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Acute Fingertip Injuries in Sudanese Patients: Patterns and Clinical Presentation

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Abstract

Background: Acute fingertip injuries are common and may lead to functional and aesthetic complications if not treated properly. Different types of trauma result in injuries with variable severity and affect certain risk groups. **Objectives:** To study the high-risk groups affected by fingertip injuries, their etiological factors, clinical features, and wound patterns, and the influence of hand dominance. **Study Design:** A descriptive study of 103 consecutive patients with 144 acutely injured fingertips. **Data Collection/Analysis:** We obtained demographic data, occupation, hand dominance, time and cause of trauma, and the presenting symptoms. Further, clinical examination, radiological, and laboratory studies were performed. Wound characteristics were classified according to the pulp, nailbed and bone (PNB) classification. The data were analyzed with the Fisher's exact test and Chi-square test. **Results:** A total of 103 patients (88 males, 15 females) presented with 144 injured fingertips. The male to female ratio was 5.8:1, and the mean age was 27.5 years. The age group affected most commonly was 16 - 20 years. There was a strong association between hand dominance and fingertip injuries, as in 65% of the cases, the dominant hand was injured more frequently than the non-dominant ($p = 0.01$). The sharp and blunt injuries observed involved the left hand more than the right and were often the result of machinery-related trauma ($p = 0.04$). Approximately 68% of the injuries were related to work, while 26% were attributable to domestic accidents. In 22% of the cases, seasonal workers were the category affected most often, followed by factory workers. Nearly half of the injuries were related to working with machines, while door-trapping was the most frequent cause of injury in children under 5. The index finger was injured most frequently (31.9%), followed by the middle finger (27.9%), while the thumb and little fingers were involved least (11% for each). Pulp injuries

were seen in 97% of cases, commonly with lacerations (39.6%, n = 139) while complete pulp loss was seen in 12.6% of cases. 87% of the cases were nail bed injuries, often with nail bed lacerations (28.6%, n = 126), while complete nail bed loss was observed in 9.5% of cases. Tuft fractures were the commonest bone injuries (26%), while complete bone loss was seen in 7.7% of the injured bones (n = 104). Conservative management was carried out on 9% of fingers, while the others required various methods of surgical repair. Nail bed repair was performed in 48.8% of cases (n = 126), while bone fixation was required in 20.2% (n = 104). **Conclusions:** Fingertip injuries are highly common in practice. In our study, the age, gender, mechanism of trauma and hand dominance had their influence on the pattern of injury. Finally, wound characteristics determine the type of management required.

Keywords

Fingertip, Pulp, Nailbed

1. Introduction

Many factors influence the outcome of treating fingertip injuries, such as patient age, sex, occupation, hobbies, hand dominance, pre-existing medical conditions, and the fingertip injury's anatomy. These injuries must be treated to preserve length, function, and sensation, as well as to ensure an acceptable appearance [1]. One-third of all traumatic injuries affect the hands [2], and the fingertips are the portion of the hand injured most frequently. Because it is the most distal and the last finger to be withdrawn, the middle finger is most at risk [3].

2. Classifications

There have been several classifications of fingertip injuries, such as the Allen classification (1980) and the Ishikawa classification (1990) (distal digital amputation levels). These classifications are very simple to use, but they cannot describe the details of an injury.

The PNB Classification

Evans and Bernadis introduced the PNB classification, in which the injury is divided into its effect on the fingertip bone, nail, and pulp, and each component is divided into 7 or 8 items that allow the injuries to be described more precisely. This results in a three-digit number that describes the injury accurately and can be used to document injuries without having to resort to lengthy descriptions. It may also be used as a guide for treatment and indications for referral [4]. In PNB 356 and PNB 455 and 466, surgical treatment is most suitable, and PNB 386 and PNB 666 and 700 indicate the boundary between surgical and conservative treatment [5]. Many controversies exist regarding treatment of the condition, but the management choice relies on the category of injury, the patient's occupa-

tion, hobbies, and cosmetic demands. When it is mandatory to return to manual work early, terminalization is the best treatment, and in certain cases, such as the thumb and index finger, a flap may be preferred based upon its length, sensation, and appearance [6].

Healing by Secondary Intention

- Composite Grafts;
- Revision Amputation;
- Skin Grafts;
- Local Flaps;
- Regional and Distant Flaps;
- Replantation.

3. Objectives of the Study

1) To investigate the etiology of acute fingertip injuries in Sudanese patients.

2) To determine high risk groups in relation to age, gender, and occupation and compare this with the international literature.

3) To study the association between fingertip injuries and hand dominance.

