

Postoperative Management Early Active Mobilization of Extensor Tendon Repair at Zone (V-VII)

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Abstract

Background: The extensor tendons are particularly vulnerable to trauma because their superficial location in a clenched fist, the thin mobile subcutaneous tissue offers little protection, and lacerations of the extensor tendons are common over joints that are easily exposed to contamination. **Objective:** To assess the evaluation of the postoperative early active mobilization protocol of extensor tendon repair at zone (V-VII). **Methods:** In this prospective study was carried out at Orthopedic Dept., 250 Bed General Hospital, Kishoreganj, Bangladesh from January to June 2023. Total 40 cases of fresh injury of extensor tendon at zone V to VII were treated. A protocol of early active mobilization was undertaken, using an easy to follow rehabilitation plan. Routine history taking with details of the injury, the object causing the injury, the dominant hand and the position during the injury, Physical examination, included the zone, and the possible tendons involved together with any associated injury. **Results:** Forty patients of fresh extensor tendon injuries were included in this study, their ages ranged from 20 to 55 years. There were 33 males (82.5%) and 7 females (17.5%). The dominant hand was involved in 29 of patients (72.5%). The nature of injuries was sharp cut in 34 patients (85%), with crush injuries in 6 patients (15%). The most common site of injuries was zone VI, VII and zone V respectively, and the most common tendon injured was EDC, EI, and EDM. Only 7 patients (17.5%) had single tendon injury, While 33 patients (82.5%) had multiple tendon injuries. At the end of the 6th weeks post operatively, the overall outcome result are summarized. **Conclusion:** The early mobilization of repaired extensor tendon reduces the formation of adhesion as compared to rigid immobilization. We recommend the use of this protocol following extensor tendon repair in the hand at zone V, VI, and VII in cooperative patient. It will give fairly acceptable results.

Keywords: Extensor Tendon Injury, Dargon Criteria.

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INTRODUCTION

The extensor tendons are particularly vulnerable to trauma because their superficial location in a clenched fist, the thin mobile subcutaneous tissue offers little protection, and lacerations of the extensor tendons are common over joints that are easily exposed to contamination [1-3]. The complex extensor system is covered by thin, pliable dorsal skin, leaving the tendons susceptible to trauma and exposure. Early mobilisation protocols after repair of extensor tendons in zone V and VI provide better outcomes than immobilisation protocols. This systematic review investigated different early active mobilisation protocols used after extensor tendon repair in zone V and VI. Recent systematic

reviews have found strong evidence that early mobilisation after hand/wrist extensor tendon repair provided better range of motion (ROM) outcomes compared to immobilisation protocols [4, 5]. Early mobilisation needs to be in a controlled manner to optimise the benefits of mobilisation while avoiding the risks related to unrestricted motion [6, 7]. The requirement to balance motion with protection has led to the development of early controlled mobilisation protocols where, during the early post-operative period, motion of the injured digit is allowed while being controlled by a splint [8- 10]. Early mobilisation protocols for extensor tendon repairs in zones V and VI include those allowing early passive mobilisation (EPM) and those allowing early active mobilisation (EAM) of

the repaired tendon [11, 12]. These injuries may be more difficult to treat than those of flexor tendon system, because of the complex anatomy of the extensor system, any minimum discrepancies in tendon length and tension can lead to significant functional deficits following tendon injury and repair [13]. The management of these injuries demands the same skill and knowledge as required for flexor tendon repair, on the dorsum of the hand and fingers there is a relative lack of soft tissue, therefore adhesion of the tendon to the skin are common, the bone and joints being very close to the dorsal surface are injured concurrently with extensor tendon. These tendons are extra synovial in most parts except under the extensor retinaculum, they have no vincula, and their blood supply is segmental, arising from the surrounding soft tissue and paratenon. Extensive dissection devitalizes these tendons and promotes scarring and adherence to adjacent structures [14]. Rehabilitation after repair of extensor tendon injuries had been less addressed in the literature than that of flexor tendons [15]. Early dynamic splinting was also used as a rehabilitation protocol for zone IV to VIII (proximal phalanx to distal forearm), but cautioned that requires professional supervision and highly motivated patient, the patient actively flexes the involved fingers followed by passive extension with rubber band [16]. This rehabilitation protocol is applied after the first operative day without the need for hand therapist and carried by the patient himself and involve putting the patient's hand in volar splint with 45 degree of wrist extension, flexion of the metacarpophalangeal (MP) joint to a least 50 degree and both proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints were free, for thumb injuries the carpometacarpal (CM) joint and the MP joint were kept in neutral position.

