Section: General Surgery

Original Research Article

COMPARATIVE STUDY OF RESULTS OF FLEXOR TENDON REPAIR FOLLOWED BY KLEINERT TRACTION PROTOCOL WITH THE EXISTING METHOD OF FLEXOR TENDON REPAIR, IMMOBILISATION & ULTRASOUND PROTOCOL

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ABSTRACT

Background: Injuries to the hand are very commonly encountered in today's hospital setting. The most effective method of returning strength and excursion to repaired tendons involves use of strong, resistant suture techniques followed by frequent application of controlled motion stress. Present study was aimed to compare results of flexor tendon repair followed by Kleinert traction protocol with the existing method of flexor tendon repair, immobilization & ultrasound protocol.

Materials and Methods: Present study was single-center, prospective, comparative study, conducted in flexor tendon injuries (Primary repair) with post op Kleinert traction with early mobilization protocol OR with post op immobilization protocol. After fitness patients were posted for surgery & were randomly allocated to either Kleinert traction protocol OR in immobilisation & Ultrasound protocol.

Results: In this study, we had total of 65 patients. A total of 149 fingers were repaired, distributed to the two protocols as follows: Kleinert traction- 74 fingers & Immobilisation and ultrasound- 75 fingers. An overall good to excellent outcome was seen in a total of 75.84% (113) fingers. fair outcome in 23 fingers and poor results in 13 fingers. good to excellent results were obtained in 74.32% (55) fingers. fair outcome in 12 fingers and poor results in 7 fingers. good to excellent results were obtained in 77.33% (58) fingers. Fair outcome in 11 fingers and poor results in 6 fingers. In Kleinert traction protocol, 12 patients who produced fair results out of which 10 had adhesion, 2 had flexion contracture. Out of 7 poor results all of them had flexion contracture and there was no tendon rupture in this group. In immobilisation and ultrasound protocol, 11 patients who produced fair results out of which 11 had adhesions, out of 6 poor results 5 rupture and 1 adhesion in this group.

Conclusion: With a simple and cost effective Kleinert's rubber band traction early mobilisation protocol we have achieved satisfactory results for repaired digital flexor tendons. Both the protocols yield results well within the accepted limits.

Keywords: Kleinert's traction, early mobilisation, digital flexor tendons injury, immobilization and ultrasound therapy.

INTRODUCTION

Injuries to the hand are very commonly encountered in today's hospital setting. Injuries varies from small abrasions to total amputations, But the outcome of a poorly treated hand injury is always a disability that severely affects the patient.[1,2] Flexor tendon injuries are to be treated carefully among hand injuries

because their management requires complete and clear knowledge about the anatomy of the flexor tendons, their biomechanics, the various modalities of management.

There is strong scientific documentation that early post operative motion enhances tendon healing by promoting synovial diffusion of nutrients, increasing DNA contents and collagen production and stimulating the maturation and strength of tendon wound simultaneous with remodeling of tendon scar.[3] Recent studies have demonstrated the application of early passive motion stress to repaired tendons results in more rapid recovery of tensile strength, better nutrition fewer adhesions, minimum repair site deformation and improved excursion when compared with immobilised tendons.[4]

The most effective method of returning strength and excursion to repaired tendons involves use of strong, resistant suture techniques followed by frequent application of controlled motion stress.[5] Present study was aimed to compare results of flexor tendon repair followed by Kleinert traction protocol with the existing method of flexor tendon repair, immobilization & ultrasound protocol.

MATERIALS AND METHODS

Present study was single-center, prospective, comparative study, conducted in Institute for Research and Rehabilitation of Hand and Department of Plastic and Reconstructive surgery, Stanley Medical College and hospital, Chennai., India. Study duration was of 2 years 6 months (August 2013 to March 2016). Study was approved by institutional ethical committee.

Inclusion criteria

Zone I to Zone V flexor tendon injuries (Primary repair) with post op Kleinert traction with early mobilization protocol OR with post op immobilization protocol, willing to participate in present study

Exclusion criteria

- Associated extensor injuries.
- Associated bone injuries.
- Associated brachial plexus, high median or ulnar nerve injuries.
- Associated injuries to forearm or arm muscles.
- Revascularizations.
- Children < 14 years.
- Mentally unstable and uncooperative patients.
- Delayed primary and secondary repair patient.

Study was explained to participants in local language & written informed consent was taken. Patients underwent history taking, clinical examination, laboratory & radiological evaluation. After fitness patients were posted for surgery & were randomly allocated to either Kleinert traction protocol OR in immobilisation & Ultrasound protocol.

