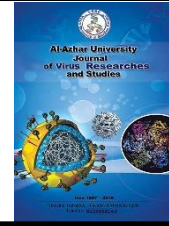




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Six Strand Repair and Early Range of Motion in Management of Flexor Tendon Injury (New Technique)

Mahmoud R. Mahmoud¹, Ashraf M. Abdelaziz¹ and Yasser A. Elbatrawy¹

¹Department of Orthopedic Surgery, Faculty of Medicine for Girls Al-Azhar University, Al-Azhar University, Cairo, Egypt

*E-mail: mahmoudreda6800@gmail.com

Abstract

Tendons repaired with 6-strands withstand joined dynamic and inactive finger movements. The rupture rate is lower with the utilization of multi-strand repair contrasted, and those after usual 2-strand repair. No randomized Prospective clinical examinations have explored this specific inquiry. Aim of work is assessment of six strands repairs in acute flexor tendon injury with new technique and starting range of motion early rather than usual 2-strand repair. Patients and methods are study of clinical consequences of flexor tendons repair utilizing six-strand stitch procedure to repair flexor tendons in 46 fingers of 22 patients. Fingers were effectively activated promptly postoperative in a defensive brace. The follow-up period 12 months. 91% of cases accomplished great to brilliant outcomes dependent on Strickland assessment framework and break rate was 4% of the cases. Determination: The utilization of a solid, hole safe stitch procedure like the six-strand method utilized in the current examination followed by the use of early postoperative controlled movement restoration brings about 91 % superb and great postoperative scope of movement. Utilizing multi-strand flexor tendons repair is better than traditional 2-strands repair in term of last useful reach and less pace of crack flexor tendons. Watchword Early assembly – six-strand.

Keywords: Flexor, Tendon, six strands, Strickland.

1. Introduction

Flexor tendons wounds stay a moving condition to figure out how to guarantee ideal result for the patient. Since Kirchmayr depicted the principal flexor tendons repair in 1917, a few ways to deal with flexor tendons injury have empowered effective repairs paces of 70-90%. Essential careful repair brings about better practical result contrasted with auxiliary repair or tendons unite a medical procedure. Flexor tendons injury repair has been widely investigated and the writing shows effective repair

requires negligible gapping at the maintenance site or impedance with tendons vascularity, secure stitch hitches, smooth intersection of tendons end and having adequate strength for mending. Nonetheless, the specific careful way to deal with make progress being presently utilized among specialists is as yet dubious [1]. While the changed Kessler repair is as yet utilized for the center tendons stitch, hand specialists are utilizing multistrand repair, for example, twofold Kessler repair,

cruciate repair, 4-strand and 6-strand circled stitch repair savage and its adjustments. double Kessler, 4-or 6- strand repair of harmed tendons was accounted for by specialists in European nations, USA, and Australia. The circled stitch tendons repair is more well known in Asian nations, for example, Japan, China and Singapore [2]. Tendons repair with 6-strands withstand consolidated dynamic and latent finger movements. The break rate is lower with the utilization of multi-strand repair contrasted and those after customary 2-strand repair. Nonetheless, no randomized Prospective clinical examinations have explored this specific inquiry [3]. Conventions for the early use of inactive and dynamic wrist and advanced movement as a way to all the more quickly increment the strength and floating of repaired tendons. Preparation following flexor tendons repair is fundamental for mending and repair. It has been indicated tentatively that early movement animates tendons recuperating and diminishes grip [4]. Early assembly is the most ordinarily detailed strategy for dealing with the mending flexor tendons. With such countless decisions, the present hand advisor should comprehend what those decisions are, yet in addition why and when to utilize them. There is nobody right approach to deal with a repaired flexor tendon; the expert who doesn't see how current strategies developed is unprepared to plan the suitable treatment for a given patient [5]. Aim of work is assessment of six strands repairs in acute flexor tendon injury with new technique and starting range of motion early rather than usual 2-strand repair.

