

Functional Recovery Measurement: Comparing Early Active Mobilization Versus Immobilization after Extensor Tendon Repair in Zones IV to VIII

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ABSTRACT

Objective: To compare the results of early active mobilization versus immobilization in term of rehabilitation after extensor tendon injury in zones IV-VIII.

Study Design: Randomized control trial (Clinical Trial no. NCT04221113).

Place and Duration of Study: Department of Plastic and Reconstructive Surgery, Dr. Ruth K.M. Pfau Civil Hospital, Karachi Pakistan, from Feb to Jul 2020.

Methodology: Patients with extensor tendon injuries of zone IV-VIII were randomly allocated to Treatment Group (early Active Mobilization) and Comparison Group (Immobilization Group) and their total active motion score was observed at fourth, sixth and eighth week.

Results: Overall mean age of study participants was 29.48±5.51 years. Half of the patients had single finger injury 25(50%). Most of the study participants presented with injury in zone V 32(64%). The two groups did not differ on basis of age ($p=0.879$), gender ($p=1.00$), zone involved ($p=0.183$) and finger involved ($p=0.396$). TAM score between the two groups was not significantly different at fourth week ($p=0.384$), sixth week ($p=0.606$) and eighth week ($p=0.122$). The frequency of complications between two groups was not statistically significantly different ($p=0.667$).

Conclusion: The current study was unable to find the significant difference in patients' outcomes when treated with early active mobilization and immobilization protocol.

Keywords: Early active mobilization, Extensor tendon repair, Hand injuries in zone IV-VIII, Immobilization, Rehabilitation.

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INTRODUCTION

Extensor tendon injuries (ETIs) of forearm and hand are commonly observed in clinical setups however, these injuries are occasionally given less attention as compared to flexor tendon injuries. ETIs constitutes 16.9% of orthopedic soft tissues injuries with incidence of 17.9 cases.¹ Mismanagement may lead to impaired functioning of hand. Therefore, appropriate treatment is required to for optimized functioning of hand and returning to work earlier.²

An approach to management is determined by the zone involved as each zone has the distinctive connection of anatomical elements and cross-sectional tendon size.³ No matter whatsoever the level or type of injury, the surgeon is ultimately interested in protection of repair, modification of peritendinous adhesions, promoting tendon excursion and preserving joint motion. Previously, ETIs have been managed with more than six weeks of immobilization followed by gradual mobilization. This persists as the mainstay of the management for distal injuries of zone

I and II because they are too lean for suturing effectively; nonetheless the tendons are higher in proximal zones and are compliant for strong primary repairing.⁴

Presently, advancement have been made in rehabilitation and surgical management of acute extensor and flexor tendon injuries of all zones which have positive effect on the outcomes.⁵ Since 1990, a protocol for controlled active mobilization has been recommended by surgeons to use following the repair of extensor tendon in zone III to VIII. Moreover, this protocol was established to restrict adhesion of tendon and sustain joints movement and simple for preparation, cost-effective, accessible and fewer complications are associated with this approach as compared to other regimens.⁶ Early active mobilization (EAM) requires to be in a restrained way to enhance the advantages of mobilization while ignoring the harms of unlimited motion.⁷

Various studies have been conducted that have shown better results for early active mobilization but there are some limitations of these studies such as some studies were conducted retrospectively, some studies enrolled clubbed cases, criteria for assessment,

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proportions of patients came back for follow-up and tendon numbers are not uniform. Various prospective studies do not have a control group. However, in the light of available literature we hypothesized that early active mobilization following the tendon repair will have better patients' outcome as compared to immobilization protocol. Therefore, the aim of this study was to compare the results of early active mobilization versus immobilization in term of rehabilitation after extensor tendon injury in zones IV-VIII.

