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Original Research Article

Epidemiology And Treatment Outcome Of Flexor Tendon Injuries To The Hand At A Tertiary Hospital Of Kashmir Valley, India.

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ABSTRACT

Background: Injury to the flexor area of the hand is one of the most common injuries in the workforce community. Tendon injuries are the most common injuries and present in a wide spectrum depending on the mechanism of injury. The prompt treatment gives the best outcome. It also depends on the technique of surgery, post-operative splintage, and physiotherapy. The study was done to know the effects of early controlled mobilization after flexor tendon repair,

Methods: This study was conducted at the department of Plastic Surgery, Sher-i-Kashmir Institute of Medical Sciences, Srinagar from January 2019 to December 2020. All adult patients with an acute tendon injury in whom primary surgery was done were included. In all patients modified Kessler's technique was used for tendon repair using non absorbable monofilament (proline 3-0) for core sutures and proline 5-0 for epitenon suturing. A dorsal blocking splint was advised in all patients with the wrist in 10 to 20-degree flexion, Metacarpophalangeal joints in 60-degree flexion, and proximal and distal inter pharyngeal joints straight. Passive flexion and passive or limited active extension with the splint in place were started from the first postoperative day.

Results:

The study was done on 108 patients for a period of two years, in about 94 percent of cases dominant hand was involved. 55% of patients had the complete flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) involved in the injury. Thumb was involved in 9% of the patients. Zone III (47%) was the most commonest to be involved followed by zone II (29%). Laceration with a sharp object (tin sheet for roofing) was the most frequent cause of injury. Fingertip to distal palmer crease distance (TPD) was < 2.0 cm in 55% of cases (average 2.4cm) at the end of 2nd postoperative week. the total number of patients on follow-up was 98 at the end of the 8th week. TPD was < 2.0 cm in 87% of patients and < 1.0 cm in 71% of cases (average 1.5cm) at the end of the 8th week. A total of 10 patients were lost to the follow-up at the end of the 8th week. Two cases of disruption of repair were noted during the study. **Conclusion:** Early active mobilization program is essential after tendon repair. The majority of the patients (93%) had fair to good results at the end of 2nd week which improved to 87% having good to excellent outcomes at end of the 8th week.

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INTRODUCTION

Among the hand injuries flexor tendon injuries are most common, and usually occur in young individuals in the prime of their life. (1) (2). Injuries can range from partial cut, complete cut, avulsion, and loss of tendon. A partial cut may be difficult to diagnose. Disability following mismanagement of tendon injury results in physical and emotional suffering of the patient as well as an economic disaster as most patients belong to a low socioeconomic class. (2) the best way to manage these patients is, early, primary, single-stage tendon repair with the proper surgical technique. (3) the initial treatment decides the outcome, and inadequate primary treatment is the most common cause of unsatisfactory treatment. (4) Surgical repair of flexor tendon requires exact knowledge of anatomy, mechanism of action, consideration of surrounding structures, and a planned surgery with adherence to principles of tendon repair. Post-operative physiotherapy program and preoperative splintage is the key to avoiding complications.

Injuries of flexor tendons are divided into five zones (Zone I to V). (2)Among the various surgical techniques modified Kessler's technique is mostly used. (5-10) Multiple post-operative physiotherapy regimes are prescribed. (2,11) In our group of patients we used the modified Duran protocol for flexor tendon injuries (R) In this exercise program equal emphasis on passive extension and passive flexion is given it is believed that passive extension allows tendons to glide distally to the repair site. However, the most widely accepted and practiced is that of Kleinert who used dynamic traction for 5 weeks after tendon repair. (12)

Post-operative assessment is equally important. Various methods have been devised, i.e. Boyes' method, Louisville system, Total Active Motion (TAM) scale, etc,(1) but the simplest method involves the measurement of the distance between fingertip and distal palm crease with the digit in active flexion1, (13-15). The study was done to evaluate the cause, mechanism, and effects of early controlled mobilization after surgery.

MATERIALS AND METHODS

This Quasi-experimental study was conducted at the Department of Plastic Surgery, Sher-i-Kashmir Institute of Medical Sciences, Srinagar from January 2019 to December 2020. All adult patients with acute tendon injury operated with primary repair of tendons were included. Patients belonging to the pediatric age group, late presentation, injury proximal to the wrist, concomitant extensor tendon injury, and needing staged reconstruction were excluded. In all patients modified Kessler's technique was used for tendon repair using non absorbable monofilament (proline 3-0) for core sutures and proline 5-0 for epitenon suturing. Wounds closed with interrupted sutures. Sterile dressings were done along with a dorsal blocking splint, with the wrist in 10–20-degree palmar flexion, and the metacarpophalangeal (MP) joint flexed at 60 degrees. The splint allowed the full extension of proximal and distal interphalangeal (IP) joints. Palmer surface of the fingers was kept relatively free.

Passive finger flexion was started from the first post-operative day, usually after the first dressing which included debulking of dressings as well. Patients were advised to flex their fingers using a contralateral hand or with the help of a physiotherapist or family member which has been well explained beforehand. Passive or limited active extension range limited by splint explained. Patients were told to do each cycle about 20 times. The angle of the splint was changed in subsequent visits and weaning off the splint started after four weeks. With time, the range of motion of all joints was increased, and strengthening exercises were initiated from 8 weeks. The heavy lifting was prohibited for about 15 weeks. Ranges of motion of the repaired fingers were checked by measuring the distance between the fingertip and distal palmer crease with the digit in full flexion. Any complication was also noted separately.

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RESULTS:

The study was done on 108 patients for a period of two years, in about 94 percent of cases dominant hand was involved. Males comprised 78% of total patients and most of the patients were from low socioeconomic classes. 55% of patients had the complete flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) involved in the injury. The next common pattern of injury was isolated flexor digitorum superficialis (FDS) injury in about 35 %pe of cases. Middle and ring fingers were most commonly involved. Thumb was involved in 9% of the patients. Zone III (47%) was the most commonest to be involved followed by zone II (29%). Laceration with a sharp object (tin sheet for roofing) was the most frequent cause of injury next being glass cut injury and knife cut injury. For assessment of outcome fingertip to palmar crease distance was measured and graded as excellent, good, fair, and poor for <1 cm, <2 cm,<4cm, and >4 cm respectively. Fingertip to distal palmer crease distance (TPD) was < 2.0 cm in 55% of cases (average 2.4cm) at the end of 2nd postoperative week. The total number of patients was 98 at the end of the 8th week. TPD was < 2.0 cm in 87% of patients and < 1.0 cm in 71% of cases (average 1.5cm) at the end of the 8th week. A total of 10 patients were lost to the follow-up at the end of the 8th week. TPD was < 1.0 cm in 67% (average 0.9cm) at the end of the 8th post-operative week. Two cases of disruption of repair were noted

Table 1: Details of patients

Total patients	108
Dominant hand injuries	102
Multiple digit injuries	18
FDP avulsion	3
Complete FDP injury only	38
Complete FDS injury only	4
Complete FDS and FDP injury	60
FPL injury	8
FPL avulsion	2

FDS = flexor digitorum superficialis
FDP = flexor digitorum profundus, FPL = flexor pollicis longus

Table 2: Zones of injury

Zone	**No. of patients**	**Percentage**
I	**5**	4.6
II	**32**	29.6
III	**51**	47.2
III	**14**	12.9
V	**6**	5.5

Table 3: Aetiology

Cause	No. of Patients	Percentage
Tin cut injury	27	25
Glass cut injury	24	22.2
Knife cut injury	17	15.7
Road traffic accident	14	12.9
Machine cut injury	12	11.1
Wood Planner injury	5	4.6
Agricultural tool	3	2.7
Others	6	5.5

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Table 4: Post-operative progress in finger movement

Grade	Week 2		Week 6		Week 8	
	N =108	%	N=101	%	N=98	%
Excellent	4	3.7	35	34.6	70	71.4
Good	56	51.8	38	37.6	16	16.3
Fair	46	42.6	28	27.7	12	12.2
Poor	6	5.5	2	2	0	0

DISCUSSION

Flexor tendon injuries are common. Each movement of the hand relies on the fine biomechanical interplay of intrinsic and extrinsic musculotendinous forces. (16)

Injuries to the flexor tendons are common. Movements of the hand rely on the finely tuned biomechanical interplay of intrinsic and extrinsic musculotendinous forces. (16) Restoring digital function after flexor tendon injury continues to be a great challenge in hand surgery. (17) The evolution of surgical techniques, understanding of anatomy, nutrition, healing, and post-operative rehabilitation have improved outcomes in flexor tendon repair. (17) Association of nerves in the injury compromises the outcome of the repair.

