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Physical Therapy and Splinting After Flexor Tendon Repair in Zone II

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ABSTRACT

Introduction: Early physical therapy and splinting after flexor tendon repair in zone II is very important to improve tendon healing, increase tensile strength, decrease adhesion formation, early return of function and less stiffness and deformity. We conducted a study to observe and record the results of early active mobilization of repaired flexor tendons in zone II. **Materials and method:** This study reports the results of physical therapy and splinting which was applied to 75 patients with 76 digits after flexor tendon repair in zone II, treated at the Department of Plastic Surgery and Physical and Rehabilitation Medicine Clinic, Pristine-Kosovo. Physical therapy and splinting started the first day after surgery and have lasts until week 12. Patients were evaluated with regarding to the range of motion and grip strength. The assessments were done at the 8, 10, 12 weeks and the finale assessments were done after 6 months. **Results:** Range of motion after 6 months according to the Strickland Classification were excellent in 21.1%, good in 44.7%, fair in 11.8% and poor in 22.4%. Grip strength was good in 63.8% of cases. **Conclusion:** Results of this study shows that using a physical therapy and splinting achieve good results in range of motion, muscle force and early return of function of the hand.

Key words: hand tendons, zone II, physical therapy, splinting.

1. INTRODUCTION

Flexor tendon injuries in zone II are very frequent because of the anatomical position and submit many clinical problems. Function restoration of the fingers after flexor tendon injuries in zone II continues to be a significant challenge in hand surgery (1, 2, 3). The advances to understand the anatomy of the tendons, nutrition, recovery and postoperative rehabilitation has generated an evaluation in the techniques that have improved outcomes after flexor tendon repair (1). So the success of the surgical tendon repair depends very much on the application of physical therapy and splinting. Early physical therapy and splinting is a very important factor in the treatment of patients after flexor tendon injuries in zone II.(4).

The role of physical therapy is to prevent the complications such as: limiting the mobility of the hand, prevent the formation of adhesions, prevent the muscle atrophy, maintaining the tendons excursion, muscle strengthening and maintaining the functionality of the hand to win the normal function of the hand as it was before (5).

The aim of this study was to confirm the role of physical therapy and splinting in returning of range of motion in the injured fingers, preventing the development of contracture, increasing the muscle strength, coordination and functionality of the hand.

2. MATERIAL AND METHODS

The study included 75 patients (76 fingers) who had flexor tendon injuries in zone II of the hand. These patients were treated in the Department of Plastic Surgery and they continued their rehabilitation in Physical Medicine and Rehabilitation Clinic, University Clinical Center of Kosovo, during the period April 2009 until June 2013. Exclusion criteria were patients who had other injuries as: fractures, and nerve injuries.

The patients had injuries from traumatic nature including cuttings with knives, glass and sharp tools which are used in construction. All patients included in the study with the tendons were recuperated using the Kessler technique and modified Kessler technique (*Figure 1*) (6).

Physical Therapy and Splinting

Physical Therapy and Splinting started from the first day after surgery and lasted until week 12. Physical Therapy application was divided into 3 phases:

The first phase: During the first four weeks we did wound care, management of edema and exercise. Exercises were applied using Duran Protocol (passive extension and passive flexion in metacarpo-phalangeal joints and interphalangeal joints, every 2 hours a day 10–15 repetition (Figure *2) (7)*. These exercises can give good results in preventing tendons adhesions.

For pain control we also used the TENS (Transcutaneous electrical nerve stimulation) (8). In week 2–3 after surgery we used a light massage to prevent skin adhesions.

The second phase: From 4-8 weeks we continued with the same exercises and added exercises "press and hold" which were replaced with tendon gliding and grip strength exercises using a hock position. In week 6 we also started with abduction and adduction of fingers and opposition of the pollicis divide to the other fingers and active exercise for radio-carpal joint (Figure 3).

The third phase: In week 8-12 the patients continued with described exercises above and we also did strengthening exercises (9) with ball for the muscles of the hand and forearm.

