

PRIMARY REPAIR OF ZONE 6 EXTENSOR TENDON INJURIES AND THEIR OUTCOMES

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ABSTRACT – The extensor apparatus is a complex muscle-tendon system that requires integrity or optimal reconstruction to preserve hand function. Extensor tendon injuries are common and they can lead decreased wrist and finger movements. Classification of extensor injuries into anatomical zones and the evaluation of the characteristics of the lesions are considered key points to select the appropriate management. In our retrospective observational study, we analyzed the demographic data, management & surgical outcomes of primary repair in 78 patients who presented with extensor tendon injuries in zone 6, according to Verdan's classification, to our institute from May 2021 to April 2022. 71 (91.02%) patients were males and 7 (8.98%) were female patients. The average age of patients were 34.6 years. Right hand was involved more than the left The most common etiology was work spot injury, mostly cutting machine injuries which accounted for 35 patients. The next most common cause was glass cut injuries seen in 23 patients. 15 patients had associated bony injuries. 55 patients had injury to multiple extensor tendons and 23 patients had injury to single extensor tendon. A total of 168 tendons were repaired. Functional outcomes were studied using Miller's criteria. The outcomes of the zone 6 extensor repair depends mainly on the severity of the tendon injury, injury to adjacent structures, strength of the repair and patient's compliance to physiotherapy

INTRODUCTION –

The extensor mechanism animates a linked skeletal structure, capable of producing complex movements with precision and speed. At the distal end of the forearm, the extensor retinaculum covers and compartmentalizes the extensor tendons. It separates the tendons into six compartments. The retinaculum prevents dorsal bowstringing of the tendons with wrist extension, volar bowstringing of the first compartment tendons with wrist flexion, and volar subluxation of the ECU with forearm pronation. Bowstringing shortens the path of the tendon, thereby resulting in less efficient power to a distal joint.

Specific injuries are divided into nine zones on the basis of crucial anatomic features. There are many treatment options for a given extensor tendon injury. Ultimately, selection of the best treatment plan depends on the surgeon's understanding of the system's mechanics, an accurate analysis of the injury, and the specific functional needs of the patient.

OBJECTIVES –

This study aims to analyze the demographic data, management & surgical outcomes of primary repair of Zone 6 extensor tendon injuries of hand. Zone 6 injuries have favorable prognosis for many reasons:

- associated joint injuries are uncommon
- comparatively greater tendon excursion

METHODS –

A retrospective observational study was performed on 78 patients who presented with extensor tendon injuries in zone 6, according to Verdan's classification, to our institute from May 2021 to April 2022.

INCLUSION CRITERIA –

All patients with zone 6 extensor tendon injuries presenting within 48 hours of injury

