FLEXOR TENDON INJURIES OF HAND: EXPERIENCE AT PAKISTAN INSTITUTE OF MEDICAL SCIENCES, ISLAMABAD, PAKISTAN

Muhammad Ahmad, Syed Shahid Hussain, Farhan Tariq*, Zulqarnain Rafiq, M. Ibrahim Khan***, Saleem A. Malik**

Department of Plastic Surgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad, *District HeadQuarter Hospital, Rawalpindi, **Department of Orthopaedic PIMS, Islamabad, ***Frontier Medical College, Abbottabad.

Background: Flexor tendon injury is one of the most common hand injuries. This initial treatment is of the utmost importance because it often determines the final outcome; inadequate primary treatment is likely to give poor long tem results. Various suture techniques have been devised for tendon repair but the modified Kessler's technique is the most commonly used. This study was conducted in order to know the cause, mechanism and the effects of early controlled mobilization after flexor tendon repair and to assess the range of active motion after flexor tendon repair in hand. **Methods:** This study was conducted at the department of Plastic Surgery, Pakistan Institute of Medical Sciences, Islamabad from 1st March 2002 to 31st August 2003. Only adult patients of either sex with an acute injury were included in whom primary or delayed primary tendon repair was undertaken. In all the patients, modified Kessler's technique was used for the repair using non-absorbable monofilament (Prolene 4-0). The wound was closed with interrupted non-absorbable, polyfilament (Silk 4-0) suture. A dorsal splint extending beyond the finger tip to proximal forearm was used with wrist in 20 – 30° palmer flexion, metacarpophalangeal (MP) joint flexed at 60°. Passive movements of fingers were started from the first post operative day, and for controlled, active movements, a dynamic splint was applied. **Results:** During this study, 33 patients with 39 digits were studies. 94% of the patients had right dominated hand involvement. 51% had the complete flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) injuries. Middle and ring fingers were most commonly involved. Thumb was involved in 9% of the patients. Zone III (46%) was the commonest to be involved followed by zone II (28%). Laceration with sharp object was the most frequent cause of injury. Finger tip to distal palmer crease distance (TPD) was < 2.0 cm in 71% cases (average 2.4cm) at the end of 2nd postoperative week. Total number of patients was 34 at the end of 6th week. TPD was < 2.0 cm in 55% patients and < 1.0 cm in 38% cases (average 1.5cm) at the end of 6th week. Total 9 patients were lost to the follow up at the end of 8th week. TPD was < 1.0 cm in 67% (average 0.9cm) at the end of 8th postoperative week. No case of disruption of repair was noted during the study. **Conclusion:** Early active mobilization programme is essential after tendon repair. Majority of the patients (92%) had fair to good results at the end of 2nd week which increased to 97% at the end of 8th week to good to excellent.

Keywords: Flexor Tendon Injury, Modified Kessler's repair, Dynamic Splint

INTRODUCTION

Flexor tendon injury is one of the most common hand injuries[1]. It often occurs in young individuals in the prime of their lives[2]. Partial tendon injury can be difficult to diagnose. Prolonged disability following such an injury can result in physical and emotional suffering and socioeconomic disaster for the patient[2]. Primary treatment with restoration of normal anatomy in a single operation is required to achieve the best possible outcome[3]. This initial treatment is of the utmost importance because it often determines the final outcome; inadequate primary treatment is likely to give poor long tem results [4].

Surgical repair of flexor tendon requires an exact knowledge of anatomy, careful adherence to some basic surgical principles, sound clinical judgment, strict atraumatic surgical technique and a well planned post operative programme.

Flexor tendon injuries are divided into five zones (Zone I to V)[2] (Fig. 1). Various suture techniques have been devised for tendon repair but the modified Kessler's technique is the most commonly used[5-10]. There are a few post operative regimens after flexor tendon repair to be followed [2,11]. 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 distance between finger tip and distal palm crease with the digit in active flexion[1, 13-15].

This study was conducted in order to know the cause, mechanism and the effects of early controlled mobilization after flexor tendon repair and

to assess the range of active motion after flexor tendon repair in hand.

