

Effectiveness Of Early Passive Mobilisation (EPM) Versus Early Active Mobilisation (EAM) Protocols On Total Active Motion And Grip Strength In Flexor Tendon Zone II Repair – A Pilot Study

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Abstract

Introduction: Despite large amount of data about different rehabilitation protocols, there were very few studies comparing early passive mobilisation (EPM) with early active mobilisation protocols (EAM). Hence, a randomized controlled trial was done to compare & determine the effectiveness of Early passive mobilisation (EPM) versus Early active mobilisation (EAM) Protocols on Total Active Motion (TAM) & Grip Strength in subjects following Flexor Tendon Zone II Repair. **Methodology:** Seventeen Subjects who underwent Primary Repair of Flexor Tendon zone II were identified. Twelve subjects met the inclusion criteria and were enrolled in the research. They were randomly assigned to EPM & EAM Groups through Simple Random Sampling method and treated for eight successive weeks. **Outcomes:** Total Active Motion (TAM) values were evaluated using the American Society for Surgery of the Hand criteria. Grip strength was measured using Jamar dynamometer. Both outcomes were assessed at 4 & 8 weeks after surgery. **Results:** Mean TAM values and Mean Grip strength were significantly greater in EAM Group. Hence, EAM Group is better than EPM Group. **Conclusion:** Early Active Mobilisation (EAM) is more effective than Early Passive Mobilisation (EPM) protocol, in restoring digital range of motion and grip strength following Flexor Tendon Zone II repair.

Keywords: Flexor Tendon zone II Repair, EAM, EPM, Early active mobilisation, Early passive mobilisation, Total Active Motion, Grip Strength

Introduction:

Flexor tendon injuries in zone 2 are common.¹ Flexor tendon injuries frequently occur through division in deep lacerations of fingers, palm or forearm.² Sterling Bunnell coined the term “No Man’s Land” for this region, due to the extreme difficulty in recovering adequate tendon excursion following repairs at this level.³ often resulting in poorer mobility and functional outcomes.⁴ Established rehabilitation regimens of flexor tendon repair are immobilisation, early passive mobilisation and controlled active

mobilisation.¹ Early Post-Operative mobilisation leads to improved Tendon healing, increased Tensile strength, decreased adhesion formation, early return of function, and less stiffness and deformity as compared to immobilisation.⁵ Early mobilization has proven so successful for zone II repairs that it has become the most common approach for treatment of flexor tendons in all zones.³

Early active motion can shorten healing time and reduce the weakness occurring ten days postoperatively that is due to contracture of the

repaired site versus the only folding of repaired tendon seen in passive motion.⁶Results of passive motion programmes are inconsistent. Active motion protocols become the standard of care in flexor tendon rehabilitation.⁷

Total Active Motion (TAM) , proposed by American society for the surgery of the Hand (ASSH) is one of the important outcome measures following flexor tendon zone II repair. Grip strength is an excellent global assessment of muscle function that can be used to establish the impact of tendon or nerve repair in hand.⁸

Despite large amount of data about different rehabilitation protocols, there were very few studies comparing early passive mobilisation (EPM) with early active mobilisation protocols (EAM).Hence, in this study, a randomized controlled trial was done to compare& determine the effectiveness of Early passive mobilisation (EPM) versus Early active mobilisation (EAM) Protocols on Total Active Motion (TAM) & Grip Strength in subjects following Flexor Tendon Zone II Repair.

METHODOLOGY

The present study was a randomized control trial to determine the Effectiveness of early active mobilisation (EAM) versus early passive mobilisation (EPM) protocols on Total Active Motion and Grip Strength following Flexor Tendon Zone II repair .The study was approved by the Institutional Ethical Committee. Between March & August,2021, 17 Patients who underwent Primary Repair of Flexor Tendon zone -IIusing 4-strand modified Kessler core suture combined with epitendinous suture were identified .Participants (n = 12) above 18 years of age with history of Laceration injury in flexor tendon zone II and who underwent primary flexor tendon repair were included. Subjects with Critical Ischemia of limb or digits, Associated extensor tendon injury, Concomitant nerve injury and fractures were excluded from the study.

After getting Informed Consent,participants were randomly assigned to two Groups through Simple Random Sampling method, as demonstrated in the CONSORT (Consolidated Standards of Reporting Trials)flowchart. EPM Group received Modified Duran protocol, whereas EAM Group received Belfast and

Sheffieldprotocol . They were treated in P.G Research laboratory at School of Physiotherapy, VISTAS, Thalambur, Chennai for eight successive weeks and No one dropped out during the study.

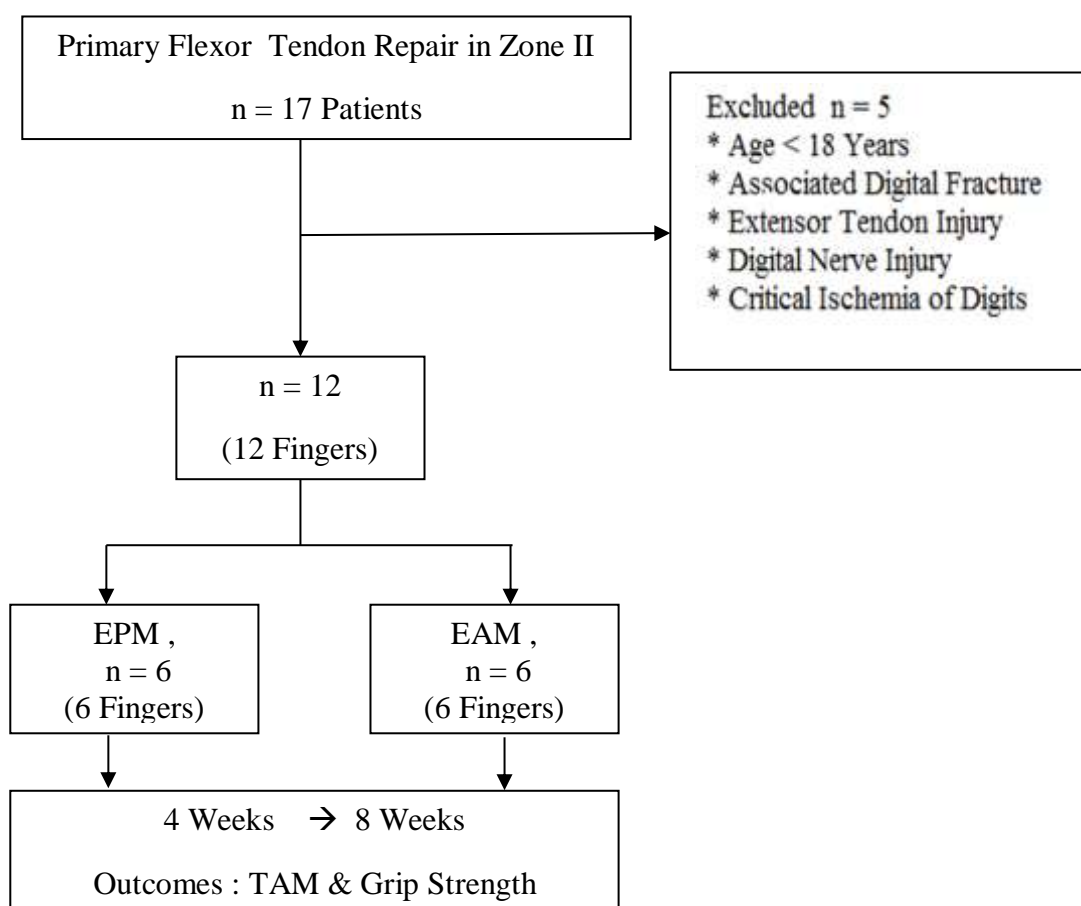


Fig . 1 : The randomisation demonstrated in the CONSORT flowchart

Outcomes:

Total Active Motion(TAM) values were evaluated by using the American Society for Surgery of the Hand criteria. Contralateral TAM was not used for functional grades, as it was not available for all subjects.

Grip strength was measured using Jamar dynamometer according to the American Society of Hand Therapist recommended position for grip strength measurement: the patient was seated with back supported, shoulder adducted and forearm in a neutral position. Grip strength was obtained by taking the average of 3 measurements on each hand. As a rule, the dominant hand is approximately 10% stronger than the non-dominant hand (10% rule).⁹

Both the outcomes were assessed at 4 & 8 weeks after surgery.

EAM and EPM protocols:

In EPM(*Modified Duran*) Protocol, the Post-Operative dorsal blocking splint holds the wrist in 20° flexion, MP joints in at 50° of flexion, and the IP joints are strapped in extension between exercise sessions. PROM exercises are initiated for isolated PIP and DIP joints within the restraints of the splint, followed by passive composite flexion of the MP, PIP and DIP joints. All Passive exercises performed twice daily for 6 to 8 repetitions per tendon per session. After 4 weeks the dorsal blocking splint will be removed.

In EAM(*Belfast and Sheffield*) Protocol, the Post-Operative dorsal blocking splint maintains the wrist at 0-20° flexion, MP Joints at 80°-90° of flexion and IP Joints were kept in full extension. Exercises were performed every 4 hours within the orthosis, included all digits and consisted of two repetitions each of full passive flexion, active flexion and active extension. After 3 weeks, splint changed to neutral wrist and at end of 4th week, splint removed.

From 4 to 8 weeks, Both the protocols consist of a common exercise program.

Between 4 to 6 Weeks , Tendon gliding(hook fist, straight fist and full fist) and blocking exercise were performed. Between 6 to 8 Weeks, Progressive resisted exercises started and if needed, corrective splints for flexion contractures in PIP joints given. Use of injured hand in ADL eg. Eating , writing and combing hair. Passive joint mobilisation progressing to flexors/extensors stretch initiated. Functional Activities training given.

Demographic Details:

In this research study, 12 participants were randomly assigned to two Groups through Simple Random Sampling method. six subjects (6 fingers) to Early Passive Mobilization Group (EPM Group) and six subjects (6 fingers) to Early Active Mobilization Group (EAM group).

Mean age and Standard Deviation (SD) of participants were 38 years & 5.4 in the EPM Group Versus 35 years & 5.1 in the EAM Group.

Each Intervention group consisted of 5 males & 1 female participants in common. All were right-hand dominant in nature.

Overall, 11 participants were injured in the right hand; the remaining one participant being left hand injured, who was in the EPM Group.

In EPM Group, the frequently injured digit was the ring finger (in 4 participants), with middle & little finger injured in one participant each; In EAM Group, each of the Index, middle & little fingers injured in 2 participants.

Statistical Analysis:

Comparison of outcomes, namely, Total Active Motion (TAM) and Grip Strength between EPM & EAM Groups (Group Comparison) done by Independent 't-test'. Comparison of outcomes at 4 weeks & 8 weeks of each group done separately by Paired 't-test'.

RESULTS

In the current study, there was Statistical significant difference in the Mean TAM values ($p < 0.05$) between the EPM & EAM Groups at 4 weeks & 8 weeks post-operatively. Mean TAM values and Mean Grip strength were significantly greater in EAM Group which is depicted using 95% Confidence Interval Plot. Hence, EAM Group is better in the outcome of TAM & Grip strength at 4 weeks & 8 weeks, which is also statistically significant.

Table 1 - Patient Details

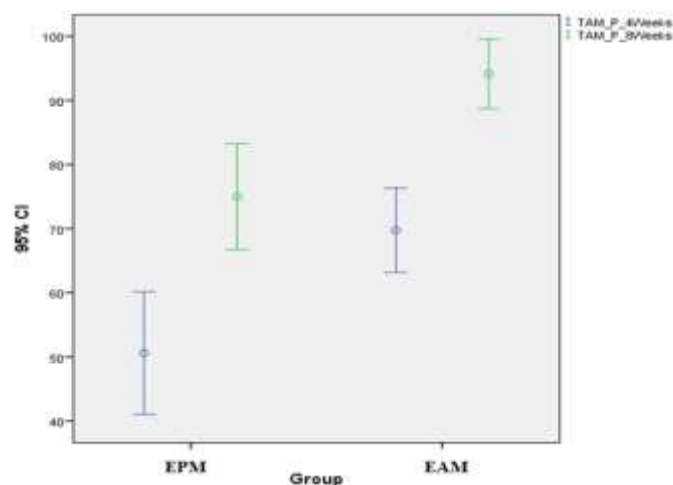
	Group A	Group B
No. of Patients	6	6
Age - Mean (sd) in years	38(5.4)	35(5.1)
Sex (Male/Female)	5/1	5/1
Right hand Dominant	6	6
Injure Hand (right/left)	5/1	6/0
Digit Injured		
Index	-	2
Middle	1	2
Ring	4	-
Little	1	2

Table 2 : Percentage of hand grip deficit in injured hand compared with uninjured hand