MATERIALS AND METHODS

In this prospective study was carried out at Orthopedic Dept., 250 Bed General Hospital, Kishoreganj, Bangladesh from January to June 2023. Total 27 patients of acute extensor injuries that were treated. A protocol of early active mobilization was undertaken, using an easy to follow rehabilitation plan.

Routine history taking with details of the injury, the object causing the injury, the dominant hand and the position during the injury, Physical examination, included the zone, and the possible tendons involved together with any associated injury. Investigations done included routine haematological and radiological exams. Before the surgical repair, we explain the injury to the patient and how it will be treated as well as inherent problems associated with injury, the need for extensive postoperative rehabilitation, the potential need for more than one surgery and the likely outcome should also explained.

Operative Procedure

General anesthesia was used in all cases, after the hand is scrubbed of gross contamination, a tourniquet is placed at the upper arm and the arm and the hand are prepared and draped with sterile technique, wound needs to be irrigated by normal saline solution and all devitalized tissue excised. Wide exposure was performed to allow meticulous repair. Exploration of a segment of extensor retinaculum may be necessary to find the tendon end. The suture technique applied was modified Kessler using 4-0 prolene sutures. Skin closure was done with polyethylene 3-0 sutures, a corrugate drain is inserted, plaster of Paris slab was applied on the volar side with wrist dorsiflexed to 45 degree and the slab extended distal to MP joint which were kept in full extension, the IPI joint and the DIP joint were kept fully extended, the patients were instructed to elevate their hands, and (cefotaxime) was started by intravenous route for three days.

The extrinsic muscles originate proximal to the wrist, their tendons passing over the dorsal aspect to insert into the hand and the wrist. At the wrist they are held in position by a transverse retinaculum band that prevents dorsal bowing on wrist extension. The tendons are held in horizontal position under the extensor retinaculum by vertical bands that form the six dorsal compartments through which all extensor tendons pass (fig. 1).

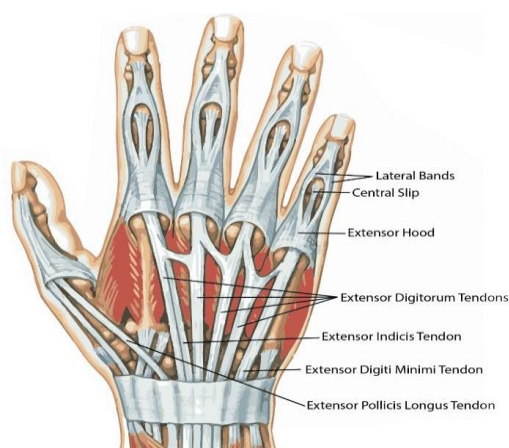


Figure 1: Extensor tendon compartments and related tendons.

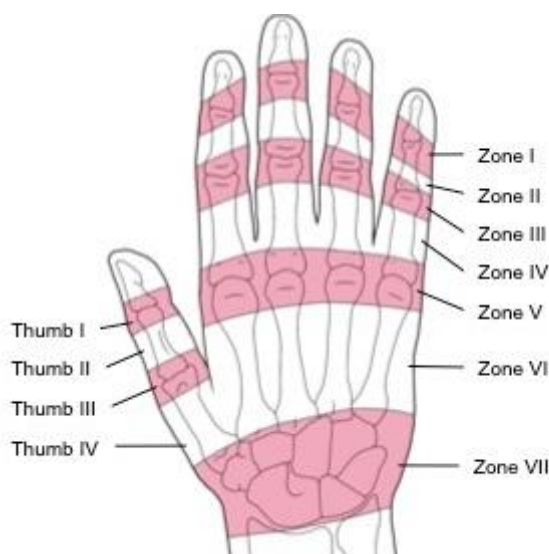


Figure-2: Extensor zone V, VI, VII of the hand.

