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Functional outcome of primary tendon repair using different techniques of suturing

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Abstract

Background: This study aimed to evaluate the functional outcomes of primary flexor tendon repair in relation to the number of core sutures, the mechanism of injury and the zone of injury and post operative mobilization protocol.

Material and methods: A prospective and hospital-based study involving observation of patients from admission to final outcome after discharge was carried out at Gandhi Medical College, Bhopal. Routine information like age, sex, clinical history, mechanism of injury, detailed local examination findings of injury and other relevant data was collected. The flexor tendon involved was repaired using modified kesseler techniques and progression, range of movement and pain during movement analyzed.

Results: Strikland scoring was decreased form baseline (68.16) to 3 weeks (75.76), 6 weeks (81.08) and 3 months (86.08). Comparison of strikland scoring with different time interval was showed statistically significant results. Excellent score was found in 40% case and good score was found in 60% cases.

Conclusion: We have evaluated the functional outcome of primary flexor tendon repair in different zone of injury with injury by sharp subjects are better and superior.

Keywords: Tendon Repair, Strikland Scoring, Primary Flexor Tendon

Introduction

Primary repair of flexor tendon injuries in the flexor tendon sheath of the hand has been reported for the past several years.[1]

The care of primary flexor tendon injury depends not only on the quality of the surgical procedure, but also heavily on postoperative treatment. This still remains a key challenge for hand surgeons, occupational therapists, physiotherapists and patients. The main goal of postoperative treatment is to maintain mobility of the sutured tendon whilst implementing as

little force as possible. Active flexion of the finger can help heal the sutured tendon by reducing a build-up of adhesions with neighbouring structures, which in turn improves its gliding efficiency.[2] Still, the suture material alone cannot handle the average strain exerted onto the repaired flexor tendon as it could rupture even with the smallest amount of load. Stability is only acquired once the collagen fibrils have been reorganized.[3]

The goal of flexor tendon injury treatment is to perform a strong repair and begin an early active rehabilitation program. Early rehabilitation decreases adhesion formation and is related to good clinical results.[4] It is important to minimize failure rates related to complications, such as gap-formation or rupture. Primary repair must be performed using a reliable and strong suture technique.[5] Flexor tendon repair techniques involve the placement of both core and peripheral sutures. The initial strength of tendon repair is closely proportional to the number of suture strands that cross the repair site.[6] Two-strand core suture and peripheral repair with running sutures was more commonly previously used.[7] Application of a two- or four-strand core suture provides greater strength but has the disadvantage of technical difficulties. Multiple strands may trigger ischemia in the intrinsic healing process because of adhesion formation.[8]

In the literature, there is a plethora of repair techniques, suture materials and postoperative treatment strategies. The greater the stability of the suture, the greater the load that can be applied onto the tendon for early dynamic postoperative care. The suture must hence guarantee sufficient tensile strength without undermining the frictionless gliding of the tendon. Current literature mainly supports a 4-strand locking core suture and additionally epitendinous repair.[9] The tensile strength of the tendon increases proportionally to the number of locking core sutures. Whilst a 2-strand suture has been shown to withstand load for passive postoperative treatment, a 4- or 6-strand suture has demonstrated sufficient tensile strength for active postoperative mobilization. Conversely, a greater number of strand sutures could thicken the tendon and restrict its gliding efficiency.[10]

The rupture rate after primary flexor tendon repair is an important parameter for treatment quality.[11] Even though there is a general agreement on the type of suture technique and postoperative treatment strategy, the optimal suture material remains unclear. Identifying the ideal suture material could help provide sufficient stability for early mobilisation and thus improve functional parameters, such as total active range of motion, grip strength and daily activities without leading to higher rupture rates.[12]

This study aimed to evaluate the functional outcomes of primary flexor tendon repair in relation to the number of core sutures, the mechanism of injury and the zone of injury and post operative mobilization protocol.

Material and methods

A Longitudinal Comparative Study was conducted at Gandhi Medical College, Bhopal during March 2020- September 2021.

A prospective and hospital-based study involving observation of patients from admission to final outcome after discharge was carried out. Routine information like age, sex, clinical history, mechanism of injury, detailed local examination findings of injury and other relevant data was collected. The flexor tendon involved was repaired using modified kesseler techniques and progression, range of movement and pain during movement analyzed.

Inclusion criteria:

Patients fulfilling following criteria

1. Isolated flexor tendon injury of hand and forearm up to zone 5
2. Those suitable for modified Kessler's technique
3. Those repaired within 48 hours of injury.

Clean cut incised wound.

Exclusion criteria:

1. Fingers with concomitant fractures, flexor tendon injury associated with extensor tendon injury, associated with concomitant ulnar nerve injury and uncooperative patients.
2. Lacerated wound having loss of skin
3. Patient who was lost to follow up.

All the patients of isolated post traumatic flexor tendon injury of hand were included in the study with proper consent. A proforma designed which included: demographic data, mode of injury, hand dominance, finger involved, associated injury, the zone of injury, tendon involved, partial or complete cut, (total movement)

All patient was operated under tourniquet with wound exploration and tendon repair.

The tendon repair to be done with one of the two methods alternate patient with **two or four strands for core suture** with epi-tendinous repair with 6-0 polypropylene with **modified Kessler techniques**.

Post-operative kliennets splinting protocol was followed. Then the patients were randomized for the early and late mobilization for physiotherapy.

Follow up assessment

- In the first three months the follow up was done on weekly bases and in the last three months, it was done on monthly bases.
- During the follow-up active range of movement, complications were recorded.

Patient was evaluated for the postoperative range of motion by original Strickland system into the excellent, good, fair and poor.

Patient was assessed for complications like adhesion, quadriga, rupture, joint stiffness, infection, lumbrical minus hand.

Investigation

- Various clinical tests done to evaluate the tendon involved
- X ray of the involved segment of to rule out any fracture.

HRSG in closed tendon injury.

When cut or damaged a tendon cannot heal without surgery, and after surgery it needs to be carefully protected.

Complete the following exercises slowly and gently. Every hour, 10 repetitions: Use your other hand to push all your fingers into a fist and hold for 5 seconds (passive flexion). Then use your own muscles to straighten the fingers to the splint (active extension).

4-5 times/day, 10 repetitions: Use your own muscles to gently bend your fingers into a half fist. Hold for 5 seconds then extend your fingers back to the splint.

Statistical analysis

The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software

program. Descriptive statistics included computation of percentages, means and standard deviations. The paired t test (for quantitative data to compare before and after observations) was applied. Level of significance was set at $P \leq 0.05$.

Results

16% patients was found in < 20 years age groups, 36% patients was found in 20-30 years age groