Are 'defective' knee joints evidence for Darwinism?

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Knee problems are among the most common conditions brought to the attention of physicians today. Darwinists claim that this is predominantly due to the idea that the joint is poorly designed. In fact, virtually all knee problems today are due to body abuse or overuse and disease, not poor design. The knee is the largest, most complex joint in the human body, but is also one of the most used (and abused) joints in the body. It is also a marvel of engineering and design. Furthermore, there is no evidence of knee evolution in the abundant fossil record.

A common argument by Darwinists is that humans could not have been created, but rather must have evolved, because, they argue, we are poorly designed. One of the most common claims of putative poor design (or 'dumb design' in the words of Shanks) is the human knee. Shanks concludes that the evolution from walking on all fours (as in apes) to the bipedal locomotion of modern humans is what 'causes many problems from knee and ankle trouble to lower back pain'.[1] Shanks provides an example of the 'poor design' argument Darwinists use (which is actually a theological argument), as follows:

> 'To an evolutionary biologist, the appearance of poor design is evidence of the operation of a bungling, unintelligent trial-and-error evolutionary process that has resulted in suboptimal anatomical structures. Biologists point to these sorts of examples because they seem hard to account for if the intelligent design was due to an all-knowing, all-good, all-powerful designer, supernatural or otherwise. And this was precisely the sort of designer who has appeared in religious objections to evolution. The point is that if these defective structures were the result of design, then the designer must presumably have been drunk, stupid, or both!'[2]

As evidence for this claim, it is often noted that knee problems are responsible for over 18.3 million visits to doctors annually.[3] Knee injuries rank second to lower back pain as the most common reason for outpatient physical therapy visits.[4] This is not surprising for several reasons, including the fact that the knee is the largest and most complex joint in the human body, and one that must support the weight of almost the entire body—often 700 to 1,100 N. When running, the forces can easily exceed 2,000 to 3,400 N at the contact points of each knee. Depending on the position of the knee joint, the area of contact can be as little as 1 cm^2, meaning that a level of force as much as 3,400 N/cm^2 results.[5] The knee is designed so that the maximum distribution of forces results during any point of load-bearing during knee motion.[6]

Another major reason for knee problems is that the 'knee is one of the most used and abused joints' in the human body.[7] The knee is also more vulnerable to injury than other joints because it is one of the most mobile and flexible joints in the body. The more mobile a joint is, the less stable the joint is, and, as a result, the more vulnerable it is to injury. The average knee joint is used over one million times per year and, as a result of all of these factors, it is one of the most injured joints in the human body. Actually, virtually all knee problems are due to documented injury, abuse or disease—not design defects.[8]

The knee unit involves a complex set of bones, cartilage, muscles, tendons, ligaments, bursa (sac), synovial membrane, sheathes, blood, nerves, veins and arteries, all designed to work harmoniously together as a single functioning unit (see figure 1). To understand how well-designed the knee is, it is important to stress the extent of the use (and abuse) of this joint by the average human. By 'the age of 85, even an average sedentary individual will easily have clocked 160,000 km' and an active person over 320,000 km, or almost 8 times around the world.[9] If maintained by proper care, and not injured or abused, such as in sports, the knee joint should last for over 200 million bends.[9] The knee must achieve a balance between strength and the flexibility to achieve the range of motion required for an active life, including in-line forward and twisting motions. Design changes to reduce the problem of misuse would compromise this balance.

Very few human inventions will last this long without major repair. An artificial knee joint designed by the world's top scientists, and produced by the leading high-tech corporations, typically, at the most, lasts only around 20 years. The original usually lasts a lifetime, in spite of the fact that many of us abuse the joint. Part of the reason for this is