Fig. 1: Zones of the Hand

MATERIALS AND METHODS

This Quasi experimental study was conducted at the department of Plastic Surgery, Pakistan Institute of Medical Sciences, Islamabad from 1st March 2002 to 31st August 2003. Only adult patients of either sex with an acute injury were included in whom primary or delayed primary tendon repair was undertaken. Patients with old injury, injury proximal to wrist, patients having concomitant extensor tendon injury or in whom delayed flexor tendon repair was performed, were excluded from the study. In all the patients, modified Kessler's technique was used for the repair of flexor tendons. Non-absorbable monofilament (Prolene 4-0) suture was used. After the repair, wound was closed with fine, interrupted non-absorbable, polyfilament (Silk 4-0) suture. Sterile dressing was applied along with a dorsal splint extending beyond the finger tip to proximal forearm. Wrist was held in 20 – 30° palmer flexion, metacarpophalangeal (MP) joint flexed at 60°. The splint allowed full extension of proximal and distal interphalangeal (IP) joints. Palmer surface of fingers was kept relatively free (Fig. 2).

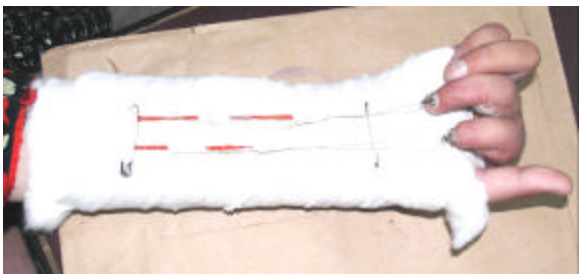

Fig 2: Protective splint with Rubber bands

Passive movement of fingers was started from the first post operative day, and for controlled, active movements, a dynamic splint was applied. Splintage was discontinued after 4 – 5 weeks and active movements were started. Heavy lifting was not allowed for 15 weeks and grip strengthening exercises were started after 16 weeks. All patients were followed up, post operatively, weekly for 4 weeks and then at the end of 6th, 8th, 10th, 12th, 4th, 16th and 18th weeks. Ranges of motion of the repaired fingers were checked by measuring the distance between finger tip and distal palmer crease with digit in full flexion. Any complication was also noted separately.

RESULTS

During this study, 33 patients with 39 digits were studies. Almost all the patients had right dominated hand (94%). 51% had the complete flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) injuries. Middle and ring fingers were most commonly involved. Thumb was involved in 9% of the patients. Some details of the patients are mentioned in Table 1. Zone III (46%) was the commonest to be involved followed by zone II (28%) (Table 2). Laceration with sharp object was the most frequent cause of injury (Table 3). Finger tip to distal palmer crease distance (TPD) was < 2.0 cm in 71% cases (average 2.4cm) at the end of second postoperative week. Total number of patients was 34 at the end of sixth week. TPD was < 2.0 cm in 55% patients and < 1.0 cm in 38% cases (average 1.5cm) at the end of sixth week. Nine patients were lost to follow up at the end of eighth week. TPD was < 1.0 cm in 67% (average 0.9cm) at the end of eighth postoperative week. No case of disruption of repair was noted during the study.

Table 1: Details of patients

Total patients	33
Total digits injured	39
Dominant hand injuries	31
Primary repair	Nil
Delayed primary repair (24–48 hours)	03
(> 48 hours)	36
Digits in hand in patients more than one digit of the same hand	03
FDP avulsion	01
Complete FDS+ complete FDS injury	20
Complete FDP+incomplete FDS injury	07
Complete FDP injury only	06
Complete FDS injury only	01
Incomplete FDS injury only	01
Complete FPL injury	02
FPL avulsion	01

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

Table 2: Zones of injury (n = 39)

Zone	No. of patients	%
I	02	05.2
II	11	28.6
III	18	46.8
IV	05	13.0
V	03	07.8

Table 3: Aetiology (n = 39)

