Hand Injury Prevention

Raymond G. Hart, MD, MPH From the Christine M. Kleinert Institute for Hand and Microsurgery, Louisville, KY.

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SEE RELATED ARTICLE, P. 630.

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"Our hands are not only beautiful, they are superb technological tools with an elegance all of their own."
"Clenched they form fists—defiant, dangerous weapons."
"Cupped they cradle heads and comfort crying kids."
"Stretched out and held open their fingers form the five radiant points of a star…"
"Quite literally, we hold knowledge, art, and soul in our hands…"
ND Mitchell, theologian, from a church newsletter

Our hands are so vital to who we are as human beings that we tend to take them for granted. They are key to our individual productivity, our work and play, and collectively, how our species learned to hunt and gather. The sensitive touch of a mother for her newborn baby, the powerful grip of a weightlifter, the brilliant finger work of a world-class pianist, and the extraordinary speed and precision of a typist are all dependent on intact and normally functioning hands. This complex combination of beauty, strength, sensitivity, and precision is ours as human beings.

Unfortunately, our fingers and hands are exposed to all types of harm and mischief. To compensate, we have developed exceptional protective reflexes that match our sensitive touch with a lightning fast withdrawal, allowing the fingers and hands continual escape from potential harm. The great mobility of our joints, coupled with the tough, protective skin and nails, helps prevent serious and permanent damage to the underlying delicate structures. Yet still, we see a significant number of hand injuries in our emergency departments (EDs). Annually, more than 4.8 million ED visits, some 4% of the total, involve injuries to the fingers or hands.[1]

Hand injuries are an important and underrepresented problem that require a heightened focus on the part of the emergency physician. Although they are rarely, if ever, life threatening, they may lead to disabilities that threaten the patient's appearance and ability to earn a living. These injuries are most commonly given a low triage priority score, and the harried emergency physician can easily overlook subtle but potentially disabling hand injuries. Therefore, emergency physicians must carefully evaluate, treat, and selectively refer appropriate patients to achieve the best possible outcomes. We must also search out opportunities to prevent as many hand injuries as possible.

The article by Conn et al[1] reports data on a very specific type of injury to the fingers and hands that we see all too frequently—amputations. An amputation is generally defined as the removal of a limb or part of a limb through trauma or by surgery and may be further classified for total and subtotal amputation.[2] The amputation of a body part is particularly devastating because it is often associated with a great personal sense of loss, requires adjustment of body image, and implies an irreversible event.[3] Amputations are not only physically painful, but they require expert care to return the healed patient to the highest possible level of pain-free functioning. The patient with a significant amputation often requires physical and occupational therapy, as well as possible psychological counseling. Fortunately, in relation to fingers, it is sometimes possible to successfully re-implant an amputated digit with near or complete return of sensation and function.[4,5]

Conn et al[1] specifically address amputations in the non–work-related population. Their results indicate that, of the 107 million ED visits that occurred in 2001, just under 3%, or 3 million, of these visits involved injury to the fingers. The largest percentage of these injuries (44%) were lacerations. For persons 15 years or older, an estimated 21,431 ED patients annually suffered amputations, which equates to about 0.75% of ED finger injuries each year. In addition, the authors identified 2 high-risk populations for sustaining finger and fingertip amputations: children younger than 4 years and men aged 45 to 65 years. The most common mechanisms of injury were doors in the younger population and power tools among the adults. This information can provide the foundation for efforts to prevent these injuries.

The "3 E's" of injury control—education, enforcement, and improved engineering—can effectively prevent many of these injuries.[6] First and foremost is surveillance with accurate data collection to document the number and mechanisms of injury. Identifying high-risk populations and common mechanisms of injury can help target prevention programs where they will do the most good. In addition, a Haddon matrix is a helpful tool (Table). An injury prevention program aimed toward preschool children and their parents is being developed here at the Kleinert Institute in Louisville, Kentucky. Our education tools include a slogan, booklets, an interactive play, an educational video, and evaluation measures. Engineering changes recommended for doors include softening of sharp edges, auto-release mechanisms, and attachable finger pinch guards. Door manufacturers and automobile companies, particularly manufacturers of vehicles aimed at motorists with young

Table. Haddon matrix.