4) To evaluate wound characteristics according to the PNB classification, and discuss the options for management available.

4. Patients and Methods

This is a prospective descriptive study performed during a-one-year period. The study included a sample of 103 consecutive patients who presented to the Omdurman teaching hospital trauma department with 144 acutely injured fingertips (88 males, 15 females, mean age of 27.5, SD = 15.5, age range = 1.2 - 88, **Figure 1**), and injuries of more than 16 hours' duration were excluded. Initially, a comprehensive history was recorded for each patient. The participants were consented and completed a questionnaire on age, sex, contact numbers, occupation,

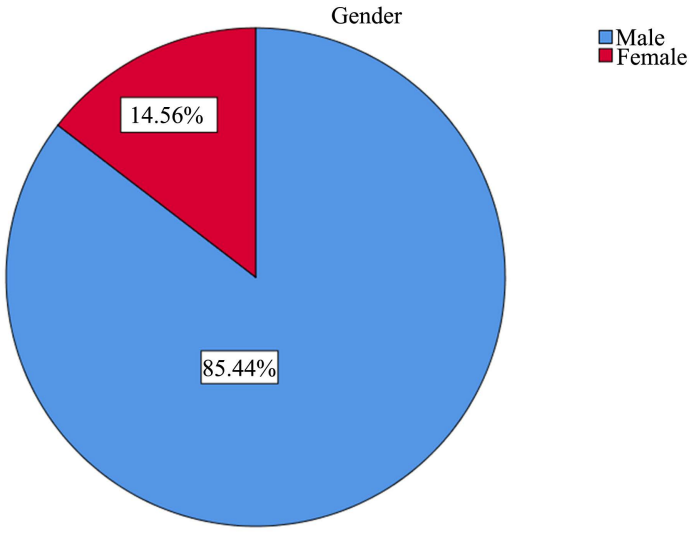

Figure 1. Gender distribution.

hand dominance, presenting symptoms, and mode of trauma. A thorough physical examination and plain X-ray findings were recorded. Wounds were assessed using the PNB classification. Data were analyzed using SPSS v.25. The Chi-square test was used, and a *p*-value of 0.05 or less was considered significant.

5. Results

Males were affected six times more than females (Figure 1). The age group in the patient population affected most commonly was 16 - 20 years (20.4% of cases), followed by 31 - 35 years (15.5%), and 21 - 25 years (11%). Children younger than 5 years constituted 11% of the total study population. Based upon the occupation analysis, seasonal and factory workers were injured most commonly, 29% and 22%, respectively. Dominant hand injuries were most common and were seen in 65% of the cases (Table 1).

The result of the Fisher exact test was significant at $p = 0.0004$ and showed a strong association between hand dominance and trauma. The most commonly observed injuries were related to machine use (Figure 2). Sharp and blunt injuries were observed that involved the left hand, while the predominant injuries of the right hand were attributable to machinery-related trauma (Table 2). Most patients presented with pain, while 73% presented with bleeding, and 38% had tissue loss. Fifty percent of patients presented within 2 hours after the trauma while 29.9% were seen 2 - 4 hours following injury. Four percent presented more than 12 hours after the time of trauma.

With respect to the trauma environment, 68% of the injuries occurred at work, and 26.2% at home. The remaining accidents occurred on the road or in school. Half of the injuries were attributable to machinery use and 25% were caused by blunt trauma. Injuries with sharp objects constituted 18.4%. Door-trapping was the commonest injury in children under 5 years (Table 3).

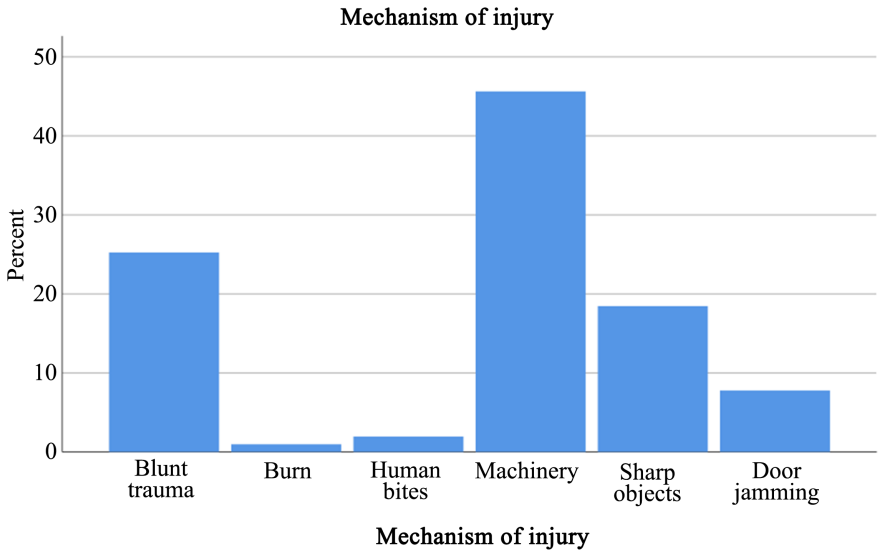

Figure 2. The mechanisms of trauma.

