



by Douglas G. Smith, MD

Partial-Hand Amputations

We routinely call upon our hands to perform a huge number of tasks. As noted in the introductory article of our series on upper-limb amputation, recovery and rehabilitation, we ask our hands to perform everything from the delicate and intricate to the strenuous and forceful.

Our hands demonstrate the architectural concepts of form and function. In surgically treating hand injuries, we often balance function with cosmesis (appearance). When the hand is badly injured or subject to disease and requires amputation surgery, our goal is to both restore as much function as possible and consider what can be done to minimize the appearance of the loss.

Until one experiences a severe hand injury or partial-hand amputation, we rarely consider the tremendous contribution of our hands to body image. In most cultures, our hands and face are what we present first to the world about ourselves. An injury to the hand that requires amputation involves more than just physical loss; it's also a profound loss of a part of ourselves. It's a loss of our presentation to others.

It should come as no surprise that the hands are the primary site for amputation injuries, since we use them so often and in so many ways. The exact number of amputations involving all or part of the hand that occur each year is difficult to determine because most researchers track only major upper-limb amputations (those above the wrist). But we know from a 12-year national



study, published last November in the journal *Pediatrics*, that nearly 92 percent of 102,257 amputations among children and adolescents involved one or more fingers.

Among children, finger and hand injuries usually involve doors. Adult finger and hand injuries are often the result of accidents with industrial or home power tools.

The Amazing Thumb

One of the things we learn as far back as elementary school is the vital importance of our thumbs. The thumb enables most of the hand's function. If you lose your thumb, it's really devastating. The thumb, many say, is one of the key things that enabled us to evolve to become the creative, designing and constructive human beings that we are. Being from Seattle, I love this quote by photographer and humorist Flash Rosenberg: "I believe humans get a lot done, not because

we're smart, but because we have thumbs so we can make coffee."

Surgically, we can do some really extraordinary things when the thumb is severely injured. We're much more likely to do salvage surgery, such as bone and skin grafts, and flaps, in hopes of saving at least part of the thumb and its function. Sometimes, if the thumb can't be saved, surgeons will take the person's index finger and relocate it to the thumb area so that it, hopefully, will restore some function. Alternatively, even the second toe can be transferred up to the thumb position. The transplanted toe is sometimes referred to as a "thoe."

Some people might ask, "Why wouldn't you perform a thumb transplant from a donor, rather than removing a toe? After all, kidney, heart and lung transplants are done all the time." While taking a toe from the same individual to replace a thumb may seem unnecessary in this day and age of donor transplants, it allows the person to avoid the issues of tissue rejection and medication. I believe that the lifelong impact of medications used to suppress rejection is vastly understated in typical discussions concerning organ and tissue transplantation.

The Fingers

The fingers, digits two through five, are located on our hands to work uniquely with digit number one: the thumb. These strong, slender extensions are also known as the index finger (the one closest to the thumb), middle finger, ring finger and small finger (sometimes referred to as the pinkie). Our fingers can come into contact with the thumb in various ways to fit the task, be it in tip-to-tip pinch, side-to-side pinch or key

pinch (the way your thumb and index finger hold a key). The fingers work in concert with the thumb and palm to give our hands maximum dexterity and strength, creating grip patterns too numerous to count.

When I speak to students who are training to become medical professionals, I'm always interested in how they'll answer the question: "If you had to lose a finger, which one would you give up?" Almost all people say they'd give up the fourth or fifth finger. (Nobody ever says the thumb.) But, interestingly, the digit that is functionally replaced most readily is the index finger. The middle finger can do everything the index finger does, and do it very well. Also, the space caused by the loss of an index finger is less noticeable than the loss of other fingers since there's already a gap between the index finger and the thumb. Losing the middle and/or ring finger leaves a gap that is quite noticeable and makes it difficult to hold some objects or pick up things, such as coins.

The loss of the fourth or fifth finger results in a frustrating loss of grip strength and hand power. Try the doorknob test: Grasp a doorknob and turn it to open the door. See how much strength and leverage the ulnar side

of your hand (the part with fingers four and five) gives you to turn the knob? Without the ring finger, pinkie, or both, you lose an incredible amount of strength for gripping and rotating the hand.