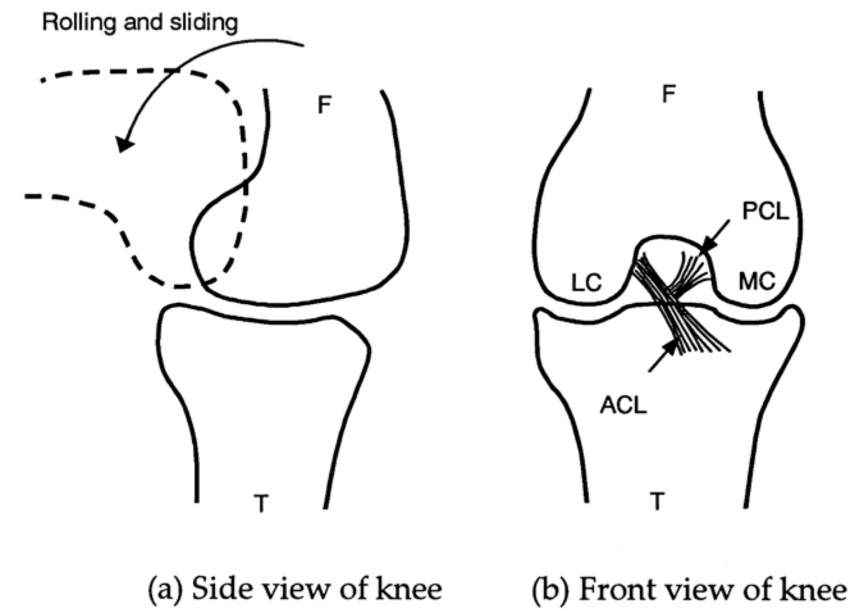


Figure 1. Anatomy of the knee joint (peripheral ligaments and knee cap removed). F=Femur, T=Tibia, LC=Lateral condyle, MC=Medial condyle, PCL=Posterior cruciate ligament, ACL=Anterior cruciate ligament.

that the knee is constructed out of bone, and no researcher has yet developed

> ‘a material as well-suited for the body’s needs as bone, which comprises only one-fifth of our body weight. In 1867 an engineer demonstrated that the arrangement of bone cells forms the lightest structure, made of least material, to support the body’s weight. No one has successfully challenged his findings.’[10]

Brand and Yancey also conclude that the design of bone produces a structure that possesses incredible strength, enough to protect and support every other cell;

> ‘Sometimes we press our bones together like a steel spring, as when a pole vaulter lands. Other times we nearly pull a bone apart, as when my arm lifts a heavy suitcase. In comparison, wood can withstand even less pulling tension, and could not possibly bear the compression forces that bone can. A wooden pole for the vaulter would quickly snap. Steel, which can absorb both forces well, is three times the weight of bone and would burden us down.’[10]

In Werth’s words, bone is ‘twice as tough as granite for withstanding compression forces, 4 times more resilient than concrete in standing up to stretching, about 5 times as light as steel’.[11] Some of the advantages of bones were described by Werth as follows:

> ‘As D’Arcy Thompson observed, bone is an architect’s dream, a building material so malleable that it can be hammered into any shape, so versatile that when it’s assembled into a light and durable framework it can execute and withstand complex mechanical movements, and so strong that it gives shape to and stiffens the whole human form without buckling. Not simply exquisite, as all great architecture must be, the edifice of the human skeleton is a perfect diagram of the lines of stress, tension, and compression involved in bearing the loaded structure—us—through a century or more of activity.’[11]

The knee manifests optimal design

Burgess concludes that the knee is a good example of optimal design. He notes it contains ‘at least 16 critical characteristics, each requiring thousands of precise units of information’ stored in the genome.[12] All of these structures must be present for the joint to achieve maximum function.[13] For example, the meniscus is a vital component of the knee joint that assists in articular cartilage nutrition, shock absorption, and knee stability.[14] Its functional complexity has been demonstrated by anatomical studies:

> ‘The fact that the knees of different species have many structures in common implies that each anatomical component of this complex biomechanical system is needed for proper functioning of the whole system. Larson, in characterizing the knee as “the physiological joint,” exquisitely described this concept. One may speculate about which characteristics of a four-bar linkage system have proved so advantageous to the design of the knee. Then one may ask which of these characteristics can be modified in the pathologically deficient knee to restore acceptable function.’[15]

A four-bar mechanism is an engineering structure that can be represented by four bars and four joints (see figure 3). Authors have struggled to explain how the knee functions in order to gain an ‘appreciation of the complex structure of the knee’, a task that is ‘made easier by studying the analogous structure in the limbs of animals’.[15] One problem in many mechanical systems is finding a design where the unit gives slightly, but does not collapse.[16] Conversely, if a part is too brittle, excess force will cause it to break. Armstrong notes that ‘the same problem has been encountered in the design of the human knee joint’—except a muscle is used instead of a spring.