METHODOLOGY

The randomized control trial was conducted at Department of Plastic and Reconstructive Surgery, Dr. Ruth K.M. Pfau Civil Hospital Karachi Pakistan, from February to July 2020. Clinical trial was registered on 7th January 2020 (clinical trial #: NCT04221113) and approval to conduct the study was also acquired from Institutional Ethics Review Committee (IRB# 1365). **Inclusion Criteria:** Patients of any gender of age 18-65 years and had simple lacerations of extrinsic extensor tendons of the hand in Verdan's zones V-VII were included.

Exclusion Criteria: Patients with complex injured hands such as significant soft tissue loss, bone and/or joint injuries other than simple breaches of the dorsal capsule of the metacarpophalangeal joint, flexor tendon injuries, partial tendon lacerations and tendon injuries at more than one level were excluded. Written informed consent was taken from patients before enrolling them into the study. Patients were randomly allocated in two groups using sequentially numbered opaque sealed envelope (SNOSE protocol).⁸

In previous study, mean value for total active motion score for patients treated with EAM and IM were 246 ± 259 and 212 ± 229 respectively. Therefore, to detect a difference of 34 between the groups at 95% confidence interval, power of 80%, the calculated sample was 8 per group. However, we enrolled total 50 participants, 25 in each group as the calculated sample size was quite small.

All patients were treated in same manner in which preoperative examination, operative management, antibiotic policy and immediate postoperative positioning in both groups. Surgical protocol included debridement of all nonviable tissues, exploration, injury assessment and repair. The procedure was performed by senior surgeon. The splint was prepared with volar plaster of Paris slab and applied from proximal forearm to the fingertips just after the procedure. Measurements were recorded for the

custom-made padded aluminum splint. Decision to discharge patients was made depending on the condition of their injuries. Patients were advised to visit outpatient department on third day of the procedure for initial assessment of the wound and splint application.

For patients in group early active mobilization, the splint was positioned in a way to give rest to injured fingers between the periods of exercise. During first week, 30 of the angle was set between the two arms of adjustable block. On third post-operative day, patients were instructed to take out the wedge and attempt for the active movement of the fingers at metacarpophalangeal joints from 0-30 and leaving the interphalangeal joints straight. Patients were advised to put back the adjustable block in place in between the periods of exercise. Patients were asked to perform three sessions of exercise, each session of 10 minutes, during first week. The movements range was increased up to 45-50 4 times 10 minutes each in second week through adjustments in splint.

During third week, the adjustment was made in splints to increase motion range to 70. The patients were instructed to perform exercise five times a day in third week. The finger providing support to limb of the adjustable block was moulded to allow the free movement of interphalangeal joints every time. The angle was set as 90 during week four for allowing the flexion of 90 at metacarpophalangeal joints and free movement at interphalangeal joints respectively. The wedge was completely discarded in fifth and sixth week in daytime to freely move under the splint i.e. from 0-90 at metacarpophalangeal joints. From seventh week, patients were given the same instructions as of conventionally treated group and final outcome was observed at eighth week for both the groups.

The patients in this group who were managed with a static splint were assessed at first, second and fourth postoperative weeks for continuous care of wound. The modification was made in splint at the end of 4th week through addition of adjustable block to carryout movements of active flexion and passive extension of 0-45 at metacarpophalangeal joints (MCPJ) whereas interphalangeal joints (IPJ) were set free. Patients were advised for mobilization four times a day after the removal of wedge and to apply again after taking exercise. At the start of week 6, the splint was adjusted in a way so that 0-90 movement of metacarpophalangeal joints may take place as much as possible during a day. The splints were removed at the start of 7th week during day time and night splintage will be continued for further 2 weeks.

Early Active Mobilization Versus Immobilization

Data was entered into statistical package SPSS version 21 for statistical analysis. Categorical variables were expressed as frequency and percentage. Continuous were summarized as Mean±Standard deviation or median with inter-quartile range as appropriate according to normality of the variables. Normality assumption was assessed with Shapiro-Wilk test. Chi-square/Fisher-exact test was applied to compare categorical variables between the two treatment groups. Whereas independent t-test/Mann-Whitney U-test was applied to compare continuous variables between two groups depending on the normality assumption. p -value < 0.05 was defined as statistically significant.

