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The Human Hand: Perfectly Designed

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Abstract

Various theories of the evolution of the human hand are analyzed, revealing much speculation, but little evidence, for the evolutionary origin of this complex and highly designed system. The hand would require the simultaneous evolution of large set of intricate and matched structures, including bones, muscles, blood vessels, ligaments, tendons, skin, and nerves. In addition, the brain must have evolved systems enabling the coordinated function of the hand as an integrated unit. The result is an anatomical system that is one of the most critical parts of what makes us human. In comparison to the primate hand, there are several significant differences that indicate the uniqueness of the human hand. Also, the enormous versatility of the hand, such as ability to do tasks requiring fine motor coordination as well as brute strength, are discussed.

Introduction

The hand is one of the most complex and critical parts of the human body. Zimmer (2012, p. 98) wrote that our hands are "where the mind meets the world" and that humans use their hands to make

> fires and sew quilts, to steer airplanes, to write, dig, remove tumors, [and] pull a rabbit out of a hat. The human brain, with its open-ended creativity, may be the thing that makes our species unique. But without hands, all the grand ideas we concoct would come to nothing.

Hands also make tools, perform surgeries, express gestures, make music, produce artistic creations, and play the piano (Wagner, 1988). After studying the hand for 30 years, medical doctor John Napier concluded that, aesthetically, the hand is "one of the most beautiful parts of the human body" (Napier, 1980, p. 18). Hands are also the "chief origin of the fifth sense called touch" and "our main source of contact with the physical environment" (Napier, 1980, p. 22). Writing the introduction for *Beasley's Surgery of the Hand*, Professor Victor Meyer observed that the human

> hand can justly be called the most important extension of the intellect [adding that it is clearly] far more than just a tool with prehensile capacities, as it is complemented with a rich collection of sensory receptors. The hand and the nervous system, especially the hand and brain, form a unique functional entity. Each person's individual personality is reflected, to a greater or lesser degree, in the way they use their hands, which are permanently in the public eye … Also, the hands disclose a person's emotional composure (Beasley, 2003, p. viii).

It has been widely acknowledged that the "history of all societies reflects recognition of the special importance and appreciation of the exceptional capabilities of the human hand" (Beasley, 2003, p. 1).

Sir Charles Bell wrote a 260-page book titled *The Hand: Its Mechanism and Vital Endowments as Evidence of Design* that went through at least eight editions, the last published in 1876. In

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this book he wrote that the hand belongs exclusively to humans and its importance is so critical that it has converted "the being who is the weakest in natural defenses, to the ruler over animate and inanimate nature" (Bell and Shaw, 1865, p. 12).

The human hand has several unique anatomical features not found in any other living creature. Humans have comparatively shorter palms and fingers, but a longer and stronger thumb than the apes. Human fingers can be individually controlled to a greater degree than is true for all other animals, even those primates that are anatomically similar to humans. This unique design give the "human hand unparalleled dexterity" (Wayman, 2013, p. 16). In addition, Zimmer (2012, p. 98) wrote that the reason

> we can use our hands for so many things is their extraordinary anatomy. Underneath the skin, hands are an exquisite integration of tissues. The thumb alone is controlled by nine separate muscles. Some are anchored to bones within the hand, while others snake their way to the arm. The wrist is a floating cluster of bones and ligaments threaded with blood vessels and nerves. The nerves send branches into each fingertip. The hand can generate fine forces or huge ones. A watchmaker can use his hands to set springs in place under a microscope. A pitcher can use the same anatomy to throw a ball at a hundred miles an hour.

The human hand's extraordinary dexterity cannot be explained solely by its anatomical design. A major reason for the hand's unique abilities is the complex brain and the neural machinery that control it.

Primates have direct connections between certain cortical motor neurons and spinal motor neurons, enabling the cerebral cortex to achieve fine control over the hand muscle motor neurons (Flanagan and Johansson, 2002). Because control of the unique human hand is a result of our central nervous system, the hand is a direct tool of our brain. Its design enables both fine and gross dexterity, which allows for incredible creativity, including hand gestures that effectively express our personalities (Putz and Tuppek, 1999).

Hand Anatomy

Touch

The body's most sensitive areas on the skin include the lips and fingertips. Of all our senses, touch is the most difficult to do without. Hundreds of nerve endings exist in

> every square inch of skin, your body functions like an antenna, receiving a constant stream of information ranging from the firmness of the chair you're sitting on to the heat of the sun through the window. Touch is the first sense we develop in utero, and it is critical to survival … touch helps to protect us from harm. Some nerves are specialized to feel texture and pressure, others to detect temperature or register pain (Kahn, 2012, p. 8).

The hand is also designed to absorb a fair amount of abuse due to its thick skin cover consisting of horny callosities (calluses) plus a layer of tough fibrous tissue called the *palmer aponeurosis* beneath the skin, both at the wrist and in the palm of the hand (Napier, 1980, p. 22).

Skeletal Structure

Figure 1 shows the skeletal anatomy of the hand. The human hand and wrist consist of 27 bones: 14 finger bones, the 5 metacarpal bones (i.e., the bones of the palm or "hand proper"), a distal row of bones (trapezium, trapezoid, capitate, and hamate) that articulates with the other four short bones of the wrist organized into a proximal row (scaphoid, lunate, triquetral, and pisiform), which articulates with the forearm skeleton. The arm's ulna and radius allow supination and pronation (rotation about the axis of the forearm).

Muscles and Associated Structures

The muscles acting on the hand include the extrinsic and intrinsic muscle groups. The intrinsic muscle groups include the thenar (thumb) and hypothenar (little finger) muscles, the interossei muscles (four dorsally and three volarly), and the lumbrical muscles arising from the deep flexor that insert on the dorsal extensor hood mechanism.

The extensors of the fingers are extrinsic muscles and are a group comprised of six named extensor muscles. The primary function of the extensor muscle is to straighten out the digits. The flexors cause the actual bending of the fingers, and two long flexor muscles connect to the phalanges of the fingers by tendons. The deep flexor attaches to the distal phalanx, and the superficial flexor attaches to the middle phalanx. The thumb has one long flexor (extrinsic) and a short flexor in the thenar muscle (intrinsic) group. These muscles move the thumb in opposition to the four fingers, making grasping small items, such as pencils, possible (Beasley, 2003).

The tendons unite with the interosseous and lumbrical muscles to form the extensor hood mechanism. The thumb is unique because it has two specially designed extensors that extend into the forearm. The index finger also has an extra extensor to enable actions such as pointing. For this reason, no other finger can point as effectively as the index finger.

Anatomic Variability

Anatomic variability of the hand allows one person to excel at playing the piano and another to excel at brain surgery (Carson, 1990). Data used in the published literature produces an unavoidable source of error because clear differences in human hands exist due to interpersonal variations of the structures

