International Journal of Research in Orthopaedics
Soujanya M et al. Int J Res Orthop. 2025 Jan;11(1):60-67
http://www.ijoro.org

Original Research Article

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20243453

A comprehensive study of fingertip injuries at a tertiary care centre-fingertip injury outcome score subset pilot

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Received: 24 October 2024
Revised: 06 November 2024
Accepted: 12 November 2024

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ABSTRACT

Background: Fingertip injury outcome score (FIOS) is a specialized tool designed to assess functional and aesthetic outcomes after treatment of fingertip injuries. It helps both clinicians and researchers evaluate the effectiveness of treatment strategies and monitor patient recovery. This pilot study aims to evaluate the feasibility and effectiveness of a customized FIOS tool using retrospective fingertip injuries data from the hospital, before broader implementation
Methods: A retrospective analysis of 58 hand injury patient's data admitted in hospital with fingertip injuries having tissue loss, between January 2023 and February 2024. A customized FIOS tool, focusing on specific aspects such as complications, aesthetic outcome, patient satisfaction, ability to perform daily tasks and pain, was applied to the collected data. Data analyzed to evaluate how well the FIOS outcome score reflected patient outcomes and clinical findings.
Results: The customized FIOS effectively captured key aspects of fingertip injury outcomes, including pain levels, functional recovery. 7% had poor outcome score and 80% of those with poor outcomes suffered injuries from the heavy instruments with complications like revision surgery. 22% of the patients had excellent outcome scores, 53.4% had good aesthetic outcome score.
Conclusion: This pilot study demonstrates that using a customized FIOS tool with retrospective data is a viable approach for evaluating fingertip injury outcomes. The findings suggest that the FIOS subset can provide valuable insights into functional and aesthetic recovery. This approach facilitates seamless data capture, minimize duplicated efforts, and reduce errors and discrepancies.

Keywords: Fingertip injury, Fingertip injury outcome score, Outcome measurement, Functional recovery, Aesthetic outcomes

INTRODUCTION

Fingertip injuries are among the most prevalent conditions seen in hand surgery and emergency departments.[1] Simple pulp lacerations to total distal amputations that are irreversible can be the extent of fingertip injuries.[2] The fingertip's distinct architecture contributes to the complexity and difficulty of treating these injuries.[3] With the exception of those over sixty, injuries constitute the primary cause of mortality and disability across all age categories. In poorer nations, injuries constitute a neglected epidemic.[4] According to recent research by Samantaray et al, accidents involving equipment, motorcycle chains, and manual tools account for the greatest number of fingertip injuries in India. According to the study, motorcycle chain accidents accounted for 22.5% of injuries, whereas machinery was linked to 17.6% of injuries.[5] More research analyzing the clinical management and treatment outcomes of fingertip injuries is required. Fine motor control, sensory perception, and

distal phalanx protection all depend on the fingertip. The hand, as a "tool," is often subjected to everyday strain and the possibility of harm.[6] Hand injuries result in loss of function and body image deformities, which have several psychological repercussions.[4] As a result, even little injuries can have a big effect on quality of life and hand function. The goal of treatment is to minimize discomfort and avoid problems such as infection, persistent pain, cold sensitivity, deformity, and restore the morphology and functionality of the fingertip.[1,7]

In order to avoid long-term morbidity, research highlights the significance of prompt and adequate care for fingertip injuries.[8,9] The kind, location, and extent of the damage determine which treatment is best. Surgical repair, conservative care, and, in extreme circumstances, amputation are common techniques.[7,9]

To determine the best treatment strategy, Allen classification is commonly used in the management of fingertip injuries as it provides a systematic way to categorize the extent and type of injury, which guides treatment decisions and predicts outcomes.[10] It helps by categorizing the injuries based on the extent of tissue damage, which directly influences the treatment plan, surgical approach, and prognosis.[11]

Different types of injuries require different management strategies, such as conservative treatment, surgical repair, or even more complex reconstructive procedures. For example, Type I injuries, which involve only the pulp, may be treated with conservative methods, whereas Type IV injuries, which include bone exposure, may require more aggressive surgical intervention.[10,11]

By using a standardized classification system like Allen classification, surgeons, nurses, therapists, and other healthcare providers can communicate more effectively about the injury's severity and the planned approach to treatment. It also helps in documentation, research, and comparison of treatment outcomes across different cases or institutions.

The Allen Classification is a diagnostic tool that helps in the initial classification and treatment planning of fingertip injuries, focusing on the anatomical extent of damage. To assess post-treatment outcomes, including the patient's functional recovery and overall satisfaction, an outcome measurement tool known as the Fingertip Injury Outcome Score (FIOS) is utilized. FIOS offers valuable insights into the long-term success of the treatment.

This score helps both clinicians and researchers evaluate the effectiveness of treatment strategies and monitor patient recovery. The FIOS is a comprehensive tool that plays a crucial role in evaluating and improving the management of fingertip injuries. It provides a structured way to assess both the functional and aesthetic outcomes of treatment, guiding long-term clinical decisions, enhancing patient care, and contributing to research in this area.[12]

Although FIOS has shown promise, its widespread adoption is limited. A pilot study was conducted to evaluate the feasibility and effectiveness of a customized FIOS tool using retrospective data from Prabhakar Kore's KLE hospital, affiliated to J.N. Medical College, KAHER, Belagavi.

The primary objectives of this pilot study were to assess the applicability of a customized FIOS in analyzing past fingertip injury cases, evaluate its effectiveness in outcomes measurement and identify any potential challenges or areas for improvement before broader implementation.

METHODS

Study design

A retrospective study was conducted at Prabhakar Kore's KLE Hospital in Belagavi, focusing on cases of fingertip injuries with tissue loss among patients admitted to the hospital.

Patient data

This study utilized retrospective data of patients admitted to the hospital with fingertip injuries involving tissue loss, collected in the one-year period from January 2023 to February 2024.

Inclusion criteria

The patients fulfilling the following criteria were included in the study. Amputation of digit. Loss of skin on dorsal surface with or without nail and nail bed injuries. Loss of skin on volar aspect of digit with or without bony injuries. Crush injuries of finger where there was tissue loss in form of skin avulsion or and nail bed or bony loss. Patients with hand injuries other than fingertip or not fulfilling the above criteria were excluded from the study.

Thus, a total of 58 patient's data in the period January 2023 to February 2024, fulfilling the inclusion criteria was utilized in this study.

The primary components of the data included demographic details, the mechanism and type of injuries, their causes, and the types of surgeries performed. The Allen classification method was employed to categorize the types of injuries.

Ethical considerations

The research was conducted in accordance with the Declaration of Helsinki, and the requirement for informed consent was waived by the institutional ethics committee, as the study utilized retrospective data.

Fingertip injuries outcome score

The FIOS tool, employed by Jerome JTJ et al in their study, includes 10 parameters, as illustrated in the figure 1. A customized FIOS subset tailored to our requirements, focusing on parameters such as complications, cosmetic outcome, patient feedback, ability to perform daily tasks, and pain.

These five key parameters were selected based on their significance, hospital needs, availability of data and including both functional and aesthetic aspects. The customized FIOS parameters and Likert-type scale is illustrated in figure 1.

The outcome for each patient was evaluated using the customized FIOS parameters, which included complications, cosmetic outcome, patient feedback, ability to perform daily tasks, and pain severity. Data was collated from various reports to measure these parameters. The scores were then reviewed and validated with the relevant surgeons and clinical staff for correctness. The outcome scale ranged from 5-15, with scores of 10-15 classified as poor, 6-9 as good, and less than 6 as excellent.

All the data was analyzed in Microsoft excel and SPSS. Quantitative data was expressed as means and standard deviation, whereas categorical data was expressed as proportions. Chi square test was used to test the association between the variables and p value <0.05 considered as significant.

RESULTS

The retrospective data analysis of 58 patients, showed the patients' ages ranged from 1 year to 74 years, 10% were below 7 years of age, 13.8% in the age group 7 to 18 years, 62% were in the age group 18 to 50 years and 13% above 50 years of age.

