

# Comparative Evaluation of Early Passive Mobilization and Early Active Mobilization in Post Repair Flexor Tendon Injuries Zone 2 and 3 of Hand

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## ABSTRACT

**Objective:** To compare early passive mobilization and early active mobilization in post repair Flexor Tendon Injuries (FTI) zone 2 and 3 of hand.

**Study Design:** - A prospective randomized design.

**Methods:** - 40 subjects with zone 2 and 3 post repair FTI were randomly allocated to early passive mobilization and early active mobilization groups. Digit/s total IP joint ROM was measured as outcome measure at 3<sup>rd</sup> postoperative day (POD) and at end of 6<sup>th</sup> week for comparison.

**Results:** - Statistical analysis showed significant gain in total IP joint ROM in early active mobilization group (106.31) than early passive mobilization group (86.84) at the end of 6<sup>th</sup> week.

**Conclusions:** - Early active mobilization is more effective than early passive mobilization in post repair FTI Zone 2 and 3 of hand.

**Keywords:** - FTI zone 2 and 3 of hand, early active mobilization, early passive mobilization, ROM.

## INTRODUCTION

In daily activities of living, profession and sports, hand is the main executing organ of the body. Due to its overuse it is always exposed to injuries. [1] There are higher rates of FTI as tendons lie close to skin. According to Roseberg et al and Small et al these injuries results mainly from lacerations by knives (30%), glass (45%), other sharp objects (15%) and severe crushing injuries (10%) with a higher incidence in lower socioeconomic status. Gault proposed proportion of zone 2 FTI to be 24%, 27%, 24% and 25% in index, middle, ring and little finger respectively. [2] Patients generally are unable to bend the affected finger actively, complain of pain on

attempting to bend and localized swelling in the finger. [3]

Complications can be tendon adhesion due to poor tendon gliding and pulley rupture [3] joint contractures, [4] and tendon rupture which is the worst complication and is seen in 3-9% of cases. [3] Zone 2 is referred to as “no man’s land” by Bunnell [5] as injuries in this level have difficulties in obtaining maximal function and have worst prognosis. [6,7] Due to reduced tendon gliding, normal joint motion can be affected. In measuring ROM, goniometric measurements are more precise and it is considered to be reliable and accurate. [6]

Management of FTI is a challenging task. Postoperative management needs to be carefully planned. The goals of rehabilitation after Flexor Tendon Repair (FTR) in zone 2 and 3 of hand are to promote intrinsic tendon healing and minimize extrinsic scarring to promote tendon gliding at sutured ends of tendon; this improves functional range of motion. Mobilization is essential to prevent adhesions and improve gliding. Three main methods for tendon rehabilitation used are: immobilization, early active mobilization and early passive mobilization. In immobilization method, tendons are immobilized for 3-4 weeks. This causes scarring of tendon and flexion contractures in digits hence disabilities. In recent year repair techniques have improved, moreover stronger and less bulky sutures are available. Researchers have demonstrated that repaired tendons when stressed through an early mobilization program heal faster, gain tensile strength faster and have less adhesions and better excursion than unstrained repairs. [8-11] In early active mobilization, tendons are mobilized within 48 hours of repair, through active gentle contractions of involved muscles (mainly flexor muscles of hand). In early passive mobilization, repaired tendons are mobilized passively either by therapist or by dynamic flexion splints. However the tendon rupture rates were also observed, it was found to be 5.3% in early active mobilization and 3.6 % in early passive mobilization. [12]

There are studies which talk about rehabilitation program of early passive mobilization and early active mobilization techniques in post repair FTI in hand. To our knowledge there are very few studies which have compared the effects of these two techniques, moreover the results among them are contradictory [12-16] hence a need arises to compare the effects of early passive mobilization with early active mobilization techniques in post repair FTI zone 2 and 3 of hand.

## **METHODOLOGY**

Prior to the study ethical clearance was obtained from the Ethical Committee of S.D.M. College of Medical Sciences and Hospital, Dharwad. In this prospective interventional study subjects of either gender with unilateral FTI zone 2 & 3 of hand, age group 16 to 60 years were included from Physiotherapy OPD of the hospital. Subject with either tendon injuries in both hands, past history of any injury which would have affected the ROM of joints of hands, any inflammatory/infective conditions such as ankylosing spondylitis, rheumatoid arthritis, any neurological conditions which can affect the movements of upper limb/s, psychological conditions and subjects who were not ready to cooperate in therapy, dermatological conditions which was contagious and any other associated injuries of hand such as fractures which requires complete immobilization were excluded from the study.

Subjects fulfilling the criteria were explained about the study and written consent was taken, demographic data was collected along with the routine evaluation with emphasis on ROM of PIP and DIP joints on 3<sup>rd</sup> POD and at the end of 6<sup>th</sup> week using universal finger goniometer.

A sample size of 40 subjects (20 in each group) was included. They were randomly allocated by lottery system into Experimental group and Control group. One subject from each group did not complete the study due to tendon rupture. So 38 (19 in each group) subjects were considered for the data analysis, group 'A': Control group: N=19, M: F= 10:9, with mean age 34.4 (SD= 11.3) and group 'B': Experimental group: N=19, M: F= 12:7, with mean age 36.2 (SD= 8.56) years.

Post operatively the hand in both groups was placed in a dorsal resting slab with wrist in 20 to 30 degree flexion, MCP joints in 50 to 60 degree flexion and IP joints in neutral. The slab was extended 2 cm beyond the fingertips to inhibit use of hand. A radial plaster wing was wrapped

around the wrist just proximal to thumb to prevent the cast from migrating distally.

To measure ROM on the 3<sup>rd</sup> POD, subject was in sitting position with involved hand placed on a pillow then carefully the dorsal resting slab was removed, maintaining wrist joint in 20 degree and MCP joint/s 50 degree flexion, subjects were asked to flex the PIP and DIP joints actively for the involved digit/s to the available end range. Then it was measured by the examiner using finger goniometer. Once measurement was done dorsal resting slab was replaced carefully to the post operated hand. Same method was followed at the end of 6<sup>th</sup> week for the ROM measurement.

In control group subjects were taught to perform passive flexion and active extension of involved digit/s (MCP, PIP and DIP joint), 15 repetitions every hourly (i.e. modified Duran and Houser's protocol was followed) for 6 weeks. [17]

In experimental group subjects were asked to actively flex and extend the digit/s (MCP, PIP and DIP joints within pain free ROM i.e Solomon's protocol) 15 repetitions every hourly till end of two weeks. From 3<sup>rd</sup> week postoperative Active-hold/place-hold mobilization with digit/s flexed (i.e. Strickland/Cannon protocol) where hold time was for 5 seconds, 15 repetitions every hourly) [17] was started, which continued till end of six weeks. Then data was collected in the same position and was sent for analysis.

**Table 1:** Comparison of total ROM scores (PIP+DIP) in degrees in early passive mobilization group (Group – A) and early active mobilization group (Group – B) at 3<sup>rd</sup> POD and 6<sup>th</sup> week.

Group	3 <sup>rd</sup> POD	SD	6 <sup>th</sup> WEEK	SD	Mean Diff	SD	t-value	p-value
Group – A {#}	1.58	2.39	86.84	32.7	85.26	32.8	11.35	0.000*
Group – B {¶}	1.32	2.26	106.31	22.4	104.99	23.74	19.27	0.000*

\*P<0.05

**Table 2:** Comparison of total ROM scores (PIP+DIP) in degrees between two groups (early passive mobilization and early active mobilization) at 3<sup>rd</sup> day and 6<sup>th</sup> week.

Variable	Groups	Mean (in degrees)	SD	SE	t-value	P-value
3rd day {#}	Early passive mobilization (Group A)	1.58	2.39	0.55	0.3487	0.7293
	Early active mobilization (Group B)	1.32	2.26	0.52		
6 week {¶}	Early passive mobilization (Group A)	86.84	32.71	7.50	2.109	0.042*
	Early active mobilization (Group B)	106.31	23.44	5.37		

\*p<0.05

## DISCUSSION

The results were analyzed using parametric tests. Table 1 {#} shows there is significant increase in total IP (PIP+DIP) joint ROM in group A at end of 6<sup>th</sup> week postoperatively (86.84) as compared to 3<sup>rd</sup> POD (1.58).

In post immobilization period, factors which can contribute to hypomobility are pain, muscle spasm, adhesions, adaptive shortening of soft tissues, impaired muscle performance (i.e weakness) and malunion. Early passive mobilization technique (where subjects did passive flexion with the help of other hand and then active extension by concentric contraction of extensors) would have prevented adhesion formation in repaired tendon ends [18] and would have also promoted intrinsic tendon healing. Also use

of elevation, passive movements and antagonist muscle contraction would have assisted lymphatic and venous return decreasing interstitial pressure. [19] Moreover due to antagonist contraction there is reciprocal inhibition of the agonist resulting in relaxation and further reduction in pain. This reduction in pain would have improved the muscle function over time and hence significant improvement in the ROM.

Table 1 {¶} shows there is significant increase in total IP (PIP+DIP) joint ROM in group B at end of 6<sup>th</sup> week postoperatively (106.31) as compared to 3<sup>rd</sup> POD (1.32).

Early active mobilization increases strength of repaired tendon. [6] In first two weeks active flexion and extension movements were performed within pain free ROM which resulted in reciprocal inhibition of both agonist and antagonist muscles and

hence pain relief. Later on “Strickland/Cannon” was protocol followed i.e. Active-place-hold mobilization (where subjects passively flexed the digits with other hand and hold for 5 seconds actively and then extended the digits again actively), this involved isometric contraction of the injured flexor muscles which pulled the tendon of Flexor digitorum superficialis and profundus proximally to produce better glide.<sup>[6,17]</sup> This would have improved the strength of the repaired tendon and prevented disuse atrophy of hand muscles also. So pain relief together with improved muscle strength and repaired tendon over time can be the cause for significant improvement in ROM.

Table 2 {#} shows there is no significant difference in total IP (PIP+DIP) joint ROM between group A (1.58) and B (1.32) at 3<sup>rd</sup> POD.

Table 2 {¶} shows there is significant improvement in total IP (PIP+DIP) joint ROM in group B (106.31) as compared to group A (86.84) at 6 weeks.

Active movements improve muscle strength, endurance and over all physical function. In the beginning during first 4-8 weeks of active exercises tension generating capacity of skeletal muscle is largely attributed to neural responses. Neural adaptations are attributed to motor learning and improved co-ordination and include increased recruitment in the number of motor units firing as well as increased rate and synchronization of firing.<sup>[20]</sup>

Lack of flexor muscles active contraction in group A would have resulted in atrophy, loss of strength, deterioration in motor unit recruitment and an increase amount of connective tissue and hence contributed to decrease mobility.

So in group B neural adaptations would have improved the strength and endurance in actively exercised muscles which may be responsible for the significant improvement in total IP (PIP+DIP) joint ROM in group B (106.31) as compared to group A (86.84) at 6 weeks.

## CONCLUSION

Early active mobilization is more effective than early passive mobilization in post repair Flexor Tendon Injuries (FTI) zone 2 and 3 of hand. Further studies can be performed on a larger sample size with importance for uniform age group and longer duration of follow up.

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