



Contents lists available at ScienceDirect

Journal of Hand Surgery Global Online

journal homepage: www.JHSGO.org

Original Research

Epidemiology of and Risk Factors for Table Saw Injuries of the Hands and Fingers

Rajeev N. Herekar, DO, * Michael K. Bokemper, MD, † Michael C. Doarn, MD, † Nino A. Coutelle, MD, * Jason A. Nydick, DO †

* Foundation for Orthopaedic Research and Education, Temple Terrace, FL

† Florida Orthopaedic Institute, Temple Terrace, FL

ARTICLE INFO

Article history:

Received for publication July 19, 2022

Accepted in revised form January 30, 2023

Available online xxx

Key words:

Hand

Injury

Prevention

Safety

Saw

Purpose: The purpose of this study was to evaluate circumstances surrounding power saw injuries. We hypothesized that power saw injuries are caused by either inexperienced or inappropriate usage of saws. **Methods:** A retrospective review of patients at our level 1 trauma center from January 2011 to April 2022 was conducted. Patients were screened using surgical billing records based on Current Procedural Terminology codes. Codes associated with revascularization; amputation of digits; and repair of tendon, nerve, and open metacarpal and phalanx fractures were queried. Patients who sustained power saw injuries were identified. They were then contacted by phone, and a standardized questionnaire was administered. Verbal consent was included in the standardized script, which was approved by the institutional review board.

Results: One hundred eleven patients were identified who underwent surgical treatment for power saw injuries of the hands. Of them, we were able to contact 44 patients, who consented to and completed the questionnaire. Of all of the contacted patients, 40 (91%) were men, with an average age of 55 years (range, 27–80 years). No patients were intoxicated when the injury occurred. Thirty-two (73%) patients had used the same saw for more than 25 times. Sixteen (36%) patients had not received formal training regarding safe use of their saw, and 7 (16%) had removed a safety mechanism prior to the injury. Thirteen (30%) patients had used the saw on an unstable surface, and 17 (39%) reported not having changed the saw blade regularly.

Conclusions: Power saw injuries occur for a multitude of reasons. Contrary to our hypothesis, more experience with the use of saws does not necessarily protect one from saw injuries. These findings highlight the need for formal training among new saw users and continuing education for the more experienced to help reduce the incidence of saw injuries that require surgical intervention.

Type of study/level of evidence: Case Series/IV.

Copyright © 2023, THE AUTHORS. Published by Elsevier Inc. on behalf of The American Society for Surgery of the Hand. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Power saw injuries of the hands and upper extremities are a common cause of disability and functional impairment. These injuries occur both occupationally and nonoccupationally and at an estimated frequency of 50,000 per year.¹ Patients who seek medical treatment for power saw injuries range from

inexperienced first-time users to patients with decades of experience.² In addition to the functional disability associated with these injuries, the financial consequences for patients can be devastating in terms of medical expenses and lost income. In 2009, investigators found a mean total cost of \$30,754 of medical expenses and lost wages for patients who sustained power saw injuries.³ Table saw injuries alone constitute medical costs estimated at 2 billion dollars per year.⁴ Prevention of power saw injuries is essential to decrease associated costs for patients and the health care system.

Several safety features have been added to certain types of power saws to decrease both the frequency and severity of these injuries. Blade guards, riveting knives, and SawStop are several

Michael K. Bokemper has moved to Nebraska Orthopaedic Center, Lincoln, NE
Declaration of interests: No benefits in any form have been received or will be received related directly to this article.

Corresponding author: Nino A. Coutelle, MD, Foundation for Orthopaedic Research and Education, 13020 Telecom Pkwy N, Temple Terrace, FL 33637.

E-mail address: ninocoutelle@comcast.net (N.A. Coutelle).

<https://doi.org/10.1016/j.jhsg.2023.01.017>

2589-5141/Copyright © 2023, THE AUTHORS. Published by Elsevier Inc. on behalf of The American Society for Surgery of the Hand. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Table 1
Patient Demographics

Demographics	Value
Sex	
Men	90.9% (40)
Women	9.01% (4)
Age (y)	
Average	55.0
Min/max	27/80
History of previous saw injury?	
Yes	15.9% (7)
No	84.1% (37)
Alcohol or drug use prior to saw injury?	
Yes	0% (0)
No	100% (44)
Tobacco use prior to saw injury?	
Yes	11.4% (5)
No	88.6% (39)
Hand dominance	
Right	95.5% (42)
Left	4.5% (2)
Side injured?	
Right	13.6% (6)
Left	86.4% (38)
Contributory medical history to saw injury?	
Yes	0% (0)
No	100% (44)
Use corrective lenses?	
Yes	59.1% (26)
No	40.9% (18)
Wearing corrective lenses when injured?*	
Yes	69.2% (18)
No	30.7% (8)

Max, maximum; min, minimum.

* Only 26 total in this row because only 26 required corrective lenses.

examples of these safety features.⁵ The Consumer Safety Product Commission and Underwriters Laboratories implemented guidelines in 2005–2006, and a subsequent decrease of 18% was noted from 2006 to 2015.^{1,5} Even with this decrease, there are still over 50,000 injuries per year.¹ Safety mechanisms are often removed by users to assist with cutting certain materials and making particular cuts.^{4,5} Lack of formal training also contributes to these injuries. Instruction manuals are often lengthy and time consuming to read.⁵ Training in schools (industrial arts or shop class) is decreasing.⁶ According to a National Center for Education Statistics report from the Department of Education, a 17% decrease was seen in Career and Technical Education credits earned in public schools in the United States from 1990 to 2009.⁶

The purpose of this study was to evaluate circumstances surrounding power saw injuries. We hypothesized that power saw injuries are caused by either inexperienced or improper usage of saws.

Materials and Methods

Patients were screened using surgical billing records based on Current Procedural Terminology codes. Codes associated with revascularization (35207 and 35236); amputation of digits (26951); and repair of tendon (26350 and 26410), nerve (64831, 64910, and 64912) and open metacarpal and phalanx fractures (26615, 26735, and 26746) were queried. Once patients were identified, a chart review was performed to determine whose injuries were caused by a power saw (n = 111). They were contacted by a single investigator (R.N.H.) using a standardized script (Appendix 1, available on the Journal's website at www.jhsgo.org). As part of the standardized script, the patients first provided verbal consent, which was followed by questions related to their injury and demographics. Contributory medical problems were those that were thought to

Table 2
Safety and Circumstantial Survey Data

Survey Questions	Response Values
Saw type?	
Table	43.2% (19)
Skill/circular	31.8% (14)
Miter/chop	15.9% (7)
Chain	6.8% (3)
Hole	2.3% (1)
Used same saw before?	
Yes	100% (44)
No	0% (0)
Used saw greater than 25 times?	
Yes	79.5% (35)
No	20.5% (9)
Used same saw greater than 25 times?	
Yes	72.7% (32)
No	27.3% (12)
Material participant was cutting when injury occurred?	
Wood	86.4% (38)
Metal	4.5% (2)
Composite	9.1% (4)
Received formal training with saw?	
Yes	63.6% (28)
No	36.4% (16)
Trained others on proper saw usage?	
Yes	43.2% (19)
No	56.8% (25)
Removed a safety mechanism from the saw?	
Yes	15.9% (7)
No	84.1% (37)
Regularly changed the saw blade?	
Yes	61.4% (27)
No	38.6% (17)
Cutting on flat/stable surface or from safe body position?	
Yes	70.5% (31)
No	29.5% (13)

affect the operator's ability to use saws safely, including movement disorders or neuropathy of the upper extremities. Details about the need for prescription eye wear and whether it was being used at the time of injury were also collected. The standardized script, including verbal consent and inquiry, was approved by the institutional review board. After data collection, percentages for each category were calculated.

Results

Of the 111 patients identified, we were able to contact 44 patients, who consented to the study, with 40 men and 4 women (average age, 55.6 years; range, 27–80 years). Neither contributory medical history nor the use of any drug or alcohol prior to sustaining their saw injury was reported. Seven (15.9%) patients had a history of a saw injury. Five (11.4%) patients reported tobacco use within 1 hour of their injury. The participants sustained their injuries from table (n = 19), skill or circular (n = 14), miter or chop (n = 7), chain (n = 3), and hole (n = 1) saws. Seven (15.9%) patients reported having removed a safety mechanism from their saw. Thirteen (29.5%) patients reported not having cut on a stable or flat surface or from a safe body position. Twenty-seven (61.4%) patients reported having regularly changed the saw blade, whereas two (4.5%) reported a dull blade being blamed for their injury. Twenty-eight (63.6%) patients reported having received formal training with their saw, and 19 (43.2%) reported having formally trained others on proper usage. Thirty-two (72.7%) patients reported having used the same saw for more than 25 times, and 20 (45.5%) of these incidents were reported to have occurred on the job.

The results of our query are listed in Tables 1 and 2.