Splinting: We applied the splint from 0-4 weeks in a dorsal part the radio-carpal joint in 30˚- 40˚ of flexion, metacarpo-phalangeal joints in 60˚- 70˚ flexion while the interphalangeal joints in extension. In 4-6 weeks the splint was continued in a dorsal side with radio-carpal joint in 10˚-15˚ flexion and metacarpo-phalangeal joints in 15˚-25˚ of flexion. 6-8 weeks splint is still continuing but the radio-carpal joint in 0˚ position and metacarpo-phalangeal joints in 15˚ flexion and interphalangeal joints in extension (Figure *4*). After week 8 the splint was removed.

Assessments

The results of range of motion were assessed according Strickland classification (10]. Strickland classification assessment represents the total active motion (TAM), the active flexion of procsimal inter-phalangeal joints and distal inter-phalangeal joints minus extension deficit of these two joints x 100% dashed for 175˚ (10). Assessments were done after 8, 10, 12 weeks and final assessments were done after 6 months. We also measured the grip strength according to the American Society of the Hand Therapists (3, 11).

The patient was positioned in a chair, the shoulder in adduction and neutral rotation, the elbow in 90˚ flexion and wrist in 30˚ flexion dorsal and 15˚ ulnar deviation. First we asked the patient to exercise with a dominant hand and then with non-dominant hand. The patient was instructed to hold the instrument and to push as hard as possible (3, 10). Both hands were measured three times. We assessed the grip strength after 3 and 6 months and instead of Jamar Dynanometer we used Hand Force Prestige (Iskra Medical).

According to The American Society of Surgery of Hand rating of the results was excellent 100%, good 75 to 99%, fair 50 to 74% and poor below 50% (12).

Ethical clearance

The study was approved by the Research Ethics Committee, University of Prishtina, Kosovo. Written informed consent of each participant was obtained.

Statistical analysis

The statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 13.0. The mean TAM measurements of the basic values, vs. 6th month were compared using the Wilcoxon Matched-Pairs Signed-Ranks test. Chi-test was used to compare non-parametric data. A p value <0.05 was considered significant.

3. RESULTS

From 75 patients (76 digits), 77.1 % were males and 22.9% females, age 1-76, with mean age 23.7 years. 52.4% of cases involved the right hand and 47.6% involved the left hand. 41.9% had injured the mm. FDS, FDP, 23.8% of cases had injured the m. FDP, 17.1% had m. FPL, 6.7% had m. FDS, and 2.9% of cases had injured m. FPL and m. FPB.

Strickland classification after 6 months were excellent in 21.1% of patient, good 44.7%, fair 11.8% and poor 22.4%, Mean 66.1%, standard deviation 22.1%, min value 19.5% and max value 90.3 % (*Table 1*).

Grip strength results after 6 months were good in 63.8% and bad 36.2% of patients (*Table 2*). With X2-test we got

Original Strickland	Week 8 n (%)	Week 10 n (%)	Week 12 n (%)	Month 6 n (%)
Poor (<50%)	71 (93.4)	51 (67.1)	22 (28.9)	17 (22.4)
Fair (50-69%)	5 (6.6)	25 (32.9)	42 (55.3)	9 (11.8)
Good (70-84%)	-	-	12 (15.8)	34 (44.7)
Excellent (85-100%)	-	-	-	16 (21.1)
Total	76 (100.0)	76 (100.0)	76 (100.0)	76 (100.0)
Mean	31.3	41.7	53.5	66.1
SD	13.3	15.9	19.4	22.1
Min	9.2	13.3	17.1	19.5
Max	58.1	68.1	79.3	90.3

Table 1. The Strickland classification results

Grading system of grip strength	3 months after		6 months after	
	N	%	N	%
Bad	68	92.4	28	36.2
Good	7	7.6	47	63.8
Total	75	100.0	75	100.0
X^2-test	X^2=69.7, P<0.001			

Table 2. The grip strength results

Figure 1. Flexor tendons repair in zone II.