Rehabilitation Protocol

Patients are reviewed for dressing, if dressing is clean; the patients are reviewed on the 10th to 12th day for suture removal. In case with infection, offending suture are removed and the patient is reviewed every two to three days with twice change of dressing till the infection cleared. Patients are instructed to continue active mobilization as advised even in the presence of infection. The drain, and the slab was removed and a new slab was applied, the wet plaster of Paris was molded over the volar side of the limb with the wrist in 45 degree of dorsiflexion and MP joint flexed at least 50 degree with the PIP joint & DIP joint were left free. The splint is secured with crepe bandage. The patient are evaluated for extension lag, if that lag is greater than 30 degrees, the splint is continued to be worn for another two weeks, and the original exercise are continued but with unlimited frequency, if no extensor lag is found or the lag is less than 30 degree, the splint is discarded during the day and worn at night for a further two weeks. After four weeks, the previous exercise is replaced with gentle flexion of the MP joint and IP joint, steadily increasing to full flexion and power grip, this fist making is

performed with unlimited frequency during the day. The splint is removed and extensor strengthening exercises advised, like flexion of the interphalangeal (IP) joints and active extension and flexion at metacarpophalangeal joint, with wrist in neutral position to improve the excursion of the repaired extensor tendon, this was done with unlimited frequency.

RESULTS

Forty (40) patients of fresh extensor tendon injuries were included in this study, their ages ranged from 20 to 55 years. There were 33 males (82.5%) and 7 females (17.5%). The dominant hand was involved in 29 of patients (72.5%). The nature of injuries was sharp cut in 34 patients (85%), with crush injuries in 6 patients (15%). The most common site of injuries was zone VI, VII and zone V respectively, and the most common tendon injured was EDC, EI, and EDM. Only 7 patients (17.5%) had single tendon injury, While 33 patients (82.5%) had multiple tendon injuries. At the end of the 6th weeks post operatively, the overall outcome result are summarized.

Table-1: Patients age details (N=40)

Age (years)	No. of Cases	%
20 - 30	7	17.5%
31-40	21	52.5
41-50	6	15.0%
51-60	6	15.0%

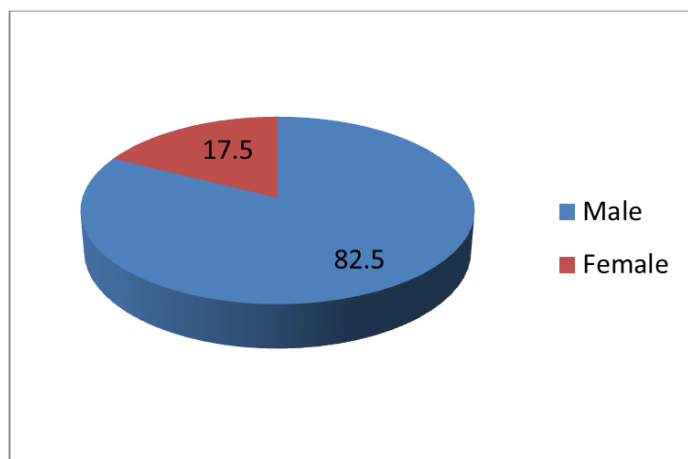


Fig-3: Sex distribution of the patients

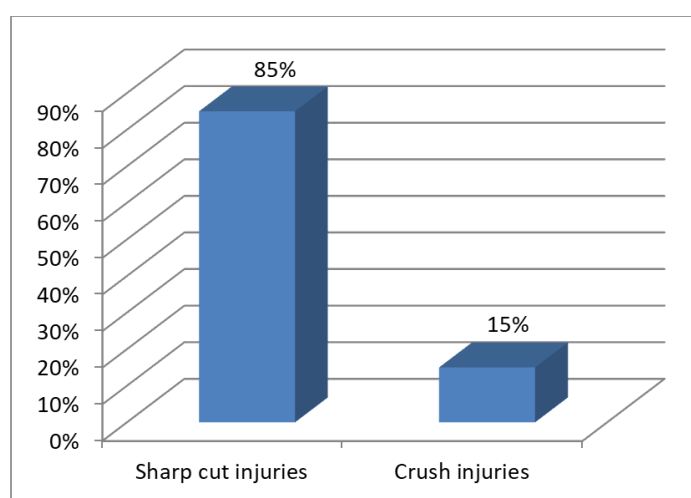


Table-4: Nature of injuries

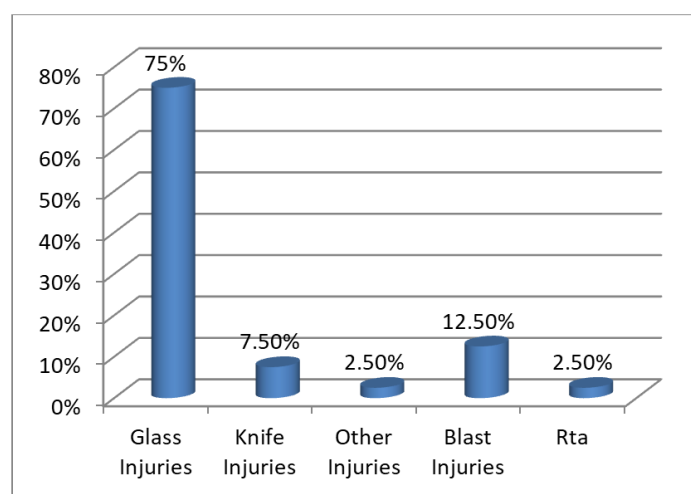


Table-5: Mode of injuries

Table-2: Details of zone of injuries and tendon injured.

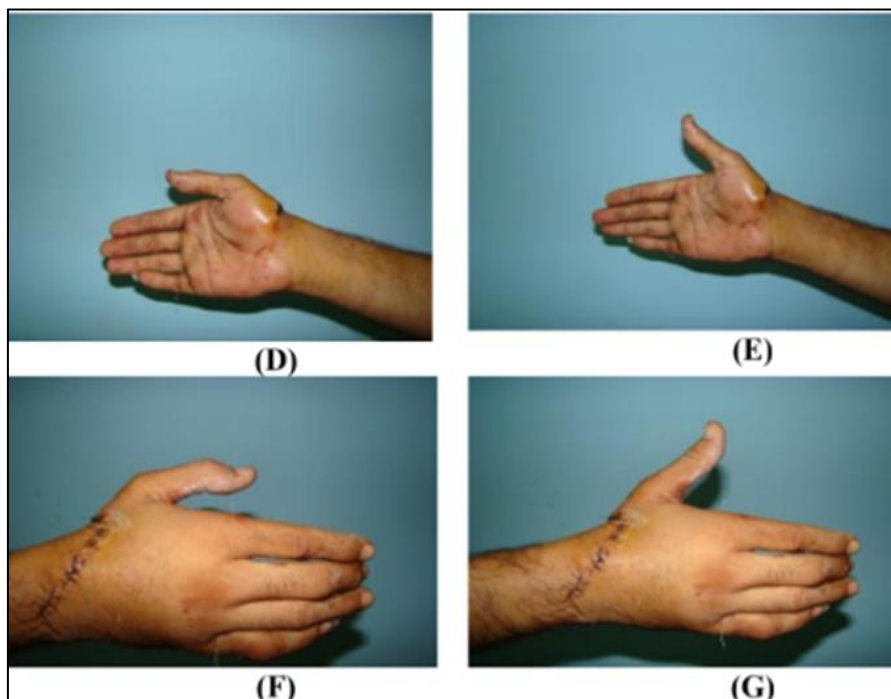
Number of cases	Zone of injury	Tendon which injured	%
28	VI	EDC, EI, and EDM	70%
7	VII	EDC, EI, APL, EPB, ECRL, ECRB & EPL	17.5%
5	V	EDC, EI, EDM	12.5%

Table-3: Complications

Post-operative complications	Number of cases	%
Tendon rupture	6	15%
Adherent scar	3	7.5%
Wound infection	3	7.5%

Table-4: Overall result at 6th post-operative weeks, according to Dargon Criteria

No. of cases	Results	%
25	Excellent	62.5%
12	Good	30%
-	Fair	-
3	Poor	7.5%



D-G: Views of early active mobilization of wrist and thumb 5th postoperative day.



H: Active extension of the wrist 2nd postoperative week. I: Active extension of the thumb 2nd postoperative week. J: Active extension of the wrist and MP joint of the index finger 6th postoperative week K: Active flexion and extension of the thumb at 6th postoperative week.