Cause	No. of patients	%
Injury by glass	15	39.0
Injury by knife	08	20.8
Road traffic accident	03	07.8
Electric saw	04	10.4
Wood planer injury	02	05.2
Firearm injury	01	02.6
Electric injury	01	02.6
Injury by a sickle	01	02.6
Others	04	10.4

Table 4: Post operative progress in finger movement (n = 39)

Grade	Week 2		Week6		Week 8	
	n=38	%	n=34	%	n=30	%
EXCELLENT < 1.0 cm	02	05	13	38	20	67
GOOD < 2.0 cm	27	71	19	55	09	30
FAIR < 4.0 cm	08	21	02	06	01	03
POOR > 4.0 cm	01	03	Nil	--	Nil	--

DISCUSSION

Injuries to the flexor tendons are common. Each specific movement of the hand relies on the finely tuned biomechanical interplay of the intrinsic and extrinsic musculotendinous forces[16]. Restoring digital function after a flexor tendon injury continues to be one of the great challenges in the filed of hand surgery[17]. Advances in understanding of tendon anatomy, nutrition, healing, and post operative rehabilitation have generated an evolution of techniques that have enhanced the results of flexor tendon repair[17]. Tendon lacerations frequently are associated with neurovascular injury that further compromises the functional results. The treatment of flexor tendon injuries requires a thorough knowledge of hand anatomy, use of atraumatic surgical technique, and a structured programme of post operative rehabilitation.

The level of flexor tendon injury carries a prognostic implication because of anatomic constrains 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 FDS tendon to the level of A1 pulley (at metacarpo-phalangeal joint). Zone III lies between level of A1 pulley and the distal limit of carpal canal. Zone IV is the area of flexor tendons that lies within the carpal canal. Zone V is between the entrance to carpal canal and the musculotendinous junctions[1].

Similar zones are also described in the thumb (Fig 1). Zone I lies distal to interphalangeal joint. Zone II extends from A1 pulley to interphalangeal joint. Zone III is the area around thenar eminence between carpal canal and 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 outcome 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 non-absorbable monofilament (Prolene 4-0) 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 slightly larger (46 patients with 55 injured digits). He used Strickland's classification to know the outcome of the repairs whereas we used the White's criteria (finger tip to distal palmer crease distance).

In majority of our patients, single digit was involved but only in 3 patients, this is in agreement with the previously published data[21], more than one digit of the same hand was involved. 39% of the patients were injured due to sharp glass. 20 % had injury due to knife. Interestingly 3 patients had blunt injury.

Tendon excursions are directly related to the joint range of motion[22]. It is essential that a large interphalangeal joint range of motion is established soon after the operation before the restrictive adhesions have time to form[19]. In majority of the 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 (Fig 2).

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 2nd, 6th

and 8th week. The range of finger tip to palmer crease distance (TPD) remained 2-4 cm (average 2.4 cm) 'good' to 'fair' in 97% patients at the end of 2nd post operative week and < 2.0 'good' at the end of 6th week in 55% patients and ,1.0cm 'excellent' in 38% patients. At the end of 8th week, TPD was <1.0cm in 67% cases and <2.0cm in 30% cases. Only 1 patient had TPD >2.0 cm.

The main problem we faced in our study was the regular follow-up of these patients. Out of 33 patients, 30(91%) 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 8th post-operative week, 26 patients turned up in OPD clinic. 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, no case of dehiscence was reported in our study as the protective dorsal splint and the rubber bands kept the fingers in the flexed position. This is better than observed in some studies [20,24]. In a study by Furgoson 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 adhesions formation. Post-operative rehabilitation is of utmost importance. We used the manual exercise protocol. In a study by the Savage et al [26], plaster splint was used.

In conclusion, this study demonstrated that early active mobilization programme is essential after tendon repair. Majority of the patients (92%) had fair to good results at the end of 2nd week that increased to 97% at the end of 8th week to good to excellent. A regular, well supervised follow up programme should be ensured to know the final outcome of the treatment and patients' motivation must be established.

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Address for Correspondence: Dr. Muhammad Ahmed, Department of Plastic Surgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad.