Management of extensor tendon injuries of the hand, wrist and forearm: A clinical study

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Abstract: INTRODUCTION: The anatomy of the extensor tendons is complex and the management of injuries is varied corresponding to the anatomical zone of injury. The important factors in the treatment of extensor tendon injuries include the anatomical zone, the type and mode of injury, its chronicity, and any pathology of the adjacent tissues. Wound debridement, rigid internal fixation of bone, repair of neurovascular structures, and skin coverage take precedence over extensor tendon repair.
OBJECTIVE: Analyze the demographic data, management, and surgical outcomes of repair of extensor tendon injuries of hand, wrist, and forearm.
METHODS: This study is a prospective, observational cohort of 30 patients who presented with extensor tendon injuries to the department of plastic surgery at Gandhi medical college and hospital, Secunderabad between August 2018 and July 2020.
RESULTS: 76.66% males and 23.34% females presented with ETI. 33.33% of them were between 31- 40 years followed by 26.66% of them between 21-30 years of age. Occupational injuries accounted for 36.66% of patients. Zone VI injuries accounted for a maximum of 43.33 % of patients. Excellent outcomes were seen in thumb extensor tendon injuries, while good outcomes were noted in zones I-IX in ulnar four fingers and in proximal injuries. Complications were noted in 13.33% of patients.
CONCLUSION: Outcome depends on the severity of the injury, anatomic zone involved, infection, concomitant injuries, and patient compliance to physiotherapy.

KEYWORDS: Extensor tendón injuries(ETI), Zones, Tendon Repair, Splintage, Physiotherapy, Outcomes.

Introduction

The anatomy of the extensor tendons is more complex and the management of injuries is varied and corresponds to the anatomical zone of injury. The extensor mechanism of the hand and digits is a balance between intrinsic and extrinsic forces and is easily disrupted. There are six extensor compartments at the wrist. Traumatic disruptions of the extensor mechanism represent a broad spectrum of injuries and are frequently seen because of the superficial location of tendons. The important factors in determining the treatment of extensor tendon injuries include the anatomical zone, the type of injury, the mode of injury, the chronicity of the injury, and any pathology of the adjacent tissues (principally skin, bone, and joints).[1] The goal of any type of treatment of the hand is to restore function. Wound debridement, rigid internal fixation, bony healing, repair of neurovascular structures, and skin coverage all take precedence over extensor tendon repair. This study aims to analyze the demographic data, management, and surgical outcomes of repair of extensor tendon injuries of hand, wrist, and forearm.

Methods

A prospective and observational study of 30 patients who presented with extensor tendon injuries to the department of plastic surgery at Gandhi medical college and hospital, Secunderabad from August 2018-July 2020.

Kleinert and Verdan classification was used for the zones of extensor tendon injuries of the Hand, wrist, and forearm.

INCLUSION CRITERIA

All patients with extensor tendon injuries of hand, wrist, and forearm admitted to the Department of Plastic Surgery, Gandhi Hospital.

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Figure 1. Extensor tendon injuries in zones IV, V, and VII.

EXCLUSION CRITERIA

1. All patients with associated skeletal injuries.
2. Injury with contamination and massive tissue loss.
3. Injuries on the volar side are excluded from the study.

ETHICAL CLEARANCE

Ethical clearance was taken from the ethical committee of Gandhi medical college and Hospital.

PREOPERATIVE EVALUATION

All patients underwent routine preoperative evaluation in the form of proper medical history, careful general and local examination, Investigations required for diagnosis and anesthesia.

SURGICAL TECHNIQUE

- Surgeries were performed under either brachial block or general anesthesia.
- Tourniquet control was used in every patient.
- All cases underwent thorough debridement and wash.
- Zone of injury is identified (**Figure 1**).
- Adequate exposure was attained by raising local flaps and the wounds were explored.
- Tendon ends were retrieved and margins freshened.
- Proper extension positioning of the involved digit or wrist was done according to the zones involved.
- The proximal and distal tendons were mobilized and repair was done using modified Kessler's technique or Mattress suturing with Polypropylene 3-0 core sutures and Polypropylene 4-0 for epitenon suturing (**Figure 2**).