> ‘The “force at the other end of the linkage” is commonly one’s weight, with modifications according to a variety of situations. Now the knee

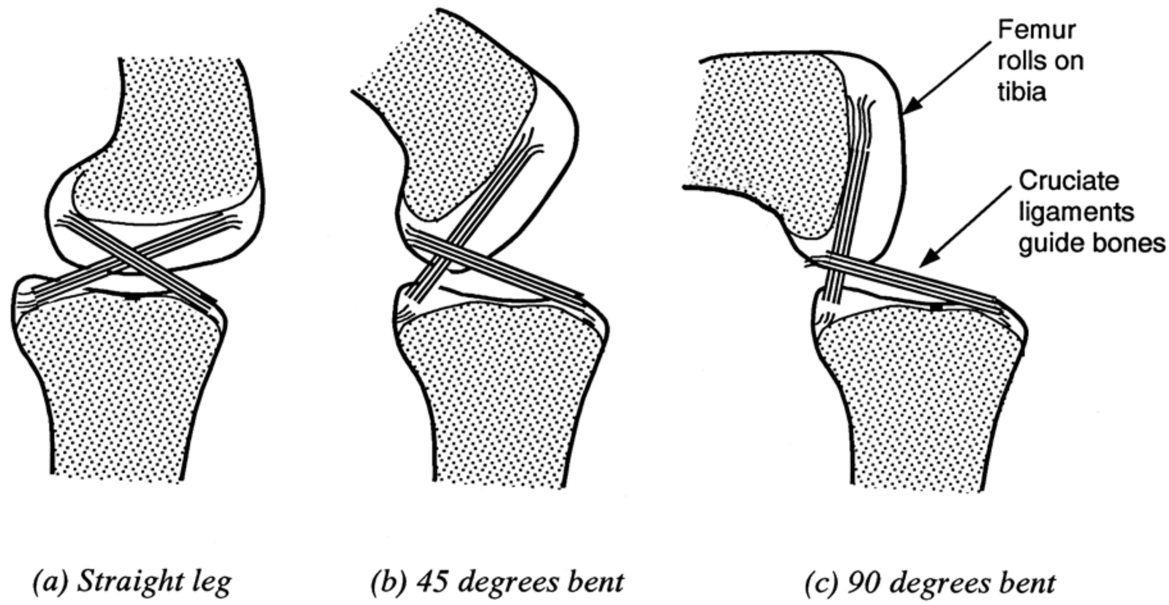


Figure 2. *The irreducible mechanism of the knee (bone cut away to show cruciate ligaments).*

joint is so designed, mainly by the shapes of parts that slide over each other, that the tension in the muscle is proportional to the "force at the other end" over quite a wide range of situations. Such an arrangement seems to be advantageous, in making it easy to adjust to a wide variety of situations. Is it necessary to ask how such a design could possibly have evolved? Surely here is a very good engineering design, and, as usual, the design shows something of the skill of the Designer.'[17]

One major factor in why the knee functions as well as it does is the complex structure and chemical composition of bone:

> 'The structural matrix of bone—a tight, interactive mix of protein and minerals—makes it a better building material than alloys and composites, but the true brilliance of its design is that it *lives*. The skeleton, like any living system, breaks down and renews itself continually. As the body grows to adulthood, it adapts its shape and proportions to match the demands of maturation. When bones break, they mend themselves. Growing outward from the middle of the shaft, the long bones that give the body its adult contours continue to grow until the age of 17 to 21. Brilliantly engineered to distribute force, the living skeleton not only bears the body's load and enables movement but also stores minerals, protects internal organs, and, in its spongy interiors, houses the main bloodworks' (italics in original).[18]

The claim is also occasionally made that certain structures connected to the knee are unnecessary. For example, Müller[5] claimed certain ligaments were not needed; but other research indicates they are a necessary part of the knee design.[19] This is why Dye concluded that the

> 'general structural and functional similarity in the knees of diverse orders of animals implies that the knee is a profoundly adaptive biomechanical system that is unique among joints in tetrapods. Something inherent in the design of this joint has worked so well that it has persisted with little modification for more than 300 million years despite major modifications of functional demand.'[20]

