

Comparison of Outcomes in Primary Extensor Tendon Repair of Hand Treated in a Tertiary Care Hospital

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ABSTRACT

Objective: To determine different treatment outcomes of early extensor tendon repair according to the zone of injury.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Department of Plastic Surgery, Dr Ruth K.M. Pfau Civil Hospital, Karachi Pakistan, from Jun 2019 to May 2020.

Methodology: Seventy-four patients, more than 17 years of age and either gender, presenting to the emergency department of a tertiary care hospital for repair of lacerated extensor tendons of hand were enrolled in the study. All the procedures were performed in an operating room under general or local anaesthesia by a consultant plastic surgeon with experience of 5 years. Tendon repairs were performed using modified Keisler's technique. After wound closure, hand splinting was provided for six weeks. Outcomes were assessed per Miller's Classification at six weeks, two months, and three months post repair and classified as excellent, good, moderate and bad.

Results: The mean age of study participants was reported as 30.69±12.86 years. Zone II (36.4) and VI (47.2) were the most common location of laceration. Of all patients with Zone II lacerations, 33.3 achieved excellent outcomes, and 29.5 achieved a good outcome. Further, in patients with zone VI, 68.5 of the patients achieved good to excellent outcomes.

Conclusion: According to Miller's Classification, the study showed excellent results with zone IV and II injuries. Zone V and 8 had good outcomes, whereas zone I and II showed moderate to bad outcomes. There was no statistical association between the proportions of outcomes and zone of injury.

Keywords: Functional outcomes, Hand injury, Miller classification, Tendon repairs, Treatment outcomes, Zone of injury

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INTRODUCTION

The anatomy of the hand is designed so that the extensor tendons are located superficially close to the bones. Thus, they are considerably less protected from injuries than their flexor counterparts.¹ Even though these tendons are easily accessible during surgery, there is a great deal of difficulty in maintaining their length and normal functions, especially in the dorsal surface of the hand and fingers, owing to the anatomical complexity of that region. Hence, achieving optimal repair of these tendons in terms of length and gliding is a particular challenge.² Nevertheless, the literature revealed that single-stage repair of injuries of complex extensor tendons could significantly improve functional outcomes in addition; it results in decreased morbidity.³

One of the scoring systems that evaluated tendon injuries reported that surgical technique coincident trauma in ways that the severity of laceration, the location of the injury, physiotherapy and patient

compliance greatly affect the surgical outcomes of tendon repair. Among these factors, post-surgical mobilization and the trauma region are the most important predictors of surgical outcomes in these patients.⁴ In addition to post-surgical mobilization and trauma region, co-occurring injuries predominantly affect the treatment outcomes. The treatment outcomes are affected in such a way that bone fracture, as well as extensor tendon laceration at the proximal interphalangeal joint or the proximal phalanx level, are known to show seriously adverse outcomes and reported to have extremely poor prognosis.⁵ In such patients, dynamic braces accompanied by controlled movements to reduce further injury are recommended compared to static braces.⁶ Similarly, another study reported that controlled movements after the surgical intervention are much more effective in extensor tendon repair outcomes.⁷

Due to the complex nature of the surgical repair of extensor tendons added by the lack of compliance on the patients' part, literature has reported that excellent surgical outcome was observed in 40 of the patients suffering from trauma in zone I in contrast, only 33 of the patients who suffered trauma in zone II

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showed excellent outcome. In addition, 40 of the patients bearing trauma in zone III also showed excellent outcomes. In zone IV injuries, 14.2 of the patients showed excellent outcomes. Furthermore, 53.8 of the patients having injuries in zone V showed excellent surgical outcomes.^{4,8} In our part of the world, trauma is increasingly common among all age groups; children, adults and the elderly, especially involving the extensor tendons of the hands. In turn, this trauma is exceedingly common due to accident, assault or self-inflicted injury, and it is imperative to report the outcomes of extensor tendon repair according to the zone of injury among such patients from the local settings. Therefore, this study aimed to determine the different treatment outcomes of early extensor tendon repair according to the zone of injury.