Immobilisation

Immobilisation with a dorsal POP slab with the wrist in neutral position, metacarpophalangeal joint in about 70 - 90 degrees flexion and the interphalangeal joint in slight flexion with the splint extending beyond the fingertip. It is kept in place for 3 weeks. Following which POP removal and active mobilization for 2 weeks and passive mobilization are gradually started.

Kleinert Protocol: Post operatively hand was immobilised in a dorsal below elbow POP slab, that extends 3cm beyond finger tips, keeping the wrist in 30-45° flexion, MP joints 60-75° flexion and IP joints neutral. We followed early mobilisation protocol by using a Kleinert's elastic band traction. After 48 hours of tendon repair, elastic band traction is applied to the finger nails through hooks from 3-4 inches proximal to wrist on volar aspect of forearm dressing. The elastic band is attached to finger nails with hooks and fixed to wrist level dressing with safety pin. The elastic band applied to finger nails produces passive flexion of finger at IP joints. The patient actively extends the fingers against rubber band traction (Active Extension -Rubber Band Flexion Method) within the confines of the splint. Rubber band traction to the thumb is given from nail hook to ulnar border of the palm separately. The patient is advised to start with 10-12 movements per hour of this regimen. Active extension stops are a point which produces pain. Tension in rubber band is adjusted so that full extension at least by 5th POD within the limits of splint is possible, for fear of developing flexion contractures.

At night the rubber bands were released and fingers strapped to the POP with IP joints in extension. The patient is constantly monitored for tension in the elastic band and development of features of flexion contracture. If features are present gentle passive extension exercises of IP joints are instituted by physiotherapist with MP joints in full flexion. This regimen is followed for a period of 3 weeks. At 3-6 Weeks, dorsal POP is removed and wrist block is provided to avoid hyperextension at wrist. Gentle active assisted flexion exercises are commenced and patient is encouraged to do full active extension at IP and MP joints with wrist in neutral. At 7-10 Weeks, mild restrictive exercises are begun from 7th week and light sustained grip activities by 10 weeks. At 11-12 weeks, moderate to heavy restrictive exercises are commenced to increase grip strength. For patient with ulnar and median nerve injuries which were repaired simultaneous, claw correcting splints and short thumb abduction splints are given after 3 weeks of initial elastic band traction regimen and followed up with electrical stimulation for intrinsic hand muscles. The follow-up of patients who had primary tenorrhaphy was between 3-12 months while the follow-up for patients who had secondary tenorrhaphy was between 5 – 14 months. The functional outcome was assessed after 12 weeks and thereafter, We adopt Louisville Grading system for assessing digital motion and IP flexion degree for thumb. For fingers we use Strickland modified grading system to assess the outcome. As suggested by Strickland, the digital flexor tendons do not have

a direct action on empty joint which is primarily flexed by the intrinsic muscles. Hence during assessment the MP joints were passively kept in flexion while actively measuring the flexion and extension grades at IP joints has enumerated above.
Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics.

RESULTS

In this study, we had total of 65 patients. A total of 149 fingers were repaired, distributed to the two protocols as follows:

1. Kleinert traction- 74 fingers.
2. Immobilisation and ultrasound- 75 fingers.

Most commonly affected age group was between 21-30 yrs with 33 patients. Youngest patient was 16 and the oldest 66 yrs old. From the above chart it is evident that the patients in between the age group from 21-30 years commonly sustain flexor tendon injury. Males (87.69 %) are most commonly affected in flexor tendon injuries when compared to females (12.30%). From the chart it is evident that the commonest mode of injury is accidental workplace injury. In our study 28 patients had injury in right side, 37 patients had injury in left side.
All four fingers injured in 15 patients. Three fingers injured in 11 patients. Two fingers injured in 17 patients. Single finger injured in 22 patients.

Table 1: General characteristics

Characteristics	No. of subjects	Percentage
Age group (in years)		
15-20	12	18.46
21-30	33	50.76
31-40	7	10.76
41-50	9	13.84
51-60	2	3.07
61-70	2	3.07
Gender		
Male	57	87.69
Female	8	12.30
Mode of Injury		
Road traffic accident	9	13.84
Assault by sharp weapon	12	18.46
Accidental injury at work	42	64.61
Intentional	2	3.07
SIDE OF INJURY		
Right	28	43.08
Left	37	56.92
Bilateral	0	0

Table 2: Number of fingers injured

Number of fingers injured	Number	Percentage
Four	15	23.08
Three	11	16.92
Two	17	26.15
One	22	33.85

The mid finger was the most commonly injured finger.