The majority were male, 49 (84.5%) were males and 9 (15.5%) were female, likely due to the predominance of males in heavy machinery occupations. The age and gender distribution details are shown in Table 1.

Nearly all of the participants in this research (64%) experienced crush injuries, with 15.5% suffering traumatic amputations. CLW occurred in 8.6% of cases. Adults between the ages of 18 and 50 made up 74% of the patients with crush injuries. The fingertip injuries distribution is provided in Table 2.

Amputations due to trauma were more common in younger children (ages 1 to 7). The reason for the fingertip injuries is provided in Figure 2.

The FIOS tool

		Score
Nail	Normal	1
	Small nail	2
	Split nail or deformed nail	3
	Hook nail	4
	Absent nail	5
Finger length (length compared with normal side length from volar crease to fingertip)	Distal third	1
	Middle third	2
	Proximal third	3
Pulp	Well padded	1
	Pulp atrophy	2
Bone	Fracture united (consolidated) or normal	1
	Nonunion	2
	Bone shortening	3
Cosmesis	Satisfactory	1
	Not satisfactory (color mismatch)	2
Sensation (2-PD)	<6 mm	1
	7–10 mm	2
	Cold intolerance	3
	Absent sensation/ hyperalgesia	4
Pain	No pain	1
	Mild	2
	Moderate	3
	Severe	4
Range of motion (TAM)	75%–100%	1
	50%–74%	2
	<49%	3
Grip strength	75%–100%	1
	50%–74%	2
	<49%	3
Return to work	Regular job	1
	Restricted job	2
	Unable to work	3

Outcome Score – customized FIOS

		Score
Complications		
	Absent	1
	Infection	2
	Discolorization	3
	Revision Surgery	4
Cosmetic Outcome		
	Excellent	1
	Good	2
	Poor	3
Patient's feedback		
	Satisfactory	1
	Not Satisfactory	2
Ability to perform daily tasks		
	Normal	1
	Restricted	2
Pain		
	No pain	1
	Mild	2
	Moderate	3
	Severe	4

Figure 1: The FIOS tool (Jerome et al) and the customized FIOS (subset).[12]

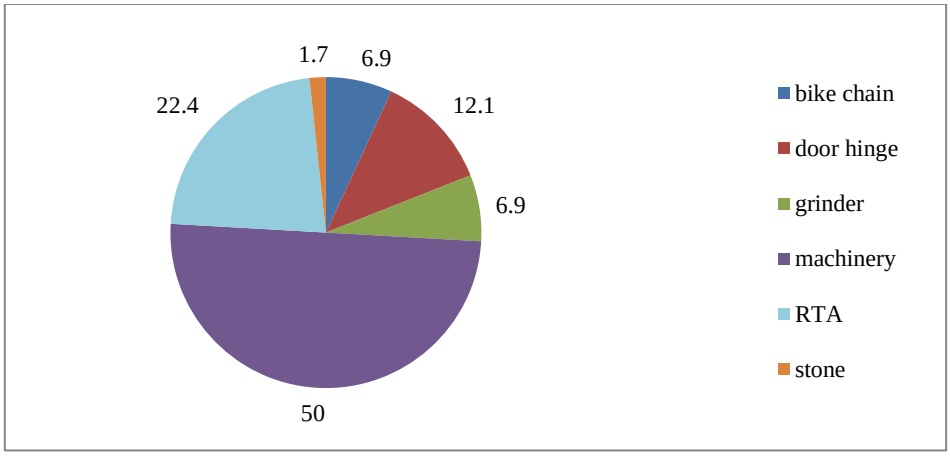

Figure 2: Reason for fingertip injury.