Types of knee problems

Knee problems are classified into two major groups—mechanical and inflammatory. Mechanical problems usually result from injury—often a direct blow to the knee, or a rapid jerk, forcing the joint beyond the normal range of movement that the knee system is designed to sustain. This condition is common in certain sports, setting some people up for the potential of a lifetime of knee problems. Many sports knee injuries are caused by contact sports such as football. In contact sports, the knee is especially vulnerable because of the way the weight of the body impacts the knee. The knee cannot be designed to withstand a major foul/side impact and still achieve the needed everyday life flexibility. Other knee problems result from—or are highly influenced by—poor lifestyle habits, including especially obesity, smoking, poor diet (such as a diet low in calcium and vitamin D) and a sedentary lifestyle. A sedentary life causes the support muscle system to weaken and, as a result,

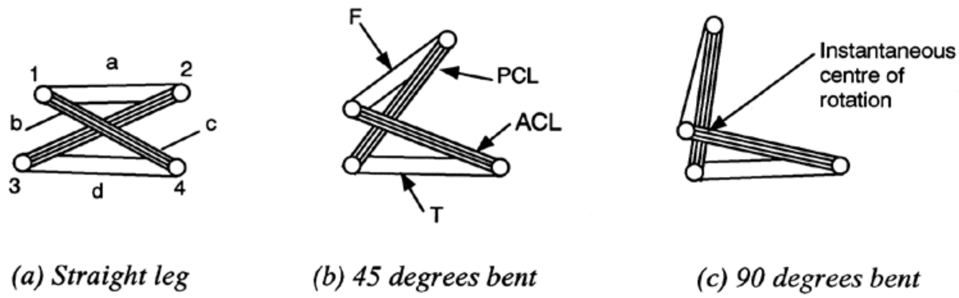


Figure 3. *Schematic of the four-bar mechanism in the knee joint*

the system is more liable to be injured when abused.

Most knee injuries are treated by allowing the joint to heal itself, ideally aided by the R.I.C.E. plus time treatment, which involves Rest, use of Ice, Compression, Elevation, plus time.[21] The knee also acts like a fuse used in electrical circuits: knee pain or problems signal that the body is being overworked or abused. If the knee was able to take more abuse, some people would likely take their body farther beyond its limits and risk more serious and permanent damage to other body parts.

The second class of knee problems includes inflammatory conditions that are a result of disease, such as osteoarthritis and rheumatoid arthritis (an autoimmune disease). These conditions are due to problems unrelated to knee design, such as genetic or body chemistry diseases.

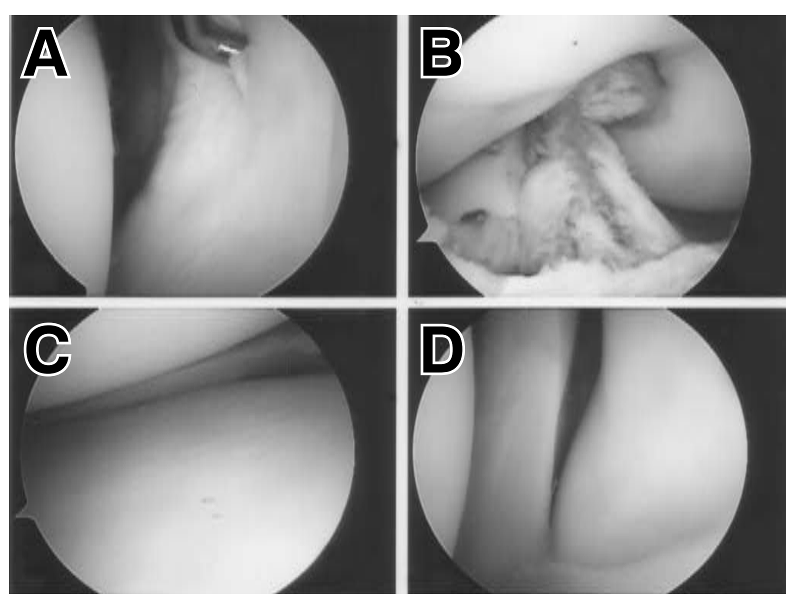
Evolution of the knee

In spite of differences, the basic design of the knee joint is similar in higher animals and humans (see figure 2).[15] Even the knee of a chicken has several striking similarities to the human joint, including a bicondylar cam-shaped ‘distal portion of the femur, relatively flat tibial plateaus, a patella, intra-articular cruciate ligaments, menisci, a broad and flat medial collateral ligament, and a more cylindrical lateral collateral ligament. The morphology of the knee in chickens also has differences, such as a femorofibular articulation and an extensor digitorum longus that originates on the lateral femoral condyle.’[22]