2. Patients and Methods

2.1. Study Design

This randomized prospective study was conducted on 22 patients with 46 who sustained acute zone (2-5) flexor tendon injury in the form of complete laceration of

isolated FDP tendon or combined FDP and FDS tendons. All patients were operated in the period between January 2021 and January 2022 in Al-Zahraa hospital in orthopedic surgery department. The injured fingers were repaired using 6-strand core suture repair. All patients recruited for this study have signed full informed consents. Patients eligible for this study were recruited after applying the following inclusion and exclusion criteria.

2.2. Patient Inclusion Criteria

- a) Zone (2-5) flexor tendon injuries.
- b) Acute (within 24 hours since the onset of injury) clean sharp injury.

2.3. Patient Exclusion Criteria

- a) Patients with other associated injuries which may affect rehabilitation .
- b) Patients who presented with soft tissue injury, skin loss, tendon loss and/or fracture of phalanges.
- c) Patients with history of previous tendon injuries or surgeries.
- d) Non-compliant patients to rehabilitation protocols.
- e) Psychological and personality disorders.
- f) Patients with local vascular compromise.
- g) Patients with any systemic disease that could affect healing capacity.

2.4. Preoperative Assessment

All patients were assessed clinically and radiologically by different means.

2.5. Operative Technique

The first “six stranded” suture technique is thought to be strong enough to allow early

active movement of the finger, and thus to avoid some of the problems of controlled dynamic mobilization. This method of using two grasping stitches was applied to plump, oval or round tendons; for flat tendons interrupted sutures were used, for small tendons (e.g., profundus of the little finger) two grasps were used and for very thin tendons (e.g., superficialis distal to its division) only one grasp was used [3].

2.6. Technique

Comprised two grasping stitches in each tendon end and six strands of 4/0 PDS suture material. To make the grasping stitch (Fig. 1), the needle entered the tendon 7 to 12 mm away from cut end, making 4 strand curicute non-locking (Fig.1) then adding 2 core suture more from center assembly Modified Tang (Fig.2). A fine "epitenon" suture of 6/0 Prolene was used in the second half of the series. The fibrous tendon sheath was repaired, but only if snagging of the tendon could be avoided [3]. This method satisfies most all of Tang's nine factors that affect the strength of a surgical repair (the number of suture strands, the tension of the repair, the core suture purchase, the type of tendon-suture junction, the diameter of the suture locks in the tendons) [6]. The tendon sheath opening was excised where sutured areas of tendons caught on the edges of their sheath windows and obstructed free movement. The A2 and A4 pulleys were not excised completely, however, to prevent tendon bowstringing. All associated nerve divisions were repaired with 7-0 nylon, and all artery lacerations were not repaired.

2.7. Post-Operative Treatment

Dorsal blocking splint used to hold the wrist 20-40 flexion the MP joints are flexed at least 60 degrees, and PIP and DIP joint in nearly full extension. Patient started active flexion of finger directly post operatively or can be delayed for couple of days till patient tolerate pain. Mostly we

include the four fingers, there has been a gradual trend toward decreasing the degree of wrist flexion in postoperative protective splint. Postoperative rehabilitation is the corner stone of a successful treatment of recent flexor tendon lesions. Applied it on immediate postoperative. We employed the early active mobilization protocol, where it basically focuses on more global active motion. We aimed at actively mobilization all joints distal and proximal to the lesion from the DIP to elbow, all this procedure is carried out with the dorsal extension block splint.

3. Results

According to Strickland [7] evaluation

- Return of 85 - 100% of active motion (excellent results) achieved in 34 fingers.
- Return of 70-84% of achieve motion (good results) achieved in 8 fingers.
- Fair results achieved in 1 finger.
- Poor results were achieved in 3 fingers.

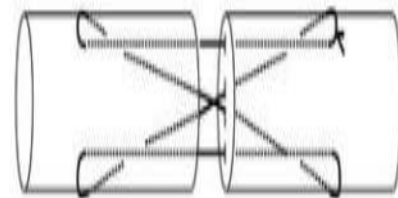


Figure (1): Cruciate non-locked 4 strand Tang

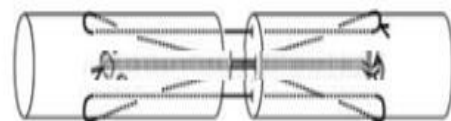


Figure (2): Adding 2 core suture assembly Modified.