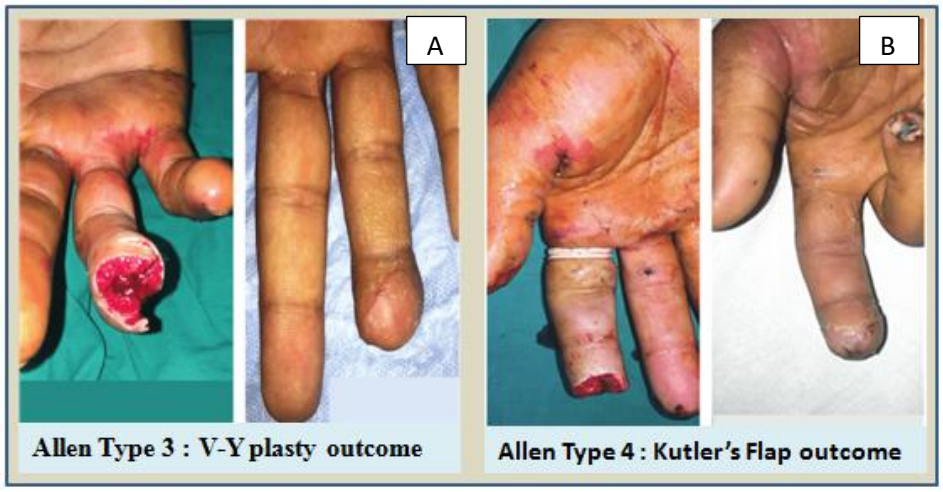

Figure 3 (A and B): V-Y plasty and Kutler's Flap outcome.

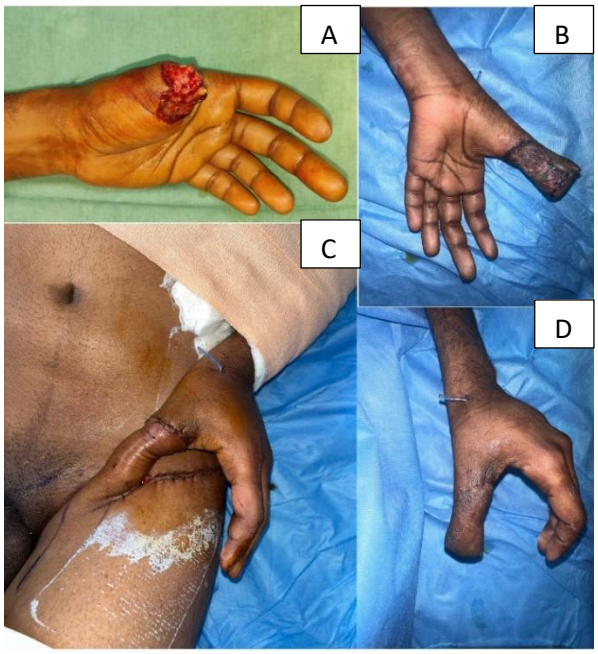

Figure 4 (A-D): Groin flap surgical outcome.

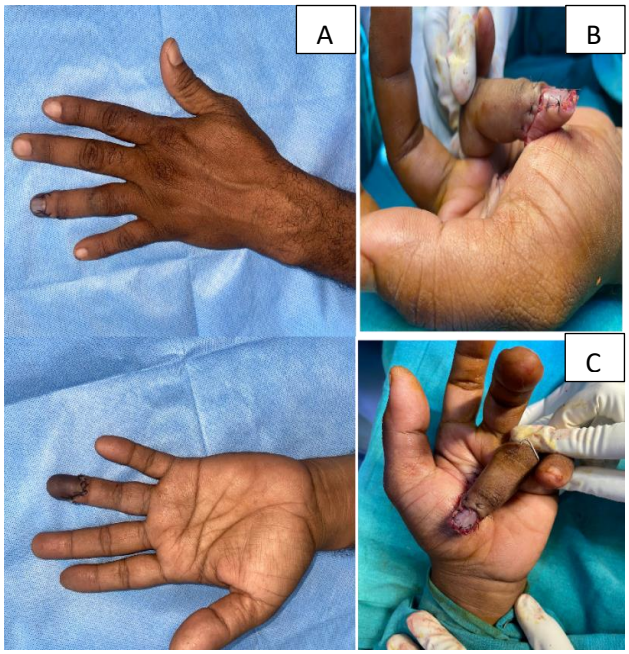

Figure 5 (A-C): Graft repositions over flap outcome.