The level of flexor tendon injury carries a prognostic implication because of anatomic constraints to flexor tendons over their course from the muscle belly in the forearm to their insertions (17). Zone I flexor tendon injuries occur in the area between the insertions of FDS and FDP tendons. Zone II extends from the insertion of the FDS tendon to the level of the A1 pulley (at the metatarsophalangeal joint). Zone III lies between the level of the A1 pulley and the distal limit of the carpal canal. Zone IV is the area of flexor tendons that lies within the carpal canal. Zone V is between the entrance to the carpal canal and the musculotendinous junctions1. Similar zones are also described in the thumb. Zone, I lies distal to the interphalangeal joint. Zone II extends from the A1 pulley to the interphalangeal joint. Zone III is the area around the thenar eminence between the carpal canal and the A1 pulley. Zones IV and V correspond to their respective zones of fingers. Zone II where the tendons are enclosed within their fibro-osseous sheath has been termed as ‘no man’s land’ because of generally worse outcomes associated with tendon repairs in this area(1). Much of the work in the literature is therefore done in Zone II. Various types of methods of flexor tendon repair have been evaluated (18-20). In our study, 46% were zone III injuries and 28% were zone II injuries. We used the modified Kessler’s technique using a non-absorbable monofilament `(Prolene 3-0) suture and an epitendinous circumferential continuous suture using 6-0 Prolene both on round body needles. Almost the same technique was used by Silfverskiold (14) but his sample size was smaller (46 patients with 55 injured digits). He used Strickland’s classification to know the outcome of the repairs whereas we used White’s criteria (fingertip to distal palmer crease distance).
In the majority of our patients' multiple digits were involved, this differs from previously published data (21). 25% of the patients were injured due to sharp tin usually around construction sites this was followed by glass cut injury in 22% of cases and knife cut in 15 % of cases.

Tendon excursions are directly related to the joint range of motion. (22). A good interphalangeal joint range of motion must be established soon after the operation before the restrictive adhesions have time to form(19). In the majority of patients, initial pain tends to inhibit voluntary active flexion. The strain on the repair may be tremendous if the extensors are also simultaneously working which increases the risk of rupture. To prevent this complication, we used the protective dorsal splint
Initially, we devised the schedule of post-operative follow-up at the end of each week but it was difficult for the patients to come on every week. Therefore, we noted the readings at the end of the

2nd, 6th, and 8th week. The range of fingertip to palmer crease distance (TPD) remained 2-4 cm (average 2.4 cm) 'good' to 'fair' in 97% of patients at the end of 2nd post-operative week. At the end of the 8th week, TPD was <1.0cm (excellent) in 71% of cases and <2.0cm (good) in 16% of cases.

The main problem we faced in our study was the regular follow-up of these patients. Out of 108 patients, 102 patients turned up at the end of 6th week. This number even decreased after the 1st week of the splint removal and at the end of the 8th postoperative week to 98 patients. Therefore we presumed that the follow-up schedule was too heavy. Various factors may be responsible for this low turn-up. The lack of interest perhaps once the finger started some movement, poor socio-economic conditions, variable distances from the hospital (as most of the patients were referrals from other hospitals), illiteracy, etc. Various complications are documented (23), however, only two cases of dehiscence were reported in our study as the protective dorsal splint prevented the accidental extension of fingers. This is better than observed in some studies. (20, 24) In a study by Ferguson et al(25), hydrogel was used to prevent adhesion formation at the repair site. But regular active and passive movements of the fingers, in our study, prevented adhesion formation. Post-operative rehabilitation is of utmost importance. We used the manual exercise protocol. In a study by Savage et al (26), a plaster splint was used, however, at our center, we used a thermoplastic splint with straps on the volar aspect customized to every patient.

It is mandatory to mention that in Kashmir due to weather conditions, metallic tin roofing sheets are used in construction. These sheets have sharp edges and this accounts for the major cause of tendon injury in our part of the world. These injuries mostly occur around construction sites and are sometimes due to falls when a person accidentally holds the edge of the tin sheet which is at times used as a partition between houses.

CONCLUSION

This study demonstrated that an early active mobilization program is essential after tendon repair. The majority of the patients (55%) had good to excellent results at the end of 2nd week which increased to 97% at the end of the 8th week. A regular well supervised follow-up program should be ensured to know the outcome of the treatment and patients' motivation must be established.

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