Group	# Sample	Injured Finger	Injured Hand_4 Weeks	Injured Hand_8 Weeks	Uninjured Hand_4 Weeks	Uninjured Hand_8 Weeks	Injured Hand /Uninjured_4 Weeks	Injured Hand /uninjured_8 Weeks	10% Rule_4 weeks	10% Rule_8 weeks	Hand_grip deficit %_4 weeks	Hand_grip deficit %_8 weeks	
EPM	1	Right Ring Finger	21.33	27.66	32.66	33	65	84	65	84	35	16	
	2	Right Middle Finger	22.33	26.66	33	33	68	81	68	81	32	19	
	3	Left Ring Finger	14.33	23.33	34	34.33	42	68	47	76	53	24	
	4	Right Ring Finger	20.33	25.33	32.33	32.33	63	78	63	78	37	22	
	5	Right Little Finger	23.66	27.33	34.66	33	68	83	68	83	32	17	
	6	Right Ring Finger	16	17	22.66	22	71	77	71	77	29	23	
	Mean							63	79	64	80	36	20
	SD							10.46	5.74	8.63	3.26	8.63	3.26
	C.V%							16.66	7.31	13.56	4.09	23.69	16.10
EAM	7	Right Index Finger	24.33	28.66	36	34	68	84	68	84	32	16	
	8	Right Middle	14.33	19.66	24.66	23.66	58	83	58	83	42	17	

	Finger										
9	Right Little Finger	25.33	28.33	31.33	32	81	89	81	89	19	11
10	Right Middle Finger	25	30.66	36.33	36.33	69	84	69	84	31	16
11	Right Index Finger	25.33	31.66	36.33	37	70	86	70	86	30	14
12	Right Little Finger	24.66	29.33	36	36	69	81	69	81	32	19
Mean						69	85	69	85	31	15
SD						7.24	2.39	7.24	2.39	7.24	2.39
C.V%						10.50	2.83	10.50	2.83	23.29	15.48

Fig 2 : GroupWise Comparison of TAM Scores of 4 weeks and 8 weeks



Discussion

This study showed that patients in the EAM group had better recovery than those in the EPM

group on total active motion (TAM) and Grip Strength.

Small et al (1989) in his research study had similar results. He stated that the “Belfast Regime” of Early Active Motion allowed protected Active Flexion of repaired tendons and concluded that it is the safe approach to manage injuries in Zone II.¹⁰

A favourable effect of controlled Active motion (CAM) protocol was reported when compared with Early Passive Mobilisation (EPM) protocol on TAM four weeks after surgery At 12 Weeks, however, there was no statistical significance in TAM between two protocols.¹

It was reported that the outcome of TAM was excellent in 83% of digits with Early Active Mobilisation (EAM) Protocol, following Flexor Tendon Zone II Repair.⁷

In the Current Study, the ROM was significantly higher in patients Rehabilitated with EAM than EPM Protocol. Statistically significant difference was found in TAM between the protocols at 4 and 8 weeks respectively.

It seems likely that the result of a Flexor Tendon Repair is not only dependent on the finger’s ROM, but also on strength, pain and sensibility.¹¹

TK Chan (2006) in his study reported that the mean grip strength of the injured hand was 78% that of the non-injured hand (i.e. 22% Grip strength deficit) after taking in to account the 10% rule following Flexor Tendon Zone II Repair with Combined regimen of controlled motion (EPM) as the treatment protocol. Out of 13 cases, the Grip strength deficit of 8 Patients with combined Flexor Tendon and digital Nerve Injury was 23% Versus 20% in the 5 Patients with Flexor Tendon Injury alone; This difference was not statistically significant.⁹

In the Present Research, the mean grip strength of the injured hand was 63% of that of non-injured hand in EPM Versus 69% in EAM at 4 Weeks. Whereas, The mean grip strength of the injured hand was 79% of that of non-injured hand in EPM Versus 85% in EAM at 8 Weeks. From the table 2, it is trivial that the coefficient variation is lesser in the EAM Group as compared to the EPM groups which implies that EAM will produce consistent outcome. Hence EAM group is better in Grip strength at 4 and 8 weeks as compared to EPM group.

CONCLUSION

This study concludes that Early Active Mobilisation (EAM) is effective protocol than Early Passive Mobilisation (EPM), in restoring digital range of motion and grip strength following Flexor Tendon Zone II repair.

RECOMMENDATIONS

Further Randomised control Trials with larger samples are required to confirm our results. A Patient Reported Outcome Measure (PROM) (such as patient rated wrist & hand evaluation; Michigan Hand Questionnaire) for functional outcome assessment following Flexor Tendon zone II injury should be included in future studies.

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