Table 1. The association between hand dominance and injury.

		Hand Dominance			Total
		Left-handed	Ambidextrous	Right-handed	
Affected hand	Left	12	1	33	46
	Right	1	3	53	57
Total		13	4	86	103

$p = 0.001$.

Table 2. Mechanisms of trauma in relation to the affected hand.

		Cause of trauma						Total
		Blunt trauma	Burn	Door jamming	Human bite	Machine	Sharp object	
Affected hand	Left	14	0	1	0	19	12	46
	Right	12	1	7	2	28	7	57
Total		26	1	8	2	47	19	103

$p = 0.04$.

Table 3. The mechanisms of injury in relation to environment of trauma.

	Environment in which injury occurred				Total
	Work	Street	Home	School	
Cause of trauma Blunt	14	3	8	1	26
Burn	0	0	1	0	1
Door jamming	1	0	7	0	8
Human bite	0	0	2	0	2
Machinery	43	0	4	0	47
Sharp object	13	1	5	0	19
Total	71	4	27	1	103

$p = 0.019$.

The mechanism of trauma was found to have an impact on the number of fingertips injured, machines and blunt trauma tend to affect more than one digit (**Table 4**).

The index finger was injured most frequently (31.9%). The middle finger sustained 27.1% of the total injuries, while the ring finger sustained 18%. The little fingers and thumb were affected equally (11%). The commonest finger susceptible to machine injury was found to be the middle finger, while the index finger was more prone to blunt trauma (**Table 5**).

Pulp injuries were seen in 97% of the cases and pulp laceration was the com-

monest presentation (39.6%, n = 139), followed by loss of the distal transverse pulp (18.7%). Complete pulp loss was seen in 12.2% of cases (Table 6). Nail bed injuries were seen in 87% of all cases. The sterile matrix laceration was the commonest injury, seen in 28.6% of cases (n = 126). Complete loss of the nail bed was observed in 9.5% of the cases (Table 7).

Bone injuries were observed in 72% of the cases. Tuft fractures were the most common bone injuries and were seen in 26% of cases (n = 104). Complete bone loss was observed in 7.7% of cases (Table 8).

With respect to management, 9% of the cases were treated conservatively, while 91% required various types of surgical repair, ranging from primary repair to skin grafting and tissue flaps (Table 9). Nail bed repair was performed on 48.8% of injured nails, while bone fixation was required in only 20.2% of the bones affected.

Table 4. Mechanism of injury * number of fingers involved crosstabulation.

Count						
		Number of fingers involved				Total
		Single finger	2 fingers	3 fingers	4 fingers	
Mechanism of injury	Blunt trauma	22	3	1	0	26
	Burn	1	0	0	0	1
	Human bites	1	0	1	0	2
	Machinery	25	14	5	3	47
	Sharp objects	15	4	0	0	19
	Door jamming	7	1	0	0	8
Total		71	22	7	3	103

Table 5. Mechanism of injuries related to each fingertip.

Count							
		affected finger					Total
		Index	Little	Middle	Ring	Thumb	
Cause of injury	Blunt object	14	4	8	4	5	35
	Burn	1	0	0	0	0	1
	Door	3	1	2	1	2	9
	Human bite	1	1	0	1	1	4
	Machinery	20	7	24	16	5	72
	Sharp object	7	4	5	4	3	23
Total		46	17	39	26	16	144

Table 6. The frequencies and percentages of pulp injuries.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Laceration	55	39.6	39.6	39.6
	Crush	14	10.1	10.1	49.6
	Loss-distal transverse	26	18.7	18.7	68.3
	Loss-palmar oblique partial	13	9.4	9.4	77.7
	Loss-dorsal oblique	6	4.3	4.3	82.0
	Loss-lateral	8	5.8	5.8	87.8
	Loss-complete	17	12.2	12.2	100.0
	Total	139	100.0	100.0	