The major part of the knee is bone; thus, the knee is well preserved in the fossil record of many animals. All extant ‘knees’ in the fossil record are fully formed and developed, and no evidence exists of transitional forms.[23] Dye adds that the ‘complex functional morphologic characteristics of the knee are of ancient origin’.[24] Research on fossils by Darwinists has determined that the ‘common ancestor of all living reptiles, birds, and mammals’, called *Eryops*, had a knee design very similar to the human knee.[25] Dye adds, *Eryops* had all of the ‘commonly shaped characteristics of the knees of most living tetrapods’.[26] Hosea *et al*. concluded that ‘the basic characteristics of the human knee are amazingly ancient in origin, dating back to 320 million years’.[25] Dye notes that very early in tetrapod evolution

> ‘approximately 360 million years ago, the femur, tibia, and fibula were present and distinct, and the distal end of the femur already exhibited a bicondylar shape. The proximal part of the tibia was relatively flat and articulated with the preaxial condyle of the femur. The post-axial condyle of the femur (lateral femoral-condyle analogue) articulated with the proximal part of the fibula. This fibular articulation with the femur remains a characteristic of knees in reptiles, birds, and some primitive mammals.’[22]

Interestingly, the ‘study of comparative anatomy demonstrates the similarities of [knee] design among the tetrapods’.[25,27,28] This indicates to Darwinists a common origin for the knee, but an objective evaluation indicates its effective design in the animal kingdom, and highlights



Arthroscopy revealing a 60% ruptured ACL (anterior cruciate ligament), which was caused by a touch football injury. A = a partial thickness split on the superior surface of the posterior horn of the lateral meniscus—a probe is placed in the split to see it more clearly. B = partial tear of the ACL where one of the two parts has completely torn and the second part may be stretched. C = Medial meniscus in good condition. D = Normal lateral meniscus.

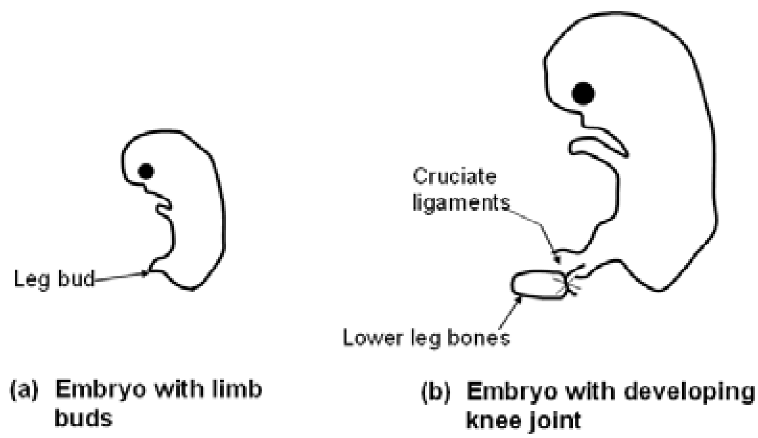


Figure 4. *Growth of the knee joint in the human embryo.*

the functional effectiveness of the joint's design. As Hosea *et al*. conclude, the fact that the knee 'has functioned with little alteration for more than 300 million years despite major functional demand changes' demonstrates the high level of effectiveness of knee design.[25] Dye reviews the details of this similarity as follows:

> 'The striking feature about the knee of the frog, and indeed all of the knees that have been dissected to date, is that the functional dynamics appear similar to those of the human knee. Each knee has a complex rolling and gliding motion of the femur on the tibia, with the point of contact on the femur moving posteriorly on the tibia with flexion, like a four-bar linkage system ... . The similarity of the asymmetrical design of the medial collateral ligament is also an unexpected finding. For example, in all of the species that have been dissected to date, the medial collateral ligament was found to be flat and broad and to have a tibial insertion well distal to the joint line.'[29]