Figure 2. Passive mobilization according Duran Protocol.

important significant results on muscular strength in the hand after 3 and 6 months (X2- test = 69.7; P < 0.001).

for thumb functions, accounted for 73.3% and 88.8% in zone II and III injuries, respectively.

The results in our study related to the range of motion if we compared with the cited authors are to somewhere the same. Except range of motion of the finger another important parameter which is indicating in hand function is grip strength (20).

Many authors in their studies after rehabilitation program evaluated grip strength. Riaz. et al. (21) in their study reported the results of grip strength, where 94% of cases were good after rehabilitation. A study done by

Figure 3. Week 6 : 1. abduction, 2. adduction, 3. flexion and extension of interphalangeal joint.

4. DISCUSSION

Flexor tendon injuries are the most frequent injuries of the hand and most often occur in the zone II (13). These injuries require a contemporary surgical treatment and rehabilitation. Zone II is accepted as a critic zone for rehabilitation, formation of tendon adhesions in this zone is frequent for the anatomical position. After flexor tendon repair in zone II is difficult to achieve a good function of the hand (14, 15).

Passive mobilization (exercises according to Duran Protocol) after flexor tendon repair helps tendons gliding which minimizes or prevents the formation of adhesions, especially in zone II of injury (6, 10, 16).

In our study the results of range of motion according to Strickland classification after 6 month were 21.1% excellent, 44.7% good, 11.8% fair and 22.4% poor. Schenck (17) showed the success of patients who had tendon injury in zone II. After intervention the patients were rehabilitated by Washington regime (Kleinert protocol combination with Duran Protocol) and they achieved this results: 36% were excellent, 12% good, 20% fair and 32% poor (10). Galanakis et al. (18) in their study reported the result of patients with flexor tendon injury in zone II, who after intervention were rehabilitated with early passive mobilization, and achieved these results: 65.2% were excellent, 21.7% good and 8.6% fair. In both studies the results were assessed according to Original Strickland (10).

In their study Chan et al. (11) reported the success of early passive mobilization, to the patients after flexor tendon repair in zone II, in a 5 year period (July 2000- June 2005). 57% were excellent, 5% very good, 19% good, 0% fair and 19% poor. The results were evaluated according to Buck-Gramcko scoring system.Also, Ozturk et al. (19) found that functional excellent and good results according to Buck-Gramcko scoring system and classification

Figure 4. Splint position: 1. week 4-6, 2. week 6-8.

Deniz. et al. (3) showed that the results of grip strength in 69% of cases were good. Libbererct et al. (10) in their study reported the results of grip strength, 80% of cases were good. To assess the grip strength they used Martin Vigonometer (22).

In our study after 6 months the grip strength results in 63.8% of cases were good and 36.2% bed. The results in our study related to the grip strength are in a lower value if we compare with other studies (3, 10, 23), and the reason was that we have made the measurement of grip strength after six months, while the cited authors have made the measurement of grip strength after 9 months or 1 year.

In summation, certain limitations appear to be present in this research. Generally, an assessment of hand disability in daily living activities which could be realized through questionnaires in our patients it isn't done. Future research might include the quality of life among these group of populations complained about difficulties in their daily living activities.

5. CONCLUSION

Flexor tendon injuries in zone II, require a contemporary surgical treatment and to achieve good results surgical intervention always should be followed by physical therapy and splinting. Early physical therapy is very important, because firstly prevents complications (adhesions and muscle atrophy) and then helps to restore the

tendon function, fingers mobility, muscle strength, flexibility and hand function.