Table 7. The frequencies and percentages of Nailbed injuries.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sterile matrix laceration	36	28.6	28.6	28.6
	Germinal, sterile matrix laceration	21	16.7	16.7	45.2
	Crush	15	11.9	11.9	57.1
	Proximal nail bed dislocation	7	5.6	5.6	62.7
	Loss-distal third	21	16.7	16.7	79.4
	Loss-distal two thirds	10	7.9	7.9	87.3
	Loss-lateral	4	3.2	3.2	90.5
	Loss-complete	12	9.5	9.5	100.0
	Total	126	100.0	100.0	

Table 8. The frequencies and percentages of bone injuries.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Tuft fracture	27	26.0	26.0	26.0
	Comminuted non-articular	17	16.3	16.3	42.3
	Articular	6	5.8	5.8	48.1
	Displaced basal	5	4.8	4.8	52.9
	Tip exposure	25	24.0	24.0	76.9
	Loss-distal half	6	5.8	5.8	82.7
	Loss-subtotal	10	9.6	9.6	92.3
	Loss-complete	8	7.7	7.7	100.0
	Total	104	100.0	100.0	

Table 9. Pulp repair options.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary repair	67	46.5	46.5	46.5
	Foucher flap	1	0.7	0.7	47.2
	Venkataswamy-Subramanian	2	1.4	1.4	48.6
	Kutler flap	5	3.5	3.5	52.1
	Palmar v-y flap	22	15.3	15.3	67.4
	Skin graft	13	9.0	9.0	76.4
	Terminalization	4	2.8	2.8	79.2
	Moberg flap	5	3.5	3.5	82.6
	Conservative treatment	13	9.0	9.0	91.7
	Composite graft	12	8.3	8.3	100.0
	Total	144	100.0	100.0	

6. Discussion

Although physicians underestimate the problem of fingertip injuries, it is the patient who pays the price of his unawareness, which is influenced by improper assessment and injudicious management. Despite the fact that hundreds of international publications have studied this problem in detail, the local literature is highly deficient in describing acute fingertip injuries. The male to female ratio in this study was 5.8:1, which is similar to the result in Saeed and Murtada's unpublished study (2005) that estimated the male to female ratio in Sudanese hand trauma patients to be 5:1. Our ratio is higher compared to that in Indian (1.5:1) [1] and Nigerian studies (1.8:1) [7] and much lower compared to a study in the United Arab Emirates (11.5:1) [8]. This reflects cultural issues related to women's work.

The age groups injured most commonly were children (younger than 5) and teenagers (16 - 20). The most frequent injuries in children were attributable to door jamming (54%), which is consistent with the results in Doraiswamy's study [9]. Teenagers were injured frequently at work, which is likely attributable to local economic issues. In the United Arab Emirates, injuries were encountered largely between 25 to 29 years [8]. In our study, we found a higher percentage of job-related finger injuries (68%), which could be related to workers' unawareness and a lack of safety measures. Further, most of the victims were teenagers and non-professional workers.

Injuries caused by machines were found in 45% of our cases, which is similar to Denise and Jerome's study [10].

The dominant hand was reported to be injured in 65% of patients compared to Ihekire and Salawu's study [7], which estimated that dominant hand injuries

were 56.8%. All of these circumstances would alter the individual functional and economic outcome, particularly if the dominant hand is affected.

Treatment options depend greatly upon the surgeon's preference, wound characteristics, and the other factors mentioned above. Primary repair was the most common modality of treatment observed in pulp lacerations. Although flaps have been used often in the literature to treat transverse pulp loss, such as the Atasoy (V. Y. flap) and Kutler flaps that provide sensation and padding of the fingertips, in our study, the Atasoy flap was used in 23 cases with minimal flap loss or hook nail deformities. These types of flaps are simple and can be performed by junior staff. Volar pulp loss has been treated often using a thenar split skin graft and was performed in 13 cases. Cross finger flaps typically compromise the adjacent finger and thenar flaps lead to joint stiffness. This is why they are not commonly used in our practice. Venkataswami's triangular flap was a good choice to treat lateral oblique pulp defects and is used by senior staff for a better outcome, although Gan Muneuchi has challenged this, and argued against the benefit of surgery in trying to achieve any cosmetic results after nail loss [5].

Composite grafts were applied in 12 fingers with acceptable outcomes, particularly in children. Conservative management was adopted in 13 patients based upon their minimal tissue loss. Typically, thumb injuries were treated by simple repair (Moberg or Foucher flaps). Moberg flaps were constructed in 5 cases and were used for distal thumb amputation when it appeared to be impossible to use the V. Y. flap. The Foucher flap, which is based on the first dorsal metacarpal artery and radial nerve branches, was used in one case in the study.

7. Conclusion

Our findings are similar to the previously published article, with minor differences. Safety measures and education are highly recommended to prevent injuries in high-risk groups.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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