of the design defect of shoe soles is, without question, tiny compared to the estimated annual U.S. medical costs of about $65 billion, and 20,000 deaths, 3,200,000 ER visits, and 700,000 hospitalizations.

Moreover, the relatively small one-time financial cost to the footwear industry should be paid for easily within the industry by a likely substantial increase in sales and profits fed by increased consumer demand for footwear that is much safer and, a major bonus, also much more comfortable. It is a rare win-win solution for industry and consumers!

Furthermore, as the quickest possible first step, **there is a simple structural fix that at least noticeably reduces the effect of the instability defect of conventional shoe soles.** It is a worthwhile increase in the stability that can be retrofitted almost immediately to existing conventional designs with little expense.



This relatively immediate and easy initial fix involves only a minor extension of the middle part of the lateral side of the shoe sole. The extension simply eliminates a conventional **lateral indention** between heel and forefoot – a previously unnoticed stability flaw. The addition of a straight-sided **Midfoot Lateral Sole Extension** (shown in **red**) is located where the mismatch (in yellow) is greatest between the narrow shoe sole and the much wider bare sole footprint, thereby **removing the existing dangerous trigger of instability**.

Using the **midfoot lateral sole extension** can reduce the number and severity of lateral ankle sprains and falls during walking and standing, particularly among the elderly, although lowering injury incidence and severity for athletics to a much lesser, but still worthwhile degree.

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In one example among many made and tested, a Nike ***Pegasus 38*** was physically modified by adding a straight-sided **midfoot lateral sole extension** to produce a more stable ***Pegasus 38***. As shown here (with touch-up assistance from ***Photoshop***), the change would be almost invisible in a similarly modified ***Pegasus 38*** in actual factory production.

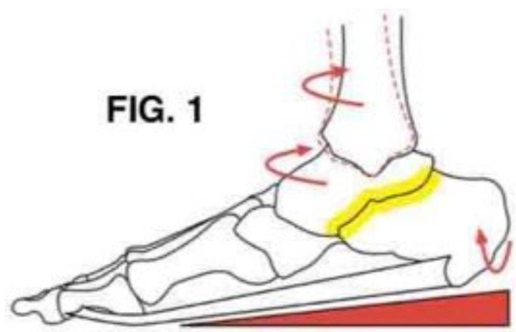
The instability triggered by the lateral indentation defect is greatest in the highly sculpted soles of many modern athletic shoes, but it also destabilizes old classics like the Converse ***All Star*** basketball sneaker. Both classic and new conventional shoe sole designs can be quickly redesigned with this simple fix to remove the dangerous trigger defect to provide a noticeably safer level of stability as soon as possible.

As destructive and costly as is the instability defect of the structure of conventional shoe soles, the overlooked effects of a different unnatural sole structure are far worse and vastly more harmful.

AN UNPRECEDENTED MEDICAL CATASTROPHE HIDDEN IN PLAIN SIGHT

The modern human body has been severely deformed by the unnatural rearfoot elevation created by the ordinary shoe heel. Every year its pervasive effects appear to cause as many as 900,000 untimely deaths and roughly $1.3 trillion in avoidable U.S. medical costs – about a third of the U.S. total.

For the past several centuries, nearly all modern humans have worn athletic and other shoes with elevated heels that unnaturally supinate the **subtalar joint** (located under the ankle bone). New research provides unusually reliable proof that when running both ankle joints are artificially tilted out **8°** away from vertical, and twisted out **18°** away from straight ahead, each to the outside in opposing directions, during peak loads of **3 G's**. Both legs are therefore badly misaligned by ordinary shoe heels during the body's highest repetitive bodyweight loads.



Under the uncomplicated operation of well-known Wolff's and Davis's Laws, the result over time is bilaterally asymmetrical malformation of all of the bone, joint, and other anatomical structures of the modern human body – from toe to head, including the brain. Wide individual variation in specific deformities is determined by factors like footwear use, genetics, and sex.

The often incredibly extensive deformity of the human body begins in early childhood and increases throughout life, reaching its greatest effect in the elderly. The artificial deformity has the potential to damage any structure of the body or degrade any function and to worsen any disease or injury, creating thereby an abnormally longer and higher level of pain and suffering.

Although this constitutes a public health catastrophe of such magnitude as to be unbelievable on its face, confirmation of its reality is provided by unusually trustworthy new evidence. The evidence is based on a revolutionary new gold standard of joint motion measurement, one that obsoletes the biomechanical results of all the relevant prior research on pronation during running. That prior research indicated substantial pronation of the subtalar joint at peak load during running, but is false and misleading. The new research unequivocally proves the opposite, that the actual position of the subtalar joint is always substantially in supination.

Overturning at least a half century of running research, the correct new data indicates that the long-observed pronation in the subtalar joint is instead only a reduction in a much greater level of supination that continues throughout the stance phase of running. It does show that inversion of the subtalar joint is reduced by 7° by motion in an eversion or pronation direction from footstrike to midstance during running. However, the subtalar joint remains inverted or supinated by at least 5° throughout running stance, even at the peak bodyweight load of 3 G's.

Unnatural shoe heel-induced supination is therefore only reduced by an unnatural pronation motion that occurs only in reaction to the artificially-induced subtalar joint supination. Such pronation does not occur in the feet or ankles of barefoot runners who have never worn shoes.

As significant as is this new empirical data, it was simply reported with other data in a running research study by Peltz et al. in 2014 that was funded and directed by Nike, the study being focused on an unrelated hypothesis. Just by happenstance, then, that overlooked data now provides extraordinarily reliable confirmation of the artificial coupling of elevated shoe heels and unnatural subtalar joint supination. I believe that it now fully justifies an extremely extensive level of formal research on its probable anatomical and medical effects, which appear to be extensive and disastrous, based on compelling preliminary evidence uncovered in my initial research.

See the most recent abridged and full drafts of this research and analysis in the **Research** section of my website: **www.AnatomicResearch.com**.