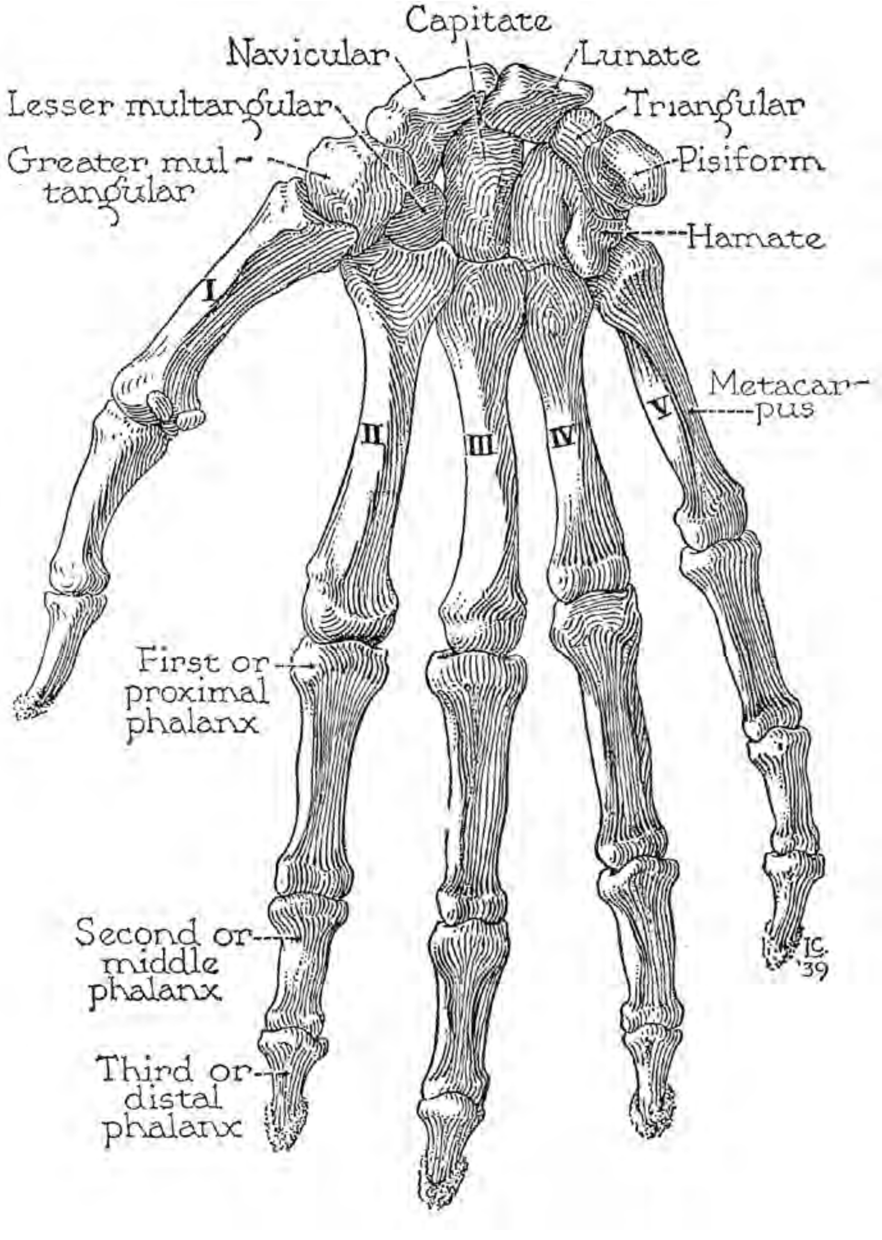

Figure 1. The bone structure of the human hand.

that make up the hand. This fact enables some of us to be superb at knitting and others to be skilled at woodworking (Schmidt and Lanz, 2004, p. 1). Another concern is explaining handedness.

> Approximately 66% of humans are right-handed, 4% are left-handed, and 30% are to varying degrees ambidextrous. Studies of families have demonstrated that genetic influences are responsible for handedness. The relationships between handedness and asymmetries in the brain have been the subject of ongoing discussion. Dominance of one hand influences the size and structure of the hemispheres, just as the brain in turn determines the hand's capability in terms of structure and functional differentiation (Schmidt and Lanz, 2004, p. 2).

Clear sexual differences also exist in hand ability. For example, every feature in men's hands is, on the average, larger than in women's hands, and the

> same is true of digit span. However, women are generally capable of larger active ranges of motion, such as flexion of the metacarpophalangeal joint of the thumb, radial or ulnar deviation, and circular hand motions (Schmidt and Lanz, 2004, p. 2).

Finger Wrinkling

Fingers and toes normally wrinkle when soaked in water for around five minutes. This response was commonly attributed to local osmotic reactions. Ironically, almost a century ago, surgeons first noted that wrinkling does not occur when the sympathetic nerve to the finger has been severed (Changizi, et al., 2011, p. 286). Evidence now exists that rather than being an accidental side effect of water exposure, wet-induced wrinkling is a result of design to enhance finger grip power in wet conditions (Changizi, et al., 2011).

An analogy can be found in that smooth tires provide the best grip in dry conditions and treaded tires the best grip in wet road conditions. The finger-wrinkle morphology displays the properties of drainage networks, enabling more efficient drainage of water from the gripped surface. The result is non-wrinkled fingers provide the best grip in dry conditions and wrinkled fingers the best grip in wet conditions (Changizi, et al., 2011, p. 287). The postulated mechanism is neutrally mediated digit pulp vasoconstriction, indicating clear evidence of design.

Wet-induced finger wrinkles not only has the signature morphology of a drainage system, but the five-minute time required for the wrinkles to appear also is appropriate for natural wet conditions. The reason is that it is soon

Figure 2. An artist's schematic view of the evolution of the human hand from a fish fin. Note that a complete lack of fossil evidence exists for this theory. Drawing reproduced with permission of Dr. Reinhard Putz, MD

enough to be helpful in dew or rainy conditions but not so fast that short contact with water, such as drinking from a wet glass, will trigger it (Changizi, et al., 2011, p. 290).