EXCLUSION CRITERIA –

Patients with loss of skin, loss of tendon

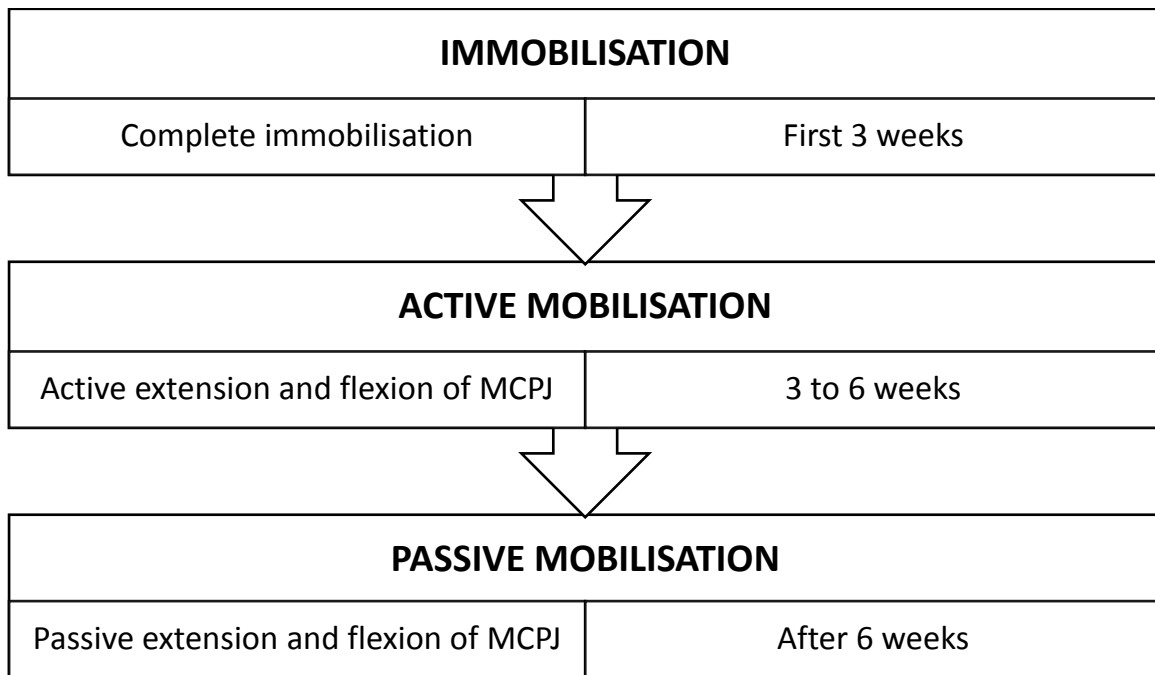
SURGICAL TECHNIQUE

All surgeries were performed under either supraclavicular block or general anesthesia. Pneumatic tourniquet control was used in every patient. All wounds were debrided and washed thoroughly. Wounds were explored after raising skin flaps when needed. Tendon ends were retrieved and freshened.

The proximal and distal tendons were approximated and tenorrhaphy was done using horizontal mattress suturing with polypropylene 3-0 core sutures. Skin was approximated using 4-0 nylon and drain was kept after achieving hemostasis. Wound dressing was done. Hand and wrist were immobilised using a volar slab POP with wrist joint in 30 degrees extension, metacarpophalangeal joints in 60 degrees flexion and interphalangeal joints in neutral position.

Patients were started on intravenous antibiotics, analgesics, and the operated limb was elevated. Patients were followed up regularly. Sutures were removed on the 14th post-operative day. POP slab was discarded by the completion of 3 weeks post-operatively.

The following protocol was followed :



The functional recovery was studied based on Miller’s criteria as degrees of total extension lag & total flexion loss in the fingers.

MILLER’S CRITERIA

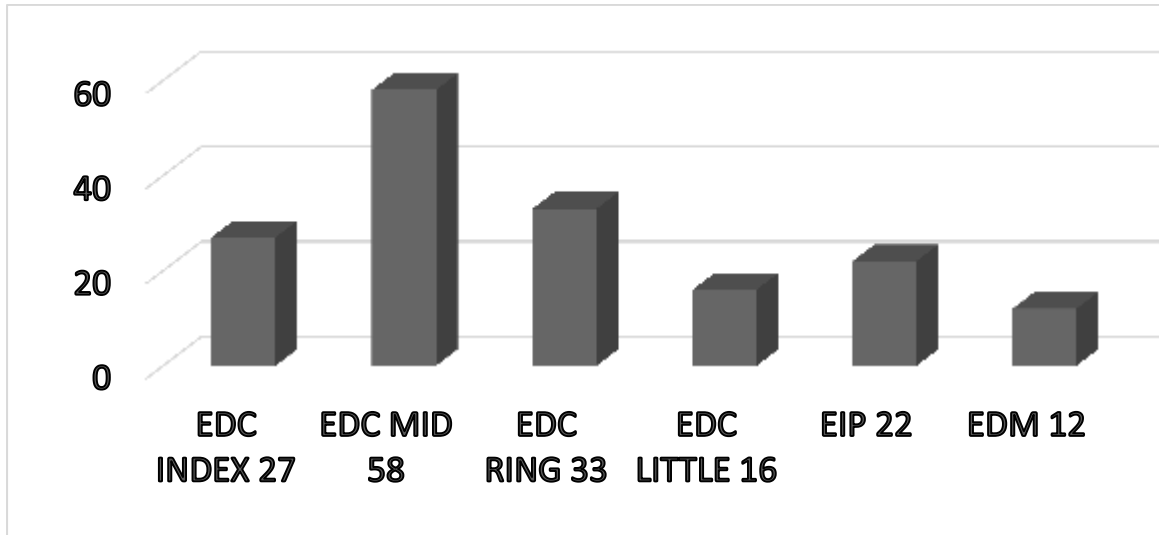
RESULTS –

In this study of 78 patients, 71 (91.02%) were males and 7 (8.98%) were female patients. The average age of patients were 34.6 years. Right hand was involved more than the left. The most common etiology was work spot injury, mostly cutting machine injuries which accounted for 35 patients. The next most common cause was glass cut injuries seen in 23 patients. 15 patients had associated bony injuries. 55 patients had injury to multiple extensor tendons and 23 patients had injury to single extensor tendon. A total of 168 tendons were

RESULT	TOTAL EXTENSION LAG (degrees)	TOTAL FLEXION LOSS (degrees)
EXCELLENT	0	0
GOOD	≤10	≤20
FAIR	11-45	21-45
POOR	≥45	≥45

repaired.