Losing One Can Weaken the Others

Many people have asked me, "I've lost one finger and damaged another, but the remaining two don't work quite right anymore. Why have the uninjured fingers lost some motion and strength?" The loss or damage of a finger impacts the others in subtle ways. The tendons that flex and extend our fingers have a great deal of "excursion" (meaning they travel long distances), but they don't work totally independently of each other. If one or two fingers are damaged, the subsequent scarring of their tendons can limit some of the uninjured tendons. This "tethering" of the tendons for the injured digit can create the very real perception that the uninjured fingers no longer have their full motion and strength.

Surgically, the solution sometimes is to remove the scarred tendons of the damaged fingers. By releasing the constriction in the

damaged digit, the uninjured, neighboring tendons are now free to move over their full excursion. Removing the "anchor effect" from the damaged digit results in restoration of fuller motion and strength in the uninjured digits.

See for yourself how restricting the movement of the tendons of two fingers affects the flexibility and dexterity of the other two. Press your ring and little fingers back a bit, as if you were trying to fold them back to touch the top of your wrist. (Not too hard or too far, though. We don't want you to hurt yourself!) Now, with those two fingers pushed back, try to make a fist with the other two fingers. Very difficult, isn't it? This demonstrates how restrictions on the tendons of some fingers greatly impact the other digits.

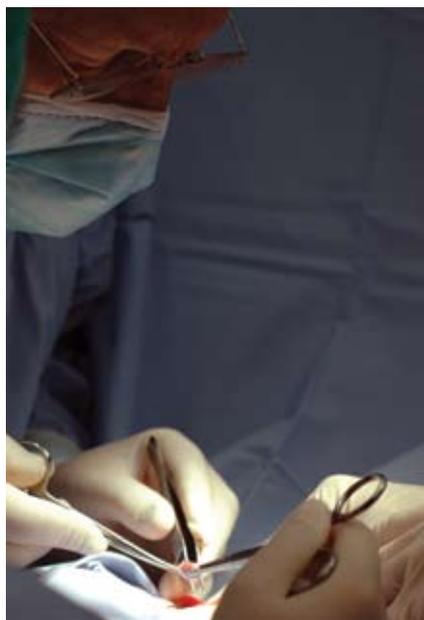
Sensitivities

Two long-term problems with all partial-hand amputations, whether palm, finger or fingertip level, are hypersensitivity and



intolerance to cold. Our fingers have so many nerves that injury can result in hypersensitivity, where the slightest pressure results in severe pain. Also, some people with partial-hand amputation can't go out in the cold without their hand "freezing up" and becoming stiff or completely immobile. Intolerance to cold is common after finger or partial-hand amputation but usually improves over time. When these two problems persist, treatment involves desensitization therapy and, occasionally, medication. Unfortunately, medications aren't always as successful as we would like.

I've also had some patients tell me of their experiences with chilblains, an itching, burning sensation resulting from exposure to moist cold. This chronic condition can cause discomfort when temperatures drop, limiting some people's outdoor activities. Some people must change professions because chilblains prevents them from



working outside in the cold. Others move to warmer regions in search of relief.

Surgical Decision-Making

As a surgeon, performing amputations on the hand involves a balance between functional needs and appearance. While contemplating treatment options for hand amputations, I want to know something about who my patients are. What they do for a living. How they use their hands. For example, do they play a musical instrument? Do they work with tools? Are they an auto mechanic, perhaps, or a fashion designer? Does the injury involve the dominant or

nondominant hand? We all use our hands in our work; how will amputation and surgical modification affect what we do for a living and how we do it?

Changes brought about by partial-hand amputation can result in a fairly noticeable defect, but attempts can be made to minimize the appearance of loss. For example, after loss of the fifth finger, the surgeon may elect to keep the palm as wide as possible to preserve hand strength, giving the person a broader surface for grip and torque. This amputation site is very obvious, with an abrupt step-off and contour change (Figure 1). But if the surgeon chooses to surgically narrow the palm by removing all but the base of the fifth metacarpal, then the loss isn't so obvious (Figure 2). However, when we surgically taper the amputation site, the hand looks more contoured, but there is no doubt that the hand is weaker.