Although no evidence exists for knee evolution, and fully formed knees appear at the start of the tetrapod fossil record, much variety exists based on the basic knee design. All of the 'complex set of attributes that we associate with the human knee' are 'extremely ancient in origin'.[20] Although all mammal knees have the same basic design, the human knee has some distinct features. Dye notes that no animal model is known for the human knee.[15] A major difference is that only the human knee is designed to lock easily in the extension (straight leg) position to allow maintaining comfortable vertical posture for a sustained period of time.[30]

This design feature is one reason why humans are able to easily walk and run upright. Apes' knees cannot lock, and must be continually loaded in the flexion (bent leg) position, requiring a great amount of muscle use, resulting in rapid tiring. Try standing with your knees slightly bent for 10 minutes or so—you soon will note this position is extremely tiring. The 'locking' mechanism occurs only in extension. As soon as motion/flexion occurs by action of the popliteal muscle, tibial rotation occurs to 'unlock' the knee. The popliteal also has functions aside from unlocking the knee joint at the beginning of flexion of the fully extended knee.

For this reason, apes are generally quadrupedal (four-legged), and it is extremely difficult for them to maintain a vertical posture for any length of time. Humans, in contrast, are biped (two-legged) and cannot efficiently walk on all fours as apes can. The only way apes can stand upright is by awkwardly bending at their ankle, knee and hip joints. Such a distorted posture means that apes can stay in a vertical position for only short periods of time and distances. In contrast, an able-bodied and fit human can stand for hours or run for many miles without any difficulty (Burgess, 1999).[12]

Improving the design of knees

Olshansky *et al*., to support their claim that the creation worldview is wrong, argue that the body is poorly designed. This proves, in their eyes, that we evolved by an impersonal, non-theistic process. A major example they use to prove this thesis is the human knee joint. They even argue that the human knee should be completely redesigned to include a thicker cartilage pad to allow the human knee to 'bend backward' as do apes' knee joints. They also advocate removal of the knee cap (the patella). They admit that their design also has its problems, such as 'the absence of a locking mechanism would make it hard to stand for very long, so further modifications would be necessary'.[31]

The patella (which they eliminated), a sesamoid bone (a bone that is free-floating rather than articulating), is also critically important. Its functions include serving as a lever to allow much greater leg strength, and its loss would seriously handicap coordinated body movement. The massive quadriceps femoris muscle is connected to a large tendon that essentially passes through the patella to attach to the tibia. The patella also helps to protect the underlying bones and tissue in the knee joint area. Their 'improved' knee is clearly a poorer design! The only way to test its design is to surgically alter knees of patients to determine if the claimed superior design is, in fact, actually superior.

Dye notes that to improve artificial joint replacement and bracing systems, scientists need to more closely copy the original design and consider the complexities and functional morphologic features of the healthy human knee.[32] The human knee is an excellent example of why a Harvard professor of medicine said about the human body:

> 'Learning how this awe-inspiring and remarkably intricate piece of machinery is assembled—how it works, its control and communication

systems, and its central programming—occupies the full attention ... of the Harvard Medical School students.'[33]

Summary

Various claims that have been made about the allegedly poor design of the knee have been demonstrated to be erroneous. The knee is actually an excellent example of evidence for design. Common knee problems are not due to poor design, but to disease, abuse, injury, common wear and tear, natural calamities, and common aging. The knee is actually a masterpiece of design, and in the absence of these factors, the knee will normally function as a very resilient structure that can be expected to give its owner over eight decades of good maintenance-free service. The conclusion that, if God designed the knee, He would have designed it differently is actually a theological, not a scientific, argument, as are all poor design claims. This argument claims to second-guess the thoughts of the Creator. If theological arguments are discussed, it is imperative to consider that the design of all body organs has been compromised by the Fall.

It was also found from a review of the fossil record that although several distinct types of knees exist, evidence for knee evolution is lacking. This conclusion is not due to a poor fossil record, but because the fossil record preserves bone over most other body structures (only teeth are usually better preserved), an excellent fossil record exists.

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