Table 1: Age and gender distribution.

Variables	N	Percentage (%)
Age (in years)		
<7	6	10.3
7 to 18	8	13.8
18 to 50	36	62.1
above 50	8	13.8
Gender		
Male	49	84.5
Female	9	15.5

Table 2: Fingertip injuries distribution.

Injury	N	Percentage (%)
Crush injury	37	63.8
CLW	5	8.6
CRUSH with near total amputation	3	5.2
Near total amputation	1	1.7
Traumatic amputation	9	15.5
Traumatic avulsion	3	5.2

Out of all the causes, machine related accounted for 50% of the injuries, followed by Road Traffic accidents (RTA) (22.4%), door hinges (12.1%), injuries caused by grinder (6.9%), stone injuries (1.7%), and bike chains (6.9%).

Most of the injuries among females were related to kitchen accidents, such as those involving a grinder. 68.4% of the adult patients were injured by machinery. Approximately 60% of the children's fingertip injuries were caused by door hinges.

Table 3: Surgical procedure on fingertip injury patients.

Surgical procedure	N	Percentage (%)
Primary repair	26	44.8
Primary repair+K wire	4	6.9
Primary repair+nail conformer	1	1.7
Repositioning+primary repair	1	1.7
Arthrodesis+extension tendon repair+K wire	1	1.7
Cross finger flap	1	1.7
Cross finger flap with Terminalisation of little finger	1	1.7
Kutler's flap	1	1.7
debridement composite graft	1	1.7
Debridement+STSG	1	1.7
Graft+thenar flap	1	1.7
groin flap	1	1.7
hypothenar flap	2	3.4
Replantation	3	5.3
Thenar flap	6	10.4
V Y plasty	7	12.1

All the injuries caused by bike chain and road traffic accidents involved males in the age group 15 to 74 years. We discovered a significant relationship ($p<0.05$) between age and the cause of damage.

Allen type classification indicated majority of injuries as type 4 at 31%, 28% as type 3, 24% as type 2 and the remaining 17% as type 1. Nearly all Allen Type 1 fingertip injuries (100%) were treated with primary repair.

In contrast, grafts, re-plantations, and flap surgeries were performed for Allen Type 2, 3, or 4 injuries, with some cases having DIP/PIP level involvement. The surgical procedures conducted across all the fingertip injury patients, in this study are shown in Table 3.

Customized fingertip injury outcome scores

The customized FIOS parameters were evaluated per patient and outcome scores calculated. The outcome score had a mean (SD) of 6.42±2.2. 22% of the patients had excellent outcomes, the majority of them, 71 %, had good results, while 7% had poor, as shown in Table 3. Two of the patients with the unsatisfactory prognosis underwent revision surgery.

The majority of adult patients (60.5%) and young people (83.3%) had favorable outcomes. The patients who had poor outcome (7%) were adults. 100% of the elderly participants achieved good outcome. Eighty percent of those with poor outcomes suffered injuries from the heavy instruments. Table 4 details the types of surgical procedures performed and their associated outcome scores, as well as the complications encountered and their respective outcomes.

22% of the patients with excellent outcome scores, underwent Thenar flap, V-Y plasty or Kutler's surgical procedure. Almost all patients who underwent V-Y plasty had an excellent score.

All 26 patients who received primary repair had a good outcome score, including the few cases of groin flap, cross -finger flap and hypothenar flap.

An excellent surgical outcome of a V-Y plasty surgical procedure performed for an Allen Type 3 fingertip crush injury of ring finger and an excellent surgical outcome of Kutler's flap for an Allen type 4 fingertip injury of index fing A case of traumatic amputation of left thumb underwent a graft and groin flap, resulting in a good surgical outcome for a patient is shown in figure 4.A graft repositioning case over flap resulting in a good surgical outcome of a ring finger injury case is shown in Figure 5.