Table (1): Postoperative care. Early active mobilization

Dorsal Splint position	Motion allowed
Wrist 30° flexion MCP 70° flexion IP full extended	0-3 days Antiedematous measures, limb elevation, active flexion allowed as much as patient can
Wrist 30° flexion MCP 70° flexion IP full extended	0-2 weeks Encourage protected active finger flexion
Wrist 0° flexion MCP 50° flexion IP full extended	2-6 weeks Encourage protected active finger flexion
Intermittent splinting: removed during exercise Splinting at night No splint	6 weeks Splint removed during exercise and patients continuous gliding exercise, flexion extension of the wrist with finger full flexed. Instruction to avoid simultaneous wrist and finger extension. Blocking exercises begin if active tip to distal palmar crease is more than 3 cm Passive extension can begin at 7 weeks
	8 weeks Progressive resistive exercises initiated.
	14 weeks unrestricted use of hand

Return to professional activity is usually allowed after 3 months postoperatively to allow maximum recovery. Overall results according to the digit involved as shown in

Table .3 and shows not statistically significant between level of TAM and finger.

Table (2): Comparison of laboratory results between different studied groups.

Strickland		
	N	%
Excellent	34	73.91
Good	8	17.39
Fair	1	2.17
Poor	3	0.0652
Total	46	100.00

Table (3): Relation between level of TAM and finger.

Side of Injury Finger	Level of TAM										Chi-Square	
	Excellent		Good		Fair		Poor		Total		X2	P-value
	N	%	N	%	N	%	N	%	N	%		
Index	4	23.53	4	16.00	0	0.00	1	33.33	9	19.57	7.642	0.812
Little	3	17.65	7	28.00	0	0.00	1	33.33	11	23.91		
Middle	4	23.53	9	36.00	0	0.00	1	33.33	14	30.43		
Ring	5	29.41	5	20.00	1	100.00	0	0.00	11	23.91		
THUMB	1	5.88	0	0.00	0	0.00	0	0.00	1	2.17		
Total	17	100.00	25	100.00	1	100.00	3	100.00	46	100.00		

3.1. Results according to the zone of injury

It was quite obvious that the zone with the most common controversy concerning the final results was zone II. Zone II constitutes the real challenge in flexor tendon surgery, followed by zone I. Zones III and V, IV on

the contrary, promise very satisfactory results. Table (4) Final overall results according to the zone of injury statistically significant between level of TAM and zone.

Table (4): Shows the relation final results according to the zone involved.

Side of Injury Zone	Level of TAM										Chi-Square	
	Excellent		Good		Fair		Poor		Total		X2	P-value
	N	%	N	%	N	%	N	%	N	%		
I	0	0.00	1	4.00	0	0.00	0	0.00	1	2.17	22.134	0.036*
II	2	11.76	12	48.00	1	100.00	2	66.67	17	36.96		
III	5	29.41	0	0.00	0	0.00	1	33.33	6	13.04		
IV	2	11.76	1	4.00	0	0.00	0	0.00	3	6.52		
V	8	47.06	11	44.00	0	0.00	0	0.00	19	41.30		
Total	17	100.00	25	100.00	1	100.00	3	100.00	46	100.00		