The Arm

A critical part of the hand is the arm. The arm and hand function together as a unit and the arm is no less well designed than the hand. This is illustrated by attempts to duplicate its function. One writer noted that, to create a brain-controlled device that could achieve the feats of a human arm was one thing,

> but to pack that device into the size and weight of a native human arm was quite another. [Scientist] Ling calls the human arm the most advanced biological tool in nature … picture all the things a human arm is required to do during the course of an ordinary day. It is strong enough to hoist a bowling ball, yet dexterous enough to pluck up a feather. It can play a piano, type on a keyboard, weed a garden, swim, shake hands, lift groceries, and in the case of a solider, field-strip an M16 rifle. It's impervious to water and to extremes in temperature ranging from below zero degrees Fahrenheit to more than one hundred degrees, and can operate … as long … as its owner is awake and active (Belfiore, 2009, p. 13).

He added that nothing

> created by the most advanced science and engineering could come anywhere close to matching this performance … think of the robots at Disneyland. You go down and look at their robots and say, "Man, look what they've got: hands that are moving and arms that are moving…." But what you don't see is what's behind the curtain. … It's this monstrous machine (Belfiore, 2009, p. 13).

Evolutionary Origin

In trying to determine how hands evolved, "researchers over the past 150 years have dug up fossils on every continent" to compare the anatomy of "hands" in a wide variety of animals (Zimmer, 2012, p. 102). They have even studied the genes that construct them and their accessory structures, such as the brain, to locate evidence of evolution. It was determined a century ago that humans have two hands and two feet whereas higher primates have four hands and most chordates have only four feet, a difference Agassiz termed "very striking" (Agassiz, 1900, p. 7). This is only one example of the chasm between humans and all other life-forms, including chimps.

The current theory of hand evolution purports that human

> hands began to evolve at least 380 million years ago from fins—not the flat, ridged fins of a goldfish but the muscular, stout fins of extinct relatives of today's lungfish. Inside these lobe fins were a few chunky bones corresponding to the bones in our arms. Over time the descendants of these animals also evolved smaller bones that correspond to our wrists and fingers. The digits later emerged and became separate, allowing the animals to grip underwater vegetation as they clambered through it (Zimmer, 2012, p. 102).

As shown in Figure 2, the basic hand structure is postulated by evolutionists to have originated from the pectoral fin of fish (Putz and Tuppek, 1999). Evolutionists also postulate that the precursors of the bones and intrinsic muscles of the hand are present in the anterior fin of primitive fishes.

Since the human hand has fewer structures than a fish fin, evolutionists theorize that the 20 to 30 digits in fish were reduced to just ten in humans (Putz and Tuppek, 1999, p. 357). A major problem is that the fossil record does not indicate the origin of these structures but instead requires a postulated loss and rearrangement:

> Early hands were more exotic than any hand today. Some species had seven fingers. Others had eight. But by the time vertebrates were walking around on dry land 340 million years ago, the hand had been scaled back to only five fingers. It has never recaptured the original exuberance of fingers—for reasons scientists don't yet know (Zimmer, 2012, p. 102).

Therefore, evolutionists postulate that instead of evolving new structures, a reduction process occurred in hand evolution since hands first began to evolve from fish fins. The theory also postulates that hand muscles evolved from fish dorsal and palmar compact plates. The differentiation process followed the development of the fingers. The development of the individual hand is controlled by a group of homeobox genes that is comparable in many different species (Putz and Tuppek, 1999, p. 357).

The prehensile hands and feet of primates are postulated to have evolved from the mobile hands of semiarboreal tree shrews (genus *Tupaiidae*) that lived about 100 million years ago. This development has been accompanied by major changes in the brain and the relocation of the eyes to the front of the face, allowing for the muscle control and stereoscopic vision required for controlled grasping. This grasping, also known as *power grip*, is supplemented by the so-called *precision grip* between the thumb and the distal finger pads made possible by the opposable thumbs.

Supposedly, when hominidae (great apes including humans) acquired an erect bipedal posture, this evolution is assumed to have freed the hands from locomotion and paved the way for the precision and range of motion in modern human hands (Schmidt and Lanz, 2004, p. 105). No detail is provided of how all this evolutionary development could have occurred. Thus, it is actually nothing more than a "just-so" story.

Tocheri et al. (2008, p. 558) concluded only that "current fossil evidence does … provide some interesting clues" about human hand evolution. They note that the fossil record does not document human hand evolution, noting "there is no question that additional fossil and comparative evidence is needed to more fully reconstruct the evolutionary history of the hominin hand" (Tocheri et al., 2008, p. 558). Their tentative summary on the current theory states that the "presence of some derived characteristics in earlier hominins suggest that the evolution of the hominin hand, from the origin of the hominin clade to the present, has probably proceeded in a mosaic fashion" (Tocheri et al., 2008, p. 558). Use of the term "mosaic" is merely an attempt to explain the fact that the fossil record does not support their theory of hand evolution.