DISCUSSION

Extensor tendon injuries are much more common than flexor tendon injuries [2, 3, 5, 6]. But these injuries are neglected in literature as it is assumed that the results following their repair are better than flexor tendon severances. Initial strategy of static immobilization following extensor tendon repair lead to frequent adhesions and poor results [5, 8, 10]. Gradually early passive mobilization strategies with dynamic splinting emerged and showed good results [7, 18]. Contrary to popular belief, these injuries may be more difficult to treat than those of flexor tendon system because of the complex anatomy of the extensor system and any minimum discrepancies in tendon length and tension can lead to significant functional deficits following tendon injury and repair [17]. However, high cost and complicated nature of the dynamic splints paved the way for use of static splints and early active mobilization which produced results as good as the dynamic splinting [19]. A flurry of innovation in postoperative rehabilitation therapy for extensor tendon injury has developed. Initially, it was believed that the lack of synovial lining, except at the level of the extensor retinaculum, limited tendon adhesion formation. In extensor tendon repairs, static splinting was accepted as the normal postoperative therapy modality, however, several articles have demonstrated improved functional outcome after early mobilization protocol [4, 8, 18]. The intention of this paper is to demonstrate that the appropriate form of therapy is variable, depending on the affected digit, zone of injury, available time for recovery and patient cooperation. The therapeutic postoperative protocol used by our study is the early active motion after the first 24 hours of repair. It is carried out using an easy to made POP splint, the results were evaluated after the sixth postoperative weeks as advocated by Hung *et al.*, [19]. In this prospective study, 40 patients with extensor tendon injury were subjected to early active mobilization protocol and were followed up to one year. In our study fourteen patients (52.5%) were between 30 – 40 years of age. These findings were not consistent with Narender Saini *et al.*, [20], whose study showed that most of his patients were < 30 years old, and also inconsistency with other series where young adults between 18 – 30 years were more affected [21, 22]. This inconsistency was because of fact that most of the injuries in our study were victims of glass injury that occurred due to blast explosions, so it was not restricted to young working age group whose being seen in the above studies. Males were affected more than females 15:5 these findings were consistence with a study by Pandy and Goyal [23]. In our series, thirty patients (75%) had their dominant hand involved. Twenty eight (70%) of injuries were in zone VI (metacarpal region) followed by Seven (17.5%) in zone VII (dorsal retinaculum) and this is consistence with Narender Saini *et al.*, [20], study were most common injuries occur in zone VI and VII. This observation is understandable since these zones were vulnerable to trauma more frequently. In our study, the tendon most common involved were EDC, EI and EDM,

these finding were consistence with the finding of Slater and Bynum [21]. In thirty three (82.5%) of cases, primary repair were done (within 24 h. after trauma), and in the remaining 6 (15%) patients, delayed primary repair were done within one week post injury since they had crushed injury and the wound was not clean enough for primary repair. The final assessment of progress was done with Dargon criteria [24] as mentioned above. At the end of sixth week, twenty five (62.5%) of patients showed excellent results and twelve (30%), showed good results. These findings were consistence with Narender Saini *et al.*, [20] results that showed (91%) excellent results and also consistence with Sylaidis, Youatt and Logo [25] who showed twenty-two (92.5%) good to excellent results. Our results are comparable with rehabilitation protocol using dynamic splinting by Cosby and Wehbi, who had 92% of good to excellent results injuries at zone IV to VII [16]. In 3 of patients (7.5%) the results were poor; those two patients were two of five patients who had crush injuries. The most common complications were tendon rupture six cases (15%) which was inconsistency with Narender Saini *et al.*, [20] who showed no tendon rupture in any of their patients, this was attributed to poor compliance of some patients, being uncooperative with our protocol in performing the exercise with caution while wearing the splint and with limited frequency. The second most common complication was adherent scar, three patients (7.5%), which was consistence with Narender Saini *et al.*, [20], who showed 31% of adherent scar, The third most common complication was wound infection, it occurred in three patients (7.5%), which responded to daily change of dressing and systemic antibiotics. Despite the wound infection, the patient continued to undergo the mobilization protocol and still had good result. These were evaluated again in the same manner, two of them had excellent outcome, and the other two had good outcome according to Dargon criteria [24]. The early repair and mobilization of extensor tendons prevent formation and adhesion as compared to rigid immobilization. While using dynamic splinting is both expensive and cumbersome and requires frequent input from an experienced capable hand therapist. Our patients showed no complaint and it was easy for them to follow the rehabilitation plan, thus helping to attain excellent results.

CONCLUSION

The early mobilization of repair extensor tendon reduces the formation of adhesions. The static splint is easy to prepare and to apply. Patients subjected to this protocol, should be carefully selected, since uncooperative and poor compliant patients are not good candidate for early active mobilization protocol. We recommend the use of this protocol following extensor tendon repair at zone V, VI and VII of the hand.

Conflict of Interest: None.

Source of Fund: Nil.

Abbreviation

ECU: Extensor Carpi Ularis
 ECRS: Extensor Carpi Radialis Brevis
 ECRL: Extensor Carpi Radialis Longus
 APL: Abductor Pollicis Longus
 EDQ: Extensor Digiti quinti
 EDC: Extensor Digitorum
 EPI: Extensor Indicis Proprius
 EPL: Extensor Pollicis Longus
 EPB: Extensor Pollicis Brevis

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