Discussion

Prevention of power or electric saw injuries is critical to reducing patient disability, patient health care costs, and lost wages. This study identified several critical factors that contribute to saw injuries. To date, the literature has primarily focused on table saw injuries; however, skill or circular saw injuries have been found to cause the most injuries.^{3–5} This finding could be a result of recent safety measures added to table saws.^{4,5} Circular or skill saws are hand-held and much more portable than table saws, allowing users to make cuts in materials that are in difficult positions. Over a quarter of the injuries surveyed in this study were a result of the patients not cutting on a safe platform or not cutting from a safe body position. The patients reported injuries due to cutting overhead or trying to balance on an unstable platform while making cuts. Prevention of saw injuries due to this cause is difficult but requires extensive training and education of saw users given the high rate of injuries caused by cutting from an unsafe position.

Contrary to our hypothesis, 72% of the patients had used the same saw more than 25 times prior to their injury. Additionally, greater than 40% of the patients reported having formally trained others on the use of the same saw. These findings could be attributed to carelessness or fatigue, given the extensive experience, or an inevitably increased risk of injury with an increased number of uses of saws. Interestingly, 15.9% of the patients reported a previous saw-related injury. Regardless, these findings highlight the need for continuing education, even for users with extensive experience.

Another factor that contributed to the injuries was dull saw blades, with two patients subjectively stating that this was the primary factor for their injury. Approximately 60% of the patients reported being aware of regular saw blade changes. Saw users need to be educated on when and how to change blades. The recommendations by several manufacturers on the frequency of blade changes are variable; however, many recommend changing it when dull.⁵ Dull blades can bind and cause the material being cut to pull the nondominant hand toward the blade. Although this seems obvious, more formalized training on signs that the blade is becoming dull (eg, binding material while cutting) could help decrease injuries.

The injuries in this study almost exclusively occurred on the nondominant hand. Although this finding is expected, given that most people use their dominant hand for cutting, this could potentially give manufacturers a target for future safety devices. For instance, a glove that could be worn on the nondominant hand that is connected to a device that would stop the blade if it came in contact with the glove could be a potential future mechanism. Other devices that could hold the material being cut instead of the nondominant hand would also reduce the number of injuries.

Safety devices are only useful if they remain in place and are not removed or altered by users. Greater than 20% of the patients reported themselves or someone else having removed these devices prior to their injury. One patient reported that his employer or supervisor replaced the safety guard after his injury. Our study showed a small rate of safety device removal compared with other studies.⁴ Despite this, tamper-proof safety mechanisms created by manufacturers could decrease this. The simplest mechanism would be to disallow the saw to be started without safety mechanisms in place.

A strength of this study is direct contact with the patients filling out the survey either by phone or in person. This allowed for follow-up questions and a better understanding of circumstances surrounding their injuries. There are several limitations to the study, including small numbers, case series design, and low response rates (39.6% of the 111 patients attempted). Despite the limitations of the study, the findings highlight the need for formal training of new saw users and continuing education even for the most experienced ones. Guidelines to help increase safety mechanisms on saws were implemented in 2005 and showed a decrease in injuries.^{4,5} Formal training programs, however, are on the decline. With increased availability of the internet, standardized online training programs for new hires, with annual reviews, is one mechanism that could be employed in the workplace to decrease injuries. A coordinated effort between manufacturers developing new safety technologies and better formalized training programs will be necessary to prevent future power saw injuries. It is also possible that there were other saw injuries that were not identified by the search based on the Current Procedural Terminology codes.

Acknowledgments

Alfred Vincent Hess II, BA; Lazaro Mesa, MD; Peter Simon, PhD, for their contributions to the collection and analysis of the data.

References

1. Vosbikian MM, Harper CM, Byers A, Gutman A, Novack V, Iorio ML. The impact of safety regulations on the incidence of upper-extremity power saw injuries in the United States. *J Hand Surg Am.* 2017;42(4):296.e1–296.e10.
2. Justis EJ, Moore SV, LaVelle DG. Woodworking injuries: an epidemiologic survey of injuries sustained using woodworking machinery and hand tools. *J Hand Surg Am.* 1987;12(5):890–895.
3. Hoxie SC, Capo JA, Dennison DG, Shin AY. The economic impact of electric saw injuries to the hand. *J Hand Surg Am.* 2009;34(5):886–889.
4. Smith SE, Kendrick I, Huntsman T. Table saw injuries: are our safety features really keeping US safe? *Hand.* 2017;13(2):181–183.
5. Chung KC, Shauver MJ. Table saw injuries: epidemiology and a proposal for preventive measures. *Plast Reconstr Surg.* 2013;132(5):777e.
6. U.S. Department of Education. The Condition of Education; 2009. Accessed February 15, 2022. <https://nces.ed.gov/pubs2009/2009081.pdf>