EDC INDEX	27
EIP	22
EDC MID	58
EDC RING	33
EDC LITTLE	16
EDM	12



RESULT	TOTAL EXTENSION LAG (degrees)	NUMBER OF PATIENTS
EXCELLENT	0	42
GOOD	≤10	24
FAIR	11-45	8
POOR	≥45	4

RESULT	TOTAL FLEXION LOSS (degrees)	NUMBER OF PATIENTS
EXCELLENT	0	67
GOOD	≤20	11
FAIR	21-45	0
POOR	≥45	0

1 patient with poor outcome had removed the splint on their own within 7 days of surgery.

2 patients with poor outcome developed wound infection. 1 patient with poor outcome had developed a swelling on the scar site after active mobilisation – diagnosed as synovitis. Secondary reconstruction of extensor tendons was done in all the 4 patients.



PRE-OPERATIVE



POST OPERATIVE

Fig 1. INJURY TO EDC MID FINGER – EXCELLENT RESULT



PRE-OPERATIVE



POST-OPERATIVE

Fig 2. INJURY TO EDC MID & RING – POOR RESULT IN RING

DISCUSSION –

Stability at each articulation depends on a precise balance between static and dynamic forces. Relatively minor injuries can disrupt the balance and disable the system, and a change of

even a few millimeters of extensor tendon length or excursion can impair hand function. Surgical treatment of this system is deceptively difficult. The superficial location of the tendons and ease of surgical exposure lead many to believe that these are trivial injuries. Unfortunately, this erroneous assumption leads to a poor functional outcome.

Newport et al showed that excellent outcomes are not easy to achieve. Extensor tendon repairs in the absence of an associated injury had 64% good to excellent results. Tendon repairs with associated injuries, such as a fracture, skin avulsion, or joint injury, had only 45% good to excellent results. Loss of flexion was common after extensor tendon injuries.

The amplitude of tendon excursion over the dorsum of the finger is extremely small; this explains why small tendon gaps, over tightening of tendon repairs, or small amounts of bony shortening or angulation can lead to dramatic extensor lags or restriction of flexion at the PIP and DIP joints. Vahey and associates found that an experimental 12-degree PIP joint extensor lag was produced with every 1 mm of tendon lengthening over the proximal phalanx. Schweitzer and Rayan showed that 1 mm of terminal tendon lengthening resulted in a 25-degree DIP joint extensor lag and that 1 mm of terminal tendon shortening severely restricted DIP joint flexion. Over the dorsum of the hand, it has been shown experimentally that relative lengthening of the extensor tendon by 2 mm produces an extensor lag of approximately 7 degrees at the MP joint. Because most MP joints had a “reserve” of hyperextension ability of about 35 degrees, however, 5 to 6 mm of relative extensor tendon lengthening in this zone may not produce a clinically relevant lack of extension.

The mean age of the patients in our study was 34.6 years compared to 37.17 which was reported by Reuf Karabeg et al and 28.9 years as reported by Lakshmi KB et al. This study included 71 (91.02%) males and 7 females (8.98%) which were similar to a study done by Reuf Karabeg et al which included 87.8% of male patients and 12.2% of female patients while Lakshmi KB et al reported 23 (76.66%) male patients and 7(23.34%) female patients. This data is consistent with epidemiological data that are encountered by other authors such as Starčević B et al and Servant C et al.

Our study observed that extensor tendon injuries of the right hand were more common than left hand which was similar to Starčević B et al. In our study, 3 patients developed complications – synovitis in one patient and surgical site infections in 2 patients.

The final results were evaluated according to Miller’s criteria. In our study, following 6 weeks after surgery, excellent results were observed in 53.8% of patients, good results in 30.7% of patients, fair results in 10.2% of patients and poor results in 5.1% which were better to the study done by Mohammed Ahmed Kadah, who studied excellent results in 32.1% of cases, good in 42.8% of patients and fair results in 17.8% of patients and by Lakshmi et al who observed excellent results in 36.66% of patients, good results in 46.66% of patients, fair results in 16.66% of patients.

CONCLUSION –

The outcomes of the zone 6 extensor repair depends mainly on

- the severity of the tendon injury
- injury to adjacent structures

- strength of the repair
- patient's compliance to physiotherapy

Injuries with associated fractures and when involving multiple tendons are prone for adhesion formation. The patient must be properly counselled regarding the nature of injury and made aware about the need for physiotherapy. The most commonly encountered extensor tendon injuries should be treated with utmost care to prevent significant disability among the working population.

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