Table 3: Pattern of Finger Injury

Finger	Kleinert		Immobilisation	
	Number	Percentage	Number	Percentage
Index	19	29.23	23	35.38
Mid	23	35.38	23	35.38
Ring	19	29.23	18	27.69
Little	13	20	11	16.92

An overall GOOD TO EXCELLENT OUTCOME was seen in a total of 75.84% (113) fingers. Fair outcome in 23 fingers and poor results in 13 fingers.

Table 4: Outcome

Outcome	No. of fingers	Percentage
Excellent	41	27.52
Good	72	48.32
Fair	23	15.44
Poor	13	8.72

Good to excellent results were obtained in 74.32% (55) fingers. Fair outcome in 12 fingers and poor results in 7 fingers. GOOD TO EXCELLENT results were obtained in 77.33% (58) fingers. Fair outcome in 11 fingers and poor results in 6 fingers.

Table 5: Protocol Wise Result

Outcome	Kleinert	Immobilis
Excellent	17	19
Good	34	30
Fair	10	12
Poor	1	9

In Kleinert traction protocol, 12 patients who produced fair results out of which 10 had adhesion, 2 had flexion contracture. Out of 7 poor results all of them had flexion contracture and there was no tendon rupture in this group. In immobilisation and ultrasound protocol, 11 patients who produced fair results out of which 11 had adhesions, out of 6 poor results 5 rupture and 1 adhesion in this group. Adhesions were managed by tenolysis and flexion contractures by splinting, physiotherapy and rupture by secondary repair, tendon graft.

Table 6: Complications

Complication	Kleinert protocol	Immobilisation and ultrasound
Adhesion	10	15
Rupture	0	2
Flexion contracture of PIPJ	9	0

DISCUSSION

Various clinical and experimental studies in the literature shows 60 to 80% good to excellent results with the core suture with epitenon sutures and Kleinert protocol.[6,7] Similarly the 2 strand core suture with epitenon sutures and immobilisation & ultrasound protocol have shown results of 45 to 60% in the literatures.

In our study we have achieved excellent results in 74.32%. of the patients who underwent primary flexor tendon repair and Kleinert traction protocol. Also patients who underwent primary flexor tendon repair and Ultrasound & immobilization protocol yielded good to excellent results in 77.33% cases. Adhesions of the repaired tendon is identified at around 20 to 40% in the multi strand core suture with epitenon sutures and Early mobilization protocols in the literatures. Similar rates are mentioned for 2 strand core sutures with epitenon sutures and Ultrasound and immobilisation protocols also.[8,9]

In our clinical study adhesion rates were 13.51% and 16% for Modified Kessler's 2 strand core suture with epitenon sutures and Kleinert protocol and. Modified Kessler's 2- strand core suture with epitenon sutures and Ultrasound & immobilization protocol respectively.

In literature, Incidence of tendon rupture is in the range of 0-46% and0-9% for Early Active Mobilisation protocol and Ultrasound & immobilization protocol respectively.[10] In our study, the rates of tendon rupture were 0% and 6% for Modified Kessler's 2- strand core suture with epitenon sutures and Kleinert Early Mobilisation protocol and Modified Kessler's 2- strand core suture with epitenon sutures and Ultrasound & immobilization protocol respectively. Though statistical comparison of the protocols on the basis of many factors, were done. The Z-Score is -0.429. The p-value is 0.3336. The result is not significant at p <0.01 The results did not show any significant changes in the results obtained by them.

The complications that occurred in our study are comparable to other studies.[11,12] Adhesions were managed with tenolysis and ruptures by secondary repair in 3 cases and tendon graft reconstruction in 2 cases. Flexion contractures identified early and stretching and splinting done.

Improved understanding of the physiologic benefits of early mobilisation at a tendon repair site over immobilisation, the development of stronger suture repair techniques and improvements in post operative management techniques have led to an increased acceptance of early mobilisation in management of repaired flexor tendons.

CONCLUSION

With a simple and cost effective Kleinert's rubber band traction early mobilisation protocol we have achieved satisfactory results for repaired digital flexor tendons. The 2 strand modified Kessler core suture with simple running epitenon suture method with the Kleinert Early mobilization protocol produces results that are comparable to international studies. These results are at par with the 2 strand modified Kessler sutures with simple running epitenon suture method with the immobilization and ultrasound therapy protocol used in our institute.

Both the protocols yield results well within the accepted limits. Complication rates can be minimized by careful monitoring of the patient. Nevertheless the overall hand function after such volar wrist lacerations after primary repair of injured structures depends on success of nerve repairs even though the range of motion of repaired tendons is satisfactory.

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