METHODOLOGY

It was a prospective longitudinal study conducted at the Department of Plastic Surgery, Dr Ruth K.M. Pfau Civil Hospital Karachi Pakistan, from Jun 2019 to May 2020. A sample size of 74 was estimated using the WHO sample size calculator by taking statistics of the excellent outcome as 14.29, the margin of error as 8 and 95 confidence level.

Inclusion Criteria: Patients presenting to the emergency department of Dr Ruth K.M Pfau Civil Hospital Karachi for the repair of lacerated extensor tendons of the hand of more than 17 years of age of either gender were enrolled in the study.

Exclusion Criteria: Patients with multiple fractures and comorbidities such as hypertension and diabetes were excluded from the study.

Non-probability consecutive sampling technique was applied for the selection of patients. The ethical approval was obtained from the Ethical Review Committee of the institute, written and informed consent was obtained from all the eligible patients. All the procedures were performed in an operating room under general or local anaesthesia by a consultant plastic surgeon with experience of five years. Tendon repairs were performed using modified Keisler's technique. After wound closure, hand splinting was provided for six weeks. The zone of injury was classified as follows; Zone I corresponded to distal interphalangeal joint,³ Zone II corresponded to the middle phalanx, Zone III corresponded to the proximal interphalangeal joint, Zone IV corresponded to the proximal phalanx, Zone V corresponded to metacarpophalangeal joint, Zone VI corresponded to metacarpal, Zone VII corresponded to tendon and retinaculum

over the wrist, and Zone VIII corresponded to muscle belly in the distal forearm. Outcomes were assessed per Miller's Classification at six weeks, two months, and three months post repair and classified as excellent, good, moderate and bad.⁸

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Mean and SD were computed for numeric variables, while frequency and percentage were computed for qualitative variables. Chi-square/Fisher exact test was applied to assess the difference between the zone of injury and outcomes. The *p*-value of ≤ 0.05 was taken as statistically significant.

RESULTS

The mean age of the study participants was reported as 30.69±12.86 years (Range: 15-70 years). Most of the patients were males (56, 75.7) and employed n=45 (60.8). Of 74 patients, 46 had right-hand dominance (62.2). About 74.3 had a wound classified as a sharp cut, 41.9 had the mechanism of injury as machinery, and 78.4 had the mode of injury as an accident (Table-I).

Table-I: Baseline Characteristics of Study Participants (n=74)

Characteristics	Frequency (Percentage)
Age (years) Mean ± SD	30.69±12.86
Gender	
Male	56 (75.7)
Female	18 (24.3)
Hand Dominance	
Right	46 (62.2)
Left	28 (37.8)
Employment Status	
Employed	45 (60.8)
Unemployed	29 (39.2)
Type of wound	
Cut	55 (74.3)
Crush	19 (25.7)
Mechanism of Injury	
Knife	10 (13.5)
Glass	16 (21.6)
Machinery	31 (41.9)
Roll-over	12 (16.2)
Door trap	4 (5.4)
Fall of a heavy object	1 (1.4)
Mode of Injury	
Accident	58 (78.4)
Assault	7 (9.5)
Self-inflicted	9 (12.2)

Zones II (n=27, 36.4) and VI (n=35, 47.2) were the most common location of the injury, while zones I (n=9, 12.2) and III (n=3, 4) were the least common location of the injury. According to the classification by

Miller, out of 27 patients with Zone II injuries, nine patients achieved excellent outcomes (33.3), and 8 achieved good outcomes (29.6). Furthermore, in 35 patients with zone VI injuries, 68.5 of the patients achieved good n=15 (42.9) to excellent n=9 (25.7) outcomes. 2 of the patients (22.2) with zone I injury achieved bad outcome, and four patients (14.8) with zone II achieved the bad outcome. Statistically, there was insignificant difference between proportions of outcomes in zone I ($p=0.823$), zone II ($p=0.999$), zone III ($p=0.759$), zone IV ($p=0.500$), zone V ($p=0.108$), zone VI ($p=0.535$) and zone VIII ($p=0.395$) (Table-II).

Table-II: Outcomes of Tendon Repairs According to Miller's Classification(n=74)

Zones	Outcomes				p-value
	Excellent	Good	Moderate	Bad	
I	2 (22.2)	3 (33.3)	2 (22.2)	2 (22.2)	0.823
II	9 (33.3)	8 (29.6)	6 (22.2)	4 (14.8)	0.999
III	2 (66.7)	1 (33.3)	0(0)	0(0)	0.759
IV	6 (46.2)	5 (38.5)	1 (7.7)	1 (7.7)	0.500
V	8 (42.1)	9 (47.4)	1 (5.3)	1 (5.3)	0.108
VI	9 (25.7)	15 (42.9)	7 (20)	4 (11.4)	0.535
VII	0(0)	0(0)	0(0)	0(0)	-
VIII	3 (20)	8 (53.3)	3 (20)	1 (6.7)	0.395
Total	23	26	14	11	

DISCUSSION

Hand injuries are the most commonly presenting injuries worldwide, especially in developing countries.⁹ The present study showed that 75 of the injuries occurred in males compared to females. These results concur with Ahmed *et al.*, Serinken *et al.*, and Sorock *et al.* reported male preponderance.¹⁰⁻¹² Another study from Pakistan favoured the present finding results of male dominance.¹³ The results also showed that sharp cuts were more common than crush injuries. Most of the injuries in the hands occurred during an accident that is analogous to studies conducted by Ihekire *et al.*, Adigun *et al.*, Urso-Baiarda *et al.* and Olu-watosin *et al.*¹⁴⁻¹⁷ Another study showed assault was one of the causes of hand fracture, whereas the present study showed that participants presenting with self-inflicted injuries and assault were the least common.¹⁸

The main aim of the present study was to determine outcomes after tendon repair. Mehdiinasab *et al.* reported that extensor tendons provide better outcomes than flexor tendons.⁴ Another study also reported that more than half of the extensor tendon repairs showed good and excellent results.⁵ The patients with Zone II injuries achieved an excellent and good outcome. Furthermore, of the patients with zone VI

injuries, the majority achieved good to excellent outcomes this is in contrast with Newport *et al.* who showed excellent results in zone III and zone V injuries.¹⁹ One study reported that zone I and zone II showed the worst outcomes.⁴

In our study, zone I and zone II showed 22 and 14 bad outcomes, respectively. This may be due to the complexity of the extensor tendon. Another study reported that zones V, VI and VII had a better function at 4th and 12th weeks when provided with dynamic splinting.²⁰ Chow *et al.* stated that clinicians preferred controlled and dynamic motion of the fingers from the first post-operative day. With zone III, the tendon repairs had excellent outcomes post-operatively.²¹ Watt *et al.* reported good results in zone I and II. They also reported that non-compliant patients could follow the static immobilization method.²² The results also showed little relation between zones of injuries and outcomes levels. This could be because each tendon has different peculiarities and complex-ties and should be dealt with great intricacy during management.

CONCLUSION

Hand injuries necessitate tremendous exploration for one to not miss any expected wounds, given their sweeping and potentially debilitating effects on patients. In addition, it requires a knowledgeable surgeon for the wounds to be appropriately managed. According to Miller's classification, the study showed excellent results with zone IV and zone II. Zone V and zone VIII had good outcomes, and zone I and II showed moderate to bad outcomes. There was no statistical association between the proportions of outcomes and zone of injury.

Conflict of interest: None.

Auhor's Contribution

RMK: Concieved idea, manuscript writing, accountable for the accuracy and intergrity of study, FAAK: Proof reading, statical analysis, HA: literature searching, contribution in manuscript writing, SK: Data collection and analysis, ZZ: Data collection and critical review, MKUA: References writing and statical analysis.

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