Hand-Brain Unit

The unique anatomical features of the human hand include a long, opposable thumb and fingers that can be controlled individually by the brain to a higher degree than that existing in any other animal.

Another major problem for Darwinism is the fact that the evolution of the human hand requires major changes, not only in the hand itself, but also in the nervous system and the brain. Also necessary is a change in the relocation of the eyes to the front of the face, which allows the fine muscle coordination and stereoscopic vision required for controlled grasping and other hand functions. The enormous complexity of brain control of the hand is illustrated by the fact that hand

> movements are controlled by many distinct regions of the brain. Component movements are subject to immediate cortical control, whereas subcortical areas (basal ganglia) regulate the patterns of activity of entire groups of muscles. The motor functions of the hand are represented in the motor cortex (Brodmann's area 4), supplementary motor cortex, and premotor cortex (area 6). Neurons of area 4, which receive afferent fibers from the cerebellum [are also important] (Schmidt and Lanz, 2004, p. 2).

The hands of other primates are anatomically similar to humans. For this reason the higher level of human hand dexterity cannot be explained solely by anatomical factors. The brain is the main source of differentiated tactile sensations—and a precise working organ enabling humans to make hand gestures—an expression of our personality often called talking with our hands (Putz and Tuppek, 1999, p. 357). The brain control of the human opposable thumb design makes possible both the grasping or power grip and the precision grip between the thumb and the distal finger pads.

Primate to Human

Analyses of the features unique to the modern human hand have shown that they were designed to deal, not only with the requirements associated with the effective use of tools, but also with the ability to achieve tasks far beyond this. For example, as noted, the hand is an expression of the brain, a direct tool of our consciousness, and our gestures are direct, outward expressions of our personality (Putz and Tuppek, 1999, p. 357). It is a main source of differentiated tactile sensations as well as a precise working organ.

Evolutionists hypothesize that around three million years ago early hominidae (ancestor of both the great apes and humans) evolved an erect, bipedal posture that freed the hands from the locomotion requirement and paved the way for the evolution of the precision and range of motion existing today in human hands (Schmidt and Lanz, 2004. p. 105). Unfortunately, the hand's supposed evolution does not follow a continuous pattern, a fact particularly evident when considering the development of the thumb design (Putz and Tuppek, 1999, p. 357).

The putative primitive features in the human hand include pentadactyly (having five fingers), the hairless skin of the palm and fingers, and the *os centrale*, a structure that exists in human embryos, prosimians, and apes but not modern adult hands. Evolutionists claim that the human hand proportions are slightly plesiomorphic, meaning they represent a primitive state of evolution relative to another organism, and thus are shared by many extant primate species.

Other anatomists note that the elongated thumbs and short human hands more closely resemble the hand proportions of Miocene apes than those of extant primates (Almécija, 2009). From this fact some evolutionists have concluded that humans could not have evolved from knuckle-walking apes (Kivella and Schmitt, 2009). Rather, they reason that chimpanzees and gorillas must have independently acquired their elongated metacarpals as part of the adaptation required to achieve their mode of locomotion (Lovejoy et al., 2009). Nonetheless, Zimmer (2012, p. 102) claims that there exists

> a great diversity of hands in living species, from dolphin flippers to eagle wings to the hanging hooks of sloths. By studying these living hands, scientists are beginning to understand the molecular changes that led to such dramatic variations—and to understand that despite the outward differences, all hands start out in much the same way. There is a network of many genes that builds a hand, and all hands are built by variations on that same network. Some sculpt the wrist; others lengthen the fingers. It takes only subtle shifts in these genes to make fingers longer, to make some of them disappear, to turn nails into claws.

Several primitive hand features speculated to be present in the postulated chimpanzee-human last common ancestor, but absent in modern humans, are believed by evolutionists to exist in the hands of Australopithecus, Paranthropus, and Homo floresiensis. This suggests to evolutionists that the changes in modern humans and Neanderthals did not evolve until after the appearance of the earliest Acheulian stone tools and that these changes are associated with tool-related tasks beyond those observed in other hominines (Tocheri et al., 2008). The *Ardipithecus ramidus* thumbs are like those on humans, but the palms of other extant higher primates are elongated to the extent that it is assumed some of the thumb's original function was lost in arboreal primates such as spider monkeys.