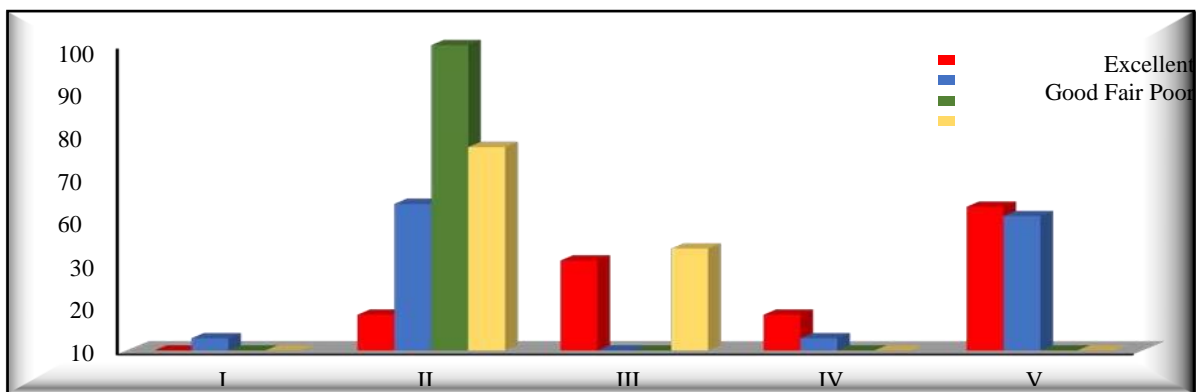


Figure (3): FAB Shows the relation final results according to the zone involved

3.2. Overall incidence of complications

The overall incidence of complications was 14.3% (6 digits with complications) Table

(5) shows the incidence of each complication in relation to the whole series.

Table (5): Incidence of Complications in the study group

Complications	No. [n=6 (14.3%)]	%
Infection	1	2.17
Rup	2	4.35
Skin contracture	3	6.52

4. Discussion

Biomechanical examines indicated the predominance of the elasticity of the six-strand stitch over the two and four strand strategies. The examinations indicated that the break strength is 24 N in regular Kessler repair, 38 N in 4-strand repair (Lee twofold circle), and 53 N in the Savage 4-strand repair. In the Savage 6-strand repair, the normal extreme strength before breakage is 84 N. Repair strength increments with the quantity of center stitches. Activation following flexor tendons repair is fundamental for mending and repair. It has been demonstrated tentatively that early movement invigorates tendons recuperating and diminishes attachment. Kleinert et al. also, Lister et al. were among the first to report astounding clinical outcomes utilizing dynamic augmentation detached flexion assembly with the guide of a powerful foothold brace. Comparative outcomes were accordingly announced by various creators. In any case, flexion contracture of the finger may create, and it has been hard to accomplish steady flexion of the distal interphalangeal joint. Osada et al. [13] Six-strand stitches utilizing the Yoshizu stitch strategy were utilized to repair flexor tendons in 27 fingers from 21 back-to-back patients. Fingers were prepared by joining dynamic augmentation and latent flexion (Klinert convention) in a defensive support for the initial 3 weeks after medical procedure. The subsequent period found the middle value of 13 months. In view of the first Strickland standards, the outcomes were fantastic in 17 fingers, great in 9, (indicated 96% superb and 4% great). The normal flexion was 62° for distal interphalangeal joints and 90° for proximal interphalangeal joints. Moriya et al [6], announced the consequence of 101 flexor tendons wounds utilizing Klinert convention as post-usable restoration program. The eventual outcome did not regard superb scopes of movement in 81 fingers (80%), reasonable in 11, and poor in 9 fingers (9%) by the Strickland's

models, with the crack in six fingers (5.4%). The six burst tendons were appraised as a helpless outcome. In Savage et.al [3] and Osada et.al [13] in their investigations there were no revealed cases had break they utilized six strands center stitch and early dynamic activation convention postoperatively. (Nonetheless, the pace of burst of different investigations was higher than our examination. LK Hung et.al [10] the crack rate was 6.5%. They utilized altered Kissler in their convention of tendons repair and received early activation program postoperatively. In Moriya et al [6], revealed the consequence of 101 flexor tendons wounds utilizing Klinert convention as post-usable recovery program. The bliss rate was 5.6 % in their investigation. Sandow et.al [11] led an investigation utilizing a 4-strand stitch procedure and received early dynamic activation as postoperative restoration convention. The break rate was 4.6 %. In our examination the utilization of six strand strategy we play out a horrendous tissue taking care of and solid repair with negligible gapping. This with the expansion of early dynamic movement treatment convention prompts positive outcomes with insignificant attachment arrangement. Commonly in our investigation patients were rebellious and included the repaired fingers in their work early. The announced break rate from our arrangement was (4%).

5. Conclusion

Utilizing multi-strand flexor tendons repair with 6 strands with our technique is better than traditional 2-strands repair in term of last useful reach and less pace of crack flexor tendons. Watchword Early assembly – six-strand.

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