RESULT	TOTAL EXTENSION LAG (DEGREES)	TOTAL FLEXION LOSS (DEGREES)
EXCELLENT	0	0
GOOD	<10	<20
FAIR	11-45	21-45
POOR	>45	>45

Table 1. Miller's Criteria

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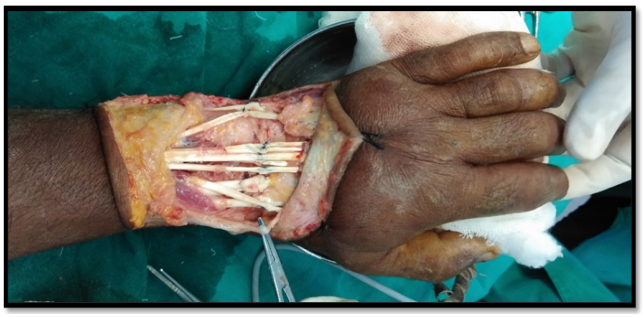

Figure 2. Intra-Operative repaired Tendons -ECRL, ECRB, EDC'S, and EDM in the zone- VII

- Tourniquet was deflated and after achieving hemostasis, a drain was placed.
- Wounds were closed in layers, A proper dressing and POP splintage was given according to the zones involved. (**Figure 3**)

POSTOPERATIVE CARE

Patients were administered antibiotics, analgesics, and the operated limb was elevated.

Patients were discharged the next day and were asked to follow up regularly , during which physiotherapy was initiated and functional outcomes were assessed regularly (figures-4, 5, &6).

DATA ANALYSIS

Data was entered in MS EXCEL 2007 and analyzed.

Results

In this study, 76.66% of males and 23.34% of female patients presented with ETI.

The most common age group affected with ETI was between 31-40 years (33.33%), followed by 21-30 years (26.66%).

The most common etiology of ETI in this study is occupational which accounted for 36.66% of patients. The second most common causes were road traffic accidents and glass cut injuries seen in 26.66% each.

Figure 3. Splintage after repair of extensor tendons

S.NO	TOTAL EXTENSION LAG (DEGREES)	NUMBER OF PATIENTS	OUTCOME
1.	0	12(40%)	EXCELLENT
2.	<10	14(46.66%)	GOOD
3.	11-45	4(13.33%)	FAIR
4.	>45	0	POOR

Table 2. Degree of finger extension lag.

In this study, 56.66% of patients had right-sided injuries and 43.34% of patients had left-sided injuries. 58.6% % of patients had an injury on their dominant hand with 96.6% having right-sided dominance.

The most common site of injury was noted in zone VI in 43.33% of patients. In thumb, the most common site of injury was noted in zone T IV (10%).

Operative management was the treatment of choice in 29(96.66%) patients, while 1(3.33%) patient was managed conservatively as the patient presented with zone –I injury.

In this study, 56.66% of patients underwent intervention within 3 days of injury, while the rest 40% had delayed procedures owing to delayed presentation to the hospital.

Most of the patients underwent modified Kessler's technique of tendon repair, while the rest of them underwent the Mattress suture technique.

In this study, 13.33% of patients presented with complications. 1(3.33%) patient had hematoma which had to be drained, 2(6.66%) had surgical site infections which were managed conservatively, one (3.33%) of them had extension lag in the zone –VII, and one of the other patients (3.33%) had pure extensor lag as the complication. Both of them were managed conservatively with physiotherapy.

S.NO	TOTAL FLEXION LOSS (DEGREES)	NUMBER OF PATIENTS	OUTCOME
1.	0	10(33.33%)	EXCELLENT
2.	<20	14(46.66%)	GOOD
3.	21-45	6(20%)	FAIR
4.	>45	0	POOR

Table 3. Degree of finger flexion loss.

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Figure 4. Post-op assessment of wound and POP splint position.

FUNCTIONAL OUTCOMES

Functional outcomes are assessed by Miller's criteria which include the degree of extensor lag and degree of flexion loss in the affected fingers (**Table 1**).

1. Degree of Extension lag in the fingers

In the present study 12(40%) patients presented with the excellent outcome with '0' degree extension lag, whereas 14(46.66%) patients presented with a good outcome with less than ten-degree extension lag. 4(13.33%) patients presented with fair outcomes (**Table 2**).

2. Degree of Flexion loss in the fingers

In this study 10(33.33%) patients presented with the excellent outcome with '0' degree flexion loss, whereas 14(46.66%) patients presented with a good outcome with less than 20 degrees flexion loss. 6(20%) patients presented with fair outcomes (**Table 3**).

3. Total Active motion regained for fingers and wrist joint

In this study following 6 weeks of surgery, 36.66% of patients had excellent outcomes, while 46.66% of patients had a good outcome and fair outcomes were noted in 16.66% of patients (**Table 4**).

S.NO	OUTCOME	TOTAL NUMBER OF PATIENTS (PERCENTAGE)
1.	EXCELLENT	36.66%
2.	GOOD	46.66%
3.	FAIR	16.66%
4.	POOR	0%

Table 4 Total Active motion regained for fingers and wrist joint.

4. Outcomes in different zones of extensor injury

In this study on average good outcomes were noted in zones I-IX in ulnar four fingers and proximally, while excellent outcomes were seen in thumb extensor tendon injuries (**Table 5**).