Functional analyses of the features unique to the human hand have shown that their features are consistent with the requirements associated with the effective use of Paleolithic stone tools, clear evidence that so-called Paleolithic people were modern humans (Marzke, 2012). Zimmer (2012, p. 98) again noted that the human

> hand is so remarkable that the great Scottish surgeon Sir Charles Bell wrote an entire book in 1833 praising it, *The Hand: Its Mechanism and Vital Endowments, as Evincing Design*. At the time, the notion that life evolved was beginning to circulate, but Bell thought a close look at the human hand would dispel such silly talk. "It presents the last and best proof of that principle of adaptation, which evinces design in the creation," he wrote.

In an attempt to refute creationist reasoning, Zimmer's main argument is that the design theory does not explain why other species have hands too.

> No one would doubt that the five fingers at the end of an orangutan's arm are anything else. In other cases we have to look closer. A bat's wings may look like sheets of skin. But underneath, a bat has the same five fingers as an orangutan or a human, as well as a wrist connected to the same cluster of wrist bones connected to the same long bones of the arm. When Charles Darwin wrote *Origin of Species*, he singled out this odd coincidence. "What can be more curious," he asked, "than that the hand of a man, formed for grasping, that of a mole for digging, the leg of the horse, the paddle of the porpoise, and the wing of the bat, should all be constructed on the same pattern?" For Darwin, there was a straightforward answer: We are cousins to bats and to all other animals with hands, and we all inherited our hands from a common ancestor (Zimmer, 2012, pp. 98, 102).

A more straightforward explanation is that the pentadactyl skeletal design is versatile and an efficient design not only for hands but also for flippers, bat wings, and penguin paddles. There is no logical reason to believe a creator would limit an efficient design to a single creation. Instead of assuming these designs are inferior and claiming they support evolution, critics should postulate an improved skeletal design for flippers, bat wings, and penguin paddles, and then document that their new design is superior.

Additional Challenges

The latest theory for the evolution of the unique human hand design is that such design allows clenching the fingers in manner so as to create an effective bludgeon to use as a punishing weapon (Morgan and Carrier, 2013). This supposedly allows humans to be more fit for survival than other primates (Wayman, 2013). The researchers note that the human hand configuration allows for the formation of a fist that, as any boxer knows, can produce a powerful blow with little damage to the hand. Knight (2013, p. i) found that

> modern chimpanzees have long palms and fingers with a short thumb, while the human palm and fingers are much shorter and the thumb longer and stronger.... This squat arrangement allows us to clench our hand into a fist when we fold the thumb across the fingertips; however, chimp fingers form an open doughnut shape when curled.... The tightly packed human fist provide[s] internal support—buttressing—to the digits to protect them from damage during combat.

The study found that the presence of the buttressing thumb doubled the delivered force by transmitting it to the wrist through the metacarpals (palm bones) of the thumb and the index finger (Knight, 2013). This theory appears to be a desperate attempt to explain the design of the hand in view of the failure of all other attempts to explain it by evolution.

Design of the human hand is regarded as a major reason for human superiority compared to all other animals, yet its design is found nowhere else in the animal kingdom. In view of its superiority, why has no other animal evolved a similar design? Some primates have a design that is similar, so it would appear that evolutionary selection would have favored any movement toward this design. Yet, this evolutionary development has not happened, and the fossil record reveals no evidence of any movement toward the human hand.

Summary

A major problem for evolution is that the human hand is irreducibly complex, requiring a number of anatomical and neurological features/systems simultaneously. This includes the concurrent evolution of a complex assembly of bones, muscles, tendons, blood vessels, skin, and ligaments. In addition, this includes the evolution of required hardware and software (namely the brain and nervous system) in order to function. Unless, and until, all of the basic parts are in place, it will not function. This is true not only of hands but also of fins and paddles found in other life-forms. Furthermore, as Schmidt and Lanz (2004, p. 1) summarized,

> the human hand is far more than merely a grasping mechanism. It is a highly developed, extremely adaptable tool … a highly sensitive organ of touch. For blind persons, it can partially compensate for loss of eyesight. Its capacity for gestures makes it an important element in interpersonal communication. In writing, music, and art, it acts as a means of expression for the human mind. Precise cerebral control of the hand's movements permit a wide range of composite motions that may be executed with strength, speed, or precision as required by the specific situation. A salient characteristic of the human hand is its opposable thumb. The mobility and strength of this structure are crucial to ensuring a fully functional hand.

Indeed, the "human hand is a finely tuned piece of equipment that is capable of remarkable dexterity: creating art, performing music and manipulating tools" (Knight, 2013, p. i).

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