Knowledge of the factors that balance function and appearance plays a role in the difficult decisions concerning reconstruction of severely injured hands, reattachment of digits and partial-hand amputation. That's why we try to find out all we can about a person's work, hobbies, and issues of appearance and body image. A person who doesn't have as great a need for hand power may be a candidate for the tapering procedure. On the other hand, someone who uses tools and performs manual labor

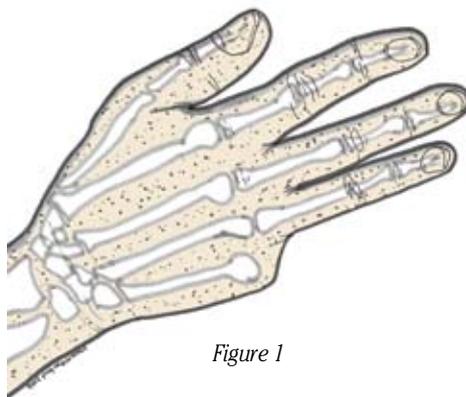


Figure 1

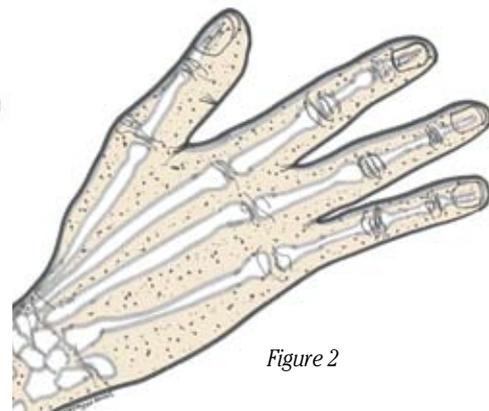


Figure 2

By Lynne McFarland. Used by permission of Prosthetics Research Study

probably needs a hand that is functionally stronger, even if he or she is left with the more abrupt-looking amputation site.

I think it's interesting to note that we frequently see examples of partial-hand amputations that we don't even notice. Most cartoon characters are drawn with only three fingers and a thumb. Animators learned long ago that a cartoon hand drawn with four fingers and a thumb just looks too big. They also realized that the eye often perceives nothing unusual-looking about a hand with three fingers and a thumb, provided the contours are smooth. We simply do not count the digits.

Even modern-day cartoonists have fun with this. An episode of the popular TV series *The Simpsons* featured Bart and Lisa talking about the future of animation and how cartoon characters might someday have five digits. They both found the idea shocking! Bart and Lisa, and all the human characters on *The Simpsons*, for that matter, have three fingers and a thumb on each hand.

Goals, Methods and Differing Opinions

Prosthetic devices for individuals with partial-hand amputations are extraordinarily diverse and individualized. Our next article in this series will focus on partial-hand prostheses and begin to introduce the incredibly complex issues of upper-limb prostheses.

Amputation surgery is primarily aimed at preserving as much length as possible, combined with restoring function to the greatest degree that we can. We also hope to prevent pain from neuromas and joint problems. Ultimately, the person wants most to return to the work and activities that make up his or her life. In addition to restoring function, we're also very concerned with the residual hand's appearance, since it's such a significant part of our self-image. In spite of the fact that no two surgeons will do the same things exactly alike, I'm happy to say that the vast majority of individuals who have partial-hand amputation procedures successfully undergo recovery and rehabilitation and return to fulfilling lives.

When physicians have different approaches to surgical techniques and methods, it's often because several methods work reasonably well but no single way of managing the injury is vastly superior to another. This leads to different treatment options that have supporters. Whenever possible, I try to explain to the patient and family members the range of surgical approaches to be considered and which one(s) I believe would be the wisest.

Some people wonder why surgeons don't always agree on techniques and procedures. I sometimes think surgeons are a bit like politicians – having many different points of view and philosophies that can be argued and debated forever. As writer and philosopher B.J. Gupta wisely stated, “All fingers are not alike. If you cut bigger ones to make all equal, it is communism. If you stretch smaller ones to make all equal, it is socialism. If you do nothing to make all equal, it is capitalism.” ■