All the three patients who had a re-plantation procedure had a poor outcome, due to delayed presentation after injury. Fifteen percent of patients had infections as a complication. 53.4% of patients had good cosmetic results, and 91.4% were happy with their treatment, while 45% had minimal pain. Interestingly, we found that 58.6% of patients were restricted to perform their daily tasks, yet the outcome scores for these patients was overall good.

Table 4: Surgical procedure, complications and outcome scores.

Surgical Procedure	#cases	Outcome	Complications	Outcome
Primary repair	26	Good (26)	Infections (7)	Good (6); poor (1)
Primary repair + K wire, reposition, arthrodesis, nail conformer etc	6	Good (5) poor (1)	Dis-colorisation (2)	Poor (2)
			Revision surgery (2)	Poor (2)
Debridement + composite graft	1	Poor (1)	Poor cosmetic outcome (3)	Poor(3)
Debridement + STSG	1	Poor (1)	Restricted daily tasks (22)	Excellent (1)
				Good (17)
				Poor (4)
			Severe pain (1)	Poor (1)
Cross finger flap	2	Good (2)	Patient dis-satisfaction (4)	Good (2); poor (1)
Kutler's flap	1	Excellent (1)	**Score range**	
Groin flap	1	Good (1)	**Score range** **N**	**Percentage (%)**
Hypothenar flap	2	Good (2)	<6 13	22
Replantation	3	Poor (3)	6-9 41	71
Thenar flap, GRF	8	Excellent (2)	10-15 4	7
		Good (6)		
V Y plasty	7	Excellent (6)		
		Good (1)		

DISCUSSION

As part of the retrospective data analysis, 84.5 percent of the patients were men and 66% of the patients were adults between the ages of 18 and 50. Similar gender and age distributions were discovered in Singhal H et al, where the age group falls under the manual production category. Males are more likely to work in high-risk occupations requiring equipment, therefore occupational exposure may potentially be connected to this gender gap.[7]

Additionally, all injuries resulting from bike chains and road traffic accidents involved only male patients. Similar findings were reported in a study by Sweta et al, in which 100% of patients with fingertip injuries caused by bike chains were also male.[13]

We found a significant connection ($p<0.05$) between the type of injury and its etiology. The study found that 63.8% of the injuries were crush injuries, with traumatic amputations accounting for 15.5% of the cases. This high prevalence of crush injuries is consistent with the findings of Samantaray et al, crush injuries were the most prevalent form of fingertip trauma as a result of heavy machinery use.[5]

It's noteworthy that younger children showed a higher incidence of traumatic amputations, which may be attributed to their increased susceptibility to door hinge accidents. According to our data, 60% of injuries in children under 7 years old are related to door hinge incidents. This finding aligns with the study results reported by Satku et al, which showed that 87% of crush injuries among children (mean age 6.1 years) were caused by doors, and 91.6% of pediatric amputations involved the fingertips.[2,14]

According to the study, it was found that 31% of the injuries were classified as Allen type 4, and 28% as Allen type 3, with machinery being the most prevalent cause. Our research's results were consistent with a Jerome et al study 12 in which approximately 25% of participants had Allen type 3. Primary repair was the most common surgical method (44.8%) in our analysis, with V-Y plasty coming in second (12.1%). The widely used technique, according to Singhal H et al, was primary closure with 32%.[7] The preferred course of action for individuals experiencing tissue loss, bone involvement, or amputations is primary closure of the digit wounds.

Overall, the outcome scores were satisfactory, 22% had excellent outcomes, 71% of patients had good results, and 7% had poor results that required revision procedures. Nearly similar results from research by Jerome et al, revealed that 64% of patients had good results and 2% had poor results.[12] Although younger patients often had better results probably, due to stronger tissue regeneration and healing ability, the age difference was not statistically significant in the outcome assessments. Those with poor outcomes were injured in accidents while operating machinery. This indicates that injuries caused by machines result in more tissue damage and less favorable outcomes.

A literature review by Chakraborty et al, on V-Y advancement flaps for fingertip reconstruction demonstrates that this technique yields favorable sensory, functional, and aesthetic outcomes.[15] Variants of the V-Y advancement flaps have been effectively used to treat Allen type 2–4 fingertip injuries. In our study, 22% of

patients with Allen type 3–4 fingertip injuries who underwent Thenar flap, V-Y plasty, or Kutler's procedure achieved excellent outcome scores. Nearly all patients who received the V-Y plasty attained an excellent outcome score.