RESULT

Total 50 patients were enrolled into the study with 25 patients in each group. The overall mean age of study participants was 29.48 ± 5.51 years. The mean age for patients treated with early active mobilization and immobilization was 29.60 ± 5.86 and 29.36 ± 5.25 respectively. The two groups did not differ on basis of age of study participants ($p=0.879$). Most of the study participants were male 42(84%). However, the two groups were not significantly different in terms of gender ($p=1.00$). Most of the study participants presented with injury in zone V 32(64%) followed by zone IV 9(18%), zone VII 6(12%) and zone VI 3(6%). Frequency of injury with respect to zone was not significantly different among interventional and comparison group ($p=0.183$). Half of the patients presented with injury in a single finger whereas remaining half had injury in multiple fingers. The two groups did not differ on basis of number of finger injuries ($p=0.396$).

The average TAM score at 4th week among early active group and immobilization group was 46.46 ± 15.18 and 49.84 ± 11.81 respectively. The median (interquartile range) TAM at 6th week was among interventional and conventionally treated group was $67.3(61.35 \pm 73)$ and $65.3(61 \pm 70.2)$ respectively. Results showed that TAM score was lower in early active group as compared to conventionally treated group at 4th and 6th week but the difference was not statistically different at 4th week ($p=0.384$) and 6th week ($p=0.606$) as well. The median (interquartile range) TAM score in early active group at 8th week was $84(78 \pm 90)$ which was higher than conventional TAM score $80(74 \pm 86)$. However, the difference was not statistically significant ($p=0.122$).

In EAM group, 2(8%) patients suffered from complications and both of these two patients suffered from complication of tendon rupture. In conventionally treated patients, 4(0.16%) patients faced the complications. Out of these 4(0.16%) patients, complication of joint stiffness alone was observed in 2(50%) patients. Only wound infection was present in 1(25%) patient. 1(25%) patient showed complication of joint stiffness and wound infection both. The frequency of complications among two groups was not statistically significantly different ($p=0.667$).

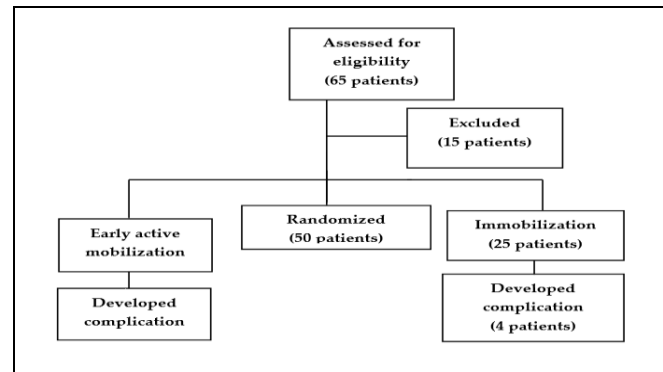


Figure: Flow of patient enrolment and occurrence of complications

Table-I: Comparison of Study Variables and Total Active Motion Score between Early Active Mobilization And Immobilization Treatment Group (n=50)

	Early active mobilization Frequency (%)	Immobilization Frequency (%)	<i>p</i> -value
Age# (in years)	29.60±5.86	29.36±5.25	0.879
Gender			
Male	21(50%)	21(50%)	1.00
Female	4(50%)	4(50%)	
Zone involved			
Zone IV	5(55.6%)	4(44.4%)	0.183
Zone V	13(40.6%)	19(59.4%)	
Zone VI	3(100%)	0(0)	
Zone VII	4(66.7%)	2(33.3%)	
Finger involved			
One finger	11(44%)	14(56%)	0.396
More than one finger	14(56%)	11(44%)	
Total active motion score at 4th week#	46.46±15.18	49.84±11.81	0.384
Total active motion score at 6thweekll	67.3(61.35±73)	65.3 (61±70.2)	0.606
Total active motion score at 8thweekll	84(78±90.2)	80(74±86)	0.122

DISCUSSION

Conventionally, the protocol of ETI treatment included static splinting and immobilization for period of 6 weeks with standard rehabilitation.⁷ However, after repairing extensor tendon, immobilization time span plausibly promotes the development of strong fibrous tissues at site of repair, which lessens the risk of breakage. The prospective pitfall is of forming adhesions near to repair site that leads to restricted flexion. The development of early controlled mobilization was led by the necessity to achieve balance motion without any hazard.¹ However, despite the better outcomes in early mobilization, the risk is involved as most probably, deterioration of tendon repair leads to rupture or extension lag or scar stretch.⁹ The current study was conducted at public sector tertiary care hospital in Karachi, which is easily reachable to people belonging to low socio-economic class of the society.

In our study, the study participants were young with mean age of 29.48 ± 5.51 years. Furthermore, 84% of injured participants were males. A Pakistani study also reported that mean age of study participants was 26 ± 11.1 years.¹⁰ The similar study was conducted in Bangladesh also reported that study participants belonged to age group of 21-30 years with male dominance.² Other international literature also reported that males were commonly affected by hand injuries.^{11,12} Occupational injury was the most common mode of injury in our study. In the current study, more than half of the patients presented with the zone V injury. It was also reported in another Pakistani study that zone V as the most common injury site.¹³ The frequency of injury site may vary depending on the occupational status and mode of injury.

In previously conducted investigations Dargan,¹⁴ Mayo Wrist Score² or TAM,¹⁵⁻¹⁷ systems have been used to assess the outcomes. The Dargan system computes the distance between fingertip and distal palmar crease and it is quite lenient in assessing the extension deficit. Dargan also presented a diagram to indicate the way of touch of finger pulp to distal crease just at 60 MCPJ flexion.¹⁴ Mayo wrist score is a combine measure of pain intensity, range of motion, grip strength and functional status.¹⁸ In the current study, patients were treated with early active mobilization protocol versus conventional immobilization technique and recruited injuries of zone V-VIII as there is minor implication of length and tension adjustment at this level as compared to the delicate relation of flexor and extensor apparatus in the digits.

The similar method was followed in other Pakistan study in which splint was immediately given after the tendon repair with 30 extension in wrist and IPJs with 0 and at the fourth week, movement of 0-45 was permitted while keeping IPJs free to move.¹⁰ This Pakistani study also used TAM score to determine the results of techniques and found that at 12th post-operative week, TAM score was significantly higher for group treated with early active mobilization. However, in the present study, no significant difference was observed in TAM score among the two techniques at 4th, 6th and 8th post-operative week. Previously, some authors documented the superiority of early active mobilization technique over the immobilization technique.^{2,9,10} The most likely explanation of the difference in our findings is the improper compliance of the instructions given to patients who were treated with early active mobilization. Majority of the patients were illiterate and did not follow the teachings and thereby the outcomes effected. Interestingly, some of the patients in early active mobilization group did not follow the treatment instruction adequately but there was no significant difference among the two groups in terms of complications while this difference was significant in other Pakistani studies.¹⁰

The current study analyzed the results following the 8th post-operative week which was the limitation of the study. Secondly, the study did not observe the time taken by study participants return to their normal routine work which was another limitation of the study. The current study included the bias as most of the study participants were illiterate and belonged to low socioeconomic status who did not satisfactorily comply with the early active protocol. We thereby recommend that in future a multi-center study at public sector hospital should be conducted to further confirm the superiority of the early active protocol over the immobilization technique particularly in the cohort of patients belonging to low socioeconomic status.

CONCLUSION

The current study was unable to find the significant difference in patients' outcomes when treated with early active mobilization and immobilization protocol.

Conflict of interest: None.

Author's contribution

Following authors have made substantial contributions to the manuscript as under:

ZZ & HA: Critical review, data acquisition, drafting the manuscript, approval of the final version to be published.

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RMK & WS: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

MF: Conception, study design, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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