Child Fingertip Amputation	Human (Individual)	Agent and Carrier	Environment	
			Physical	Social
Pre-event	Age <4 y; unsupervised; angry or playful	Weight of door; sharp edges of door; no safety features	Running; slamming doors	No understanding of danger; no door safety features
Event	Number, size, and specific digit; protective gloves	Force of slammed door; completely or partially slammed closed	Impact area of digit(s)	Age of door; door maintenance; design specifics of door
Post-event	Pre-existing conditions; first aid; EMS; ED care; hand care specialist; rehabilitation	Effect of yanking or pulling injured digit from unopened door	Urban/rural proximity to medical care; weather	Provision of medical care; financial, legal, social resources

EMS, Emergency medical services.

children, could be encouraged to include door design safety as a standard feature of their products. Quality improvement monitoring would reveal whether these mechanisms were successful. Economic incentives should be in place to reward manufacturers who design, develop, and implement these features.

The second identified high-risk population is older men using power tools. Again, proven concepts of injury control can be applied to them as well, although this population presents unique challenges. Education in the proper and safe use of this equipment is obvious and important, but it may not be enough. Conn et al's[1] article does not elucidate contributing causes to these injuries, but it is likely that the use of high-powered tools with concomitant consumption of alcohol played a role in some of these injuries. In addition, their data cannot determine whether the operators were novices unfamiliar with the equipment or experienced users whose overconfidence or momentary inattention led to injury. Engineering safety improvement to power tools may be the best option, but it is difficult to strike a balance between maximizing safety and rendering the equipment ineffective or unacceptable. Safety guards that are poorly designed or cumbersome will be quickly disabled or removed by the clever (or perhaps not so clever) user. In occupational settings, it is sometimes possible to enforce compliance with equipment guards and other safety measures through supervisory oversight. This is not feasible in home settings.

The authors generated their estimates from the National Electronic Injury Surveillance System All Injury Program, an invaluable source of data for health care, research, and injury prevention.[7] Reliable, ongoing counts of the numbers and common mechanisms of injury is one of our best tools for characterizing various injury problems and monitoring the success of efforts to control them. However, there are important limitations to the use of these data. It is difficult to have much confidence in the details of this surveillance system when a quarter of cases do not contain sufficient data to specify which digit was involved.

A casual reader of this article might erroneously conclude that these injuries were insignificant. However, amputations, even at the distal tip of the finger, may involve the nail, nail bed, and potentially the distal phalanx, causing significant pain, risk of infection, and the potential for poor healing and deformity. Some of these patients may heal by secondary intention, but most require skin grafting, a V-Y advancement flap, or a similar repair which would only be performed by the specialist. Although the vast majority of patients were "treated and released" from the ED, it is likely that most of them were referred for definitive follow-up care the next day.

The focus of this article is non–work-related injuries, but a similar number of incidents occur each year in occupational settings.[8] There are certain high-risk populations for occupational hand injuries, in particular farmers and military personnel.[9] Farmers most often experience these injuries when their hands and fingers are trapped in belts, crop pickers, cutting blades, and other items of hazardous farming equipment. Removal of handguards and other safety devices to facilitate cleaning amplifies the risk. Operator fatigue and inattention are also problems. Likewise, data on military personnel from the Veterans Administration (VA) gathered on their entire roll of service-connected disabled veterans through September 2002 lists 17,010 individual amputations of the digits and thumb, including 5,604 to the index finger alone.[10] In addition, the VA's population of multiple digit amputations exceeded 3,000, including 167 classified as "amputation of five digits of one hand."[10] These numbers are striking for the large numbers but carry an additional weight because most of these are young men with many years of productive life left.

Injury control is a valuable science. It has been applied with great effect to the prevention of car crashes, pediatric poisoning, drowning, and closed head injuries. It does not as easily translate, however, to hand injuries. Hand injuries rarely lead to death and, although they cause significant disability, they do not inspire the same sense of urgency as the aforementioned conditions. In addition, although we may intuit that a given intervention is effective, it is difficult to prove its effectiveness preventing such a defined injury.

This data set provides some answers and many more questions. What were the impairment and disability ratings on these patients? What are the direct and indirect costs of these injuries? Can we develop practical hand injury prevention measures for the general population? Can we accurately measure their success or failure?

When all is said and done, is this the proper role of the emergency physician? Certainly, we have a responsibility to diagnose and treat hand-related injuries to the best of our ability. We should also refer patients who need more specialized

care to a properly credentialed surgeon or therapist. However, we can also apply our insights and data collection abilities to focus attention on the importance of hand injury prevention. This may increase our impact and reduce the burden of disability engendered by these painful, costly, and often disabling injuries.

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Address for correspondence: Raymond G. Hart, MD, MPH, Christine M. Kleinert Institute for Hand and Microsurgery, 225 Abraham Flexner, Suite 850, Louisville, KY 40202; 502-562-0306, fax 502-562-0326; E-mail rhart@cmki.org.

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