In this study, 15% of patients had complications like infections. A higher rate of 25% was seen in the Elshishtawy et al, research among the patients who had surgical therapy.[16]

Of the patients, 91.4% were satisfied with their therapy, and 53.4% had good aesthetic results. In the study by Elshishtawy et al, around 90% of patients reported being more satisfied and having a satisfactory cosmetic result after surgery.[16]

This retrospective pilot study evaluating the FIOS provided valuable insights. FIOS allowed us to quantify outcomes, which proved useful for documentation and case comparisons, as discussed in the preceding paragraphs. As highlighted by Jerome et al, in their FIOS study, the quantitative score reduces subjectivity, facilitates communication and decision-making, and enables high-quality data analysis and research.[12] The outcome scores were satisfactory and aligned with the findings of studies by Jerome et al, and Elshishtawy et al, demonstrating the effectiveness of the FIOS tool in assessing and enhancing the management of fingertip injuries.[12,16]

Scoring the customized FIOS parameters was relatively straightforward, as most of the necessary data were available in the clinical reports post-surgery and during follow-up. However, there was some ambiguity regarding the timing of when certain parameters should be evaluated. For instance, parameters like "complications" can be assessed before discharge, while others, such as "ability to perform daily tasks," may be more appropriately evaluated after the surgical wound has fully healed, typically 3 to 6 months post-surgery.

Jerome et al, suggest that this evaluation could be conducted during a patient follow-up assessment. Since many of the data elements for the FIOS are already present in various clinical reports generated during hospitalization and discharge, it would be beneficial to integrate this evaluation into the department's workflow. Seamlessly capturing data for the outcome score from the appropriate person at the right time would help minimize duplication and errors.[12] The tool offers a structured and data driven approach to evaluate both functional and aesthetic outcomes, aiding clinical decision-making and improving patient care. By focusing on a subset or customized FIOS tool, the hospital can assess the feasibility of implementing the full tool in the future. In addition, a subset of the FIOS can be chosen to focus on specific outcomes that are most relevant to the hospital's patient population or clinical priorities. For instance, the hospital might choose to focus on functional recovery (e.g., pain and range of motion) before expanding to aesthetic outcomes.

A key takeaway was the importance of establishing a common understanding of the terminology and when to assess sub-parameters. To address this, an approximately 30-minute training cum discussion session for all stakeholders would help build support and streamline the process. This study was conducted using retrospective data from 58 patients, making it a small sample size. Scoring the outcome retrospectively was not challenging. However, a prospective study with a well-defined workflow for evaluating the complete FIOS parameters and analyzing the implementation would be valuable in identifying areas for improvement and potential opportunities.

CONCLUSION

This pilot study enhances knowledge and understanding of outcome scores for fingertip injuries, demonstrating their utility in evaluating and improving patient care. It was successful in demonstrating that using a customized FIOS tool is a viable approach for evaluating fingertip injury outcomes. The findings suggest that the FIOS tool is effective in assessment and management of fingertip injuries and provides valuable insights into functional and aesthetic recovery. To ensure timely access to accurate information from the appropriate sources, it is crucial to incorporate the FIOS parameters and sub-elements into relevant reports within the health record workflow. This integration will streamline data collection, minimize redundant efforts, and reduce the risk of errors and inconsistencies. Based on these findings, a prospective study incorporating workflow integration and clinical stakeholder training is recommended to enhance its usefulness and adoption in clinical practice.

ACKNOWLEDGEMENTS

Authors were grateful to colleague surgeons, clinical and department staff who supported and provided insights during the study. Their valuable feedback and co-operation were instrumental in the successful completion of this pilot study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Soujanya M, Rajput D. A comprehensive study of fingertip injuries at a tertiary care centre- fingertip injury outcome score subset pilot. Int J Res Orthop 2025;11:60-7.