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


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 predic-tors 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 accom-panied 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.
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.\(^8\) 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 emer-
gency 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 Com-
nittee 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 tech-
nique. After wound closure, hand splinting was pro-
vided for six weeks. The zone of injury was classified
as follows; Zone I corresponded to distal interpha-
langeal joint,\(^3\) Zone II corresponded to the middle
phalax, Zone III corresponded to the proximal
interphalangeal joint, Zone IV corresponded to the
proximal phalanx, Zone V corresponded to metacarpo-
phalangeal 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 excel-
llent, good, moderate and bad.\(^8\)

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

**RESULTS**

The mean age of the study participants was reported
as 30.69\(\pm\)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 domi-
nance (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>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years) Mean ± SD</strong></td>
<td>30.69±12.86</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>56 (75.7)</td>
</tr>
<tr>
<td>Female</td>
<td>18 (24.3)</td>
</tr>
<tr>
<td><strong>Hand Dominance</strong></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>46 (62.2)</td>
</tr>
<tr>
<td>Left</td>
<td>28 (37.8)</td>
</tr>
<tr>
<td><strong>Employment Status</strong></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>45 (60.8)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>29 (39.2)</td>
</tr>
<tr>
<td><strong>Type of wound</strong></td>
<td></td>
</tr>
<tr>
<td>Cut</td>
<td>55 (74.3)</td>
</tr>
<tr>
<td>Crush</td>
<td>19 (25.7)</td>
</tr>
<tr>
<td><strong>Mechanism of Injury</strong></td>
<td></td>
</tr>
<tr>
<td>Knife</td>
<td>10 (13.5)</td>
</tr>
<tr>
<td>Glass</td>
<td>16 (21.6)</td>
</tr>
<tr>
<td>Machinery</td>
<td>31 (41.9)</td>
</tr>
<tr>
<td>Roll-over</td>
<td>12 (16.2)</td>
</tr>
<tr>
<td>Door trap</td>
<td>4 (5.4)</td>
</tr>
<tr>
<td>Fall of a heavy object</td>
<td>1 (1.4)</td>
</tr>
<tr>
<td><strong>Mode of Injury</strong></td>
<td></td>
</tr>
<tr>
<td>Accident</td>
<td>58 (78.4)</td>
</tr>
<tr>
<td>Assault</td>
<td>7 (9.5)</td>
</tr>
<tr>
<td>Self-inflicted</td>
<td>9 (12.2)</td>
</tr>
</tbody>
</table>

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

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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)

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

**DISCUSSION**

Hand injuries are the most commonly presenting injuries worldwide, especially in developing countries. 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. Another study from Pakistan favoured the present finding results of male dominance. 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-Biaarda et al. and Olu-watosin et al. 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.

The main aim of the present study was to determine outcomes after tendon repair. Mehdinasab et al. reported that extensor tendons provide better outcomes than flexor tendons. Another study also reported that more than half of the extensor tendon repairs showed good and excellent results. 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. One study reported that zone I and zone II showed the worst outcomes.

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. 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. Watt et al. reported good results in zone I and II. They also reported that non-compliant patients could follow the static immobilization method. The results also showed little relation between zones of injuries and outcomes. This could be because each tendon has different peculiarities and complexity 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.

**Author’s Contribution**

RMK: Conceived idea, manuscript writing, accountable for the accuracy and integrity of study, FAKK: Proof reading, statistical analysis, HA: literature searching, contribution in manuscript writing, SK: Data collection and analysis, ZZ: Data collection and critical review, MKUA: References writing and statistical analysis.

**REFERENCES**