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CONFLICT OF INTEREST: NONE DECLARED

REFERENCES

1. Ahmad M, Hussain SS, Tariq F, Rafiq Z. et al: Flexor tendon injuries of hand: Experience at Pakistan Institute of Medical Sciences, Islamabad, Pakistan. J Ayub Med Coll Abbottabad. 2007; 19(1): 6-9.
2. Tang JB. Clinical Outcomes Associated with Flexor Tendon Repair. Hand Clin. 2005; 21: 199-210.
3. Deniz E, Kucukdeveci A, Kutlay S, Demirtas M, et al. Postoperative Management of Flexor Tendon Repair in Zone 2. J Phys Ther Sci. 2000; 12: 63-66.
4. DeLisa JA. Rehabilitation Medicine. Principles and Practice, second edition.J.B. Lippincot, Philadelphia, 1988: 783.
5. Clark GL. Hand Rehabilitation: A Practical Guide. 2nd edition. New York, Edinburgh, Churchill Livingstone, 1997: 103.
6. Spiguel L, Song DH. Grabb and Smith's Plastic Surgery, 6th ed Philadephia, USA: Lippincott Williams & Wilkins. 2007: 803-809.
7. Duran R, Houser R: Controlled passive motion following flexor tendon repair in zone 2 and 3. In:American Academy of Orthopedic Surgeons(AAOS): Symposium on tendon surgery in the hand, St. Louis: CV Mosby, 1975: 105-114.
8. Cameron M. Physical Agents in Rehabilitation, Saunders, second edition, Oacland, California, 2003.
9. Small JO, Brennen M, Colville J. Early mobilization following flexor tendon repair in zone 2. J Hand Surg, 1989; 14B: 383-391.
10. Libbercrcht K, Lafaire C, Van Hee R. Evaluation and Functional assessment of Flexor Tendon Repair in the Hand. Acta Chir Belg. 2006; 106: 560-565.
11. Chan TK, Ho CO, Lee WK, Fung YK, et al: Functional outcome of the hand following flexor tendon repair at the nomads land. Jurnal of Orthopaedic Surgery. 2006: 14(2): 178-183.
12. Kleinert HE, Kutz JE, Cohen MJ. Primary repair of zone 2 flexor tendon lacerations. In AAOS symposium on tendon surgery in the hand. St Louis: Mosby, 1975.
13. Saini N, Kundnani V, Patni P, Gupta S. Outcome of early active mobilization after flexor tendons repair in zones II-V in hand. Indian J. Orthop. 2010; 44(3): 314-321.
14. Sarah G. Ewald OT. A Brief Historical Overview of Published Postoperative Treatment Regimens for Zone II Flexor tendon Repairs. Swiss Hand Therapy Society Journal. 2002; 13:
15. Dovelle S, Heeter PK. The Washington Regimen: rehabilitation of the hand following flexor tendon injuries. Phys Ther. 1989; 69: 1034-1040.
16. Boyer MI, Strickland JW, Engles DR, Sachar K, et al. Flexor tendon repair and rehabilitation: State of the art in 2002. The Journal of Bone and Joint Surgery. 2002; 84(9): 1684-1706.
17. Schenck RR, Lenhart DE. Results of zone II flexor tendon lacerations in civilians treated by the Washington regime. J Hand Surg. 1996; 21(6): 984-987.
18. Galanakis I, Aligizakis A, Katonis P, Vavouranakis H. et al: Functional evaluation after primary flexor tendon repair in zone II. J. Acta Orthop Belg. 2003; 69: 252-256.
19. Ozturk K, Orhun E, Polatkan O, Polatkan S. Long-term results of early primary repair of flexor pollicis longus tendon injuries. Acta Orthop Traumatol Turc. 2004; 38(1): 50-53.
20. Skirven TM, Osterman AL, Fedorczyk JM, Amadio PC. Rehabilitation of the Hand and Upper Extremity. Sixth Edition. Elsevier, United States. 2011: 439-555.
21. Riaz M, Hill C, Khan K, Small JO. Long term outcome of early active mobilization following flexor tendon repair in zone 2. J Hand Surg. 1999; 24(2): 157-160.
22. Desrosiers J, Hébert R, Bravo G, Dutil E. Comparison of the Jamar dynamometer and the Martin vigorimeter for grip strength measurements in a healthy elderly population. Scand J Rehabil Med. 1995 Sep; 27(3): 137-143.
23. Lister GD, Kleinert HE, Kutz JE, Atasoy E. Primary flexor tendon repair followed by immediate controlled mobilization. J Hand Surg Am. 1977; 2: 441-451