Discussion

Hand function is crucial for maintaining independence during daily life activities. it has been demonstrated that a reduction in handgrip strength can predict the risk of future disability- Carmeli et al 2003. Hand injuries account for 20% of all treated injuries in an emergency department.[2]

The spectrum of traumatic hand injuries included minor soft tissue injuries and fractures to complex injuries requiring nerve, tendon, or artery repair. within this spectrum, tendon injuries are quite common and reported in 54.8% of patients with a small laceration and 92.5% of patients with a deep injury through a small laceration.[3]

Thus, the treating surgeon needs to recognize that even a small laceration to the hand may involve extensor tendon injuries.

The mean age of the patients in the present study was 28.9 compared to 37.17 which was reported by Reuf Karabeg et al [4]. This study included 23 (76.66%) male patients and 7(23.34%) female patients which were similar to a study done by Reuf Karabeg et al. According to their study, 87.8% of male patients and 12.2% of female patients were included which showed male preponderance. This data is consistent with epidemiological data that are encountered by other authors such as Starčević B et al[5] and Servant C et al[6].

According to this study, Paediatric age group patients were 3% which was similar to a study done by Johanna P. de Jong et al[7] who reported 5.2% in their study.

In this study, it was observed that extensor tendon injuries of the right hand were 57% and of the left hand were 43% which was similar to Starčević B et al[5] wherein 71% of patients had an extensor tendon injury of the right hand and 29% had an injury to the left hand.

Figure 5. Post-op assessment of extensor lag in lateral view.

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S.No	ZONES	NUMBER OF PATIENTS	AVERAGE OUTCOMES (EXCELLENT/GOOD/ FAIR/ POOR)
1.	I, II, IV	5	GOOD
2.	III	1	FAIR
3.	V-IX	26	GOOD
4.	TI-TV	3	EXCELLENT

Table 5. Outcomes in different zones of extensor tendon injury.

The most common site of injury in our study was in zone VI noted in 43% of our patients which was similar to a study done by Reuf Karabeg et al. Who reported zone -VI as the common zone of injury.

According to the present study, sharp lacerations were the most common mechanism of injury in 73.3% of patients which is comparable to the study done by Dominic Patello et al[8] who reported sharp lacerations in 60% of their patients.

Work-related injuries accounted for 36.6.% in our study which was similar to the study done by Johanna P de Jong et al[7] whose results showed 24.9% of acute traumatic injuries.

In this present study, it was noticed that excellent results were more attained in primary tendon repair than in delayed primary tendon repair.

In our study total number of patients who got complications was four (13.33%). One patient had a hematoma which was drained. Two patients had surgical site infections (6.66%). One of the other patients presented with extension lag in zone VII and they were managed with physiotherapy. These results were similar to a study done by Mohammed Ahmed Kadah[9] who reported complications in 17.8% of his patients. In his study, he noted 7.1% of his patients with post-operative infections were managed conservatively. He noticed extensor lag in 7.1% of his patients who had an injury in zone VI and VII which were managed by physiotherapy.

The final results were evaluated according to Miller's criteria classification based on total active motion evaluation. In this study, following 6 weeks after surgery, excellent results were found in 36.66% of cases, good results in 46.66%, and fair results in 16.66% which were similar to a study done by Mohammed Ahmed Kadah[9], who presented excellent results in 32.1% of cases, good in 42.8 and fair results in 17.8%.

In the present study, on average good results were noticed in zones I, II, IV-IX while the fair result was seen in a patient with zone III injury. Excellent results were seen in thumb zones of injury. These results were similar to a study done by Mohammed Ahmed Kadah where good results were obtained more often in zones I, II, and V, and the worst results were obtained more often in zone III. He noted excellent results in the thumb. Similar results were shown by studies done by Evans et al[10].

In this study, a static splint was applied at the end of the surgery immediately according to the zone of injury affected. Because of economic reasons, the main technique of splinting used was that of static one (100%) which corroborates with the study done by Mohammed Ahmed Kadah who reported static splint in 96.66% of his patients[9]. The splints were applied for a mean period of 3.23 weeks ranging from 3 to 4 weeks following which physiotherapy was started. This was compliant with other studies by Kayalaret et al and Khachaba. Other studies by Fitoussi et al and Allieu et al gave a wider range of 3–6 weeks. This variation among different studies was mainly due to the difference in the severity of injuries reported.

Conclusions

In the present study, Extensor tendon zones proximal to Metacarpophalangeal joints have better outcomes compared to zones distal to it after repair.

Final results depend on the severity of the injury, anatomic zone involved, infection, concomitant injuries, and patient compliance to physiotherapy.

The motivation of the patients in rehabilitation protocol is important as primary rehabilitation has many advantages when compared to secondary and delayed primary rehabilitation.

Figure 6. Post-op assessment of flexion loss in handgrip position.

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Conflicts of interests

There was no conflict of interest during the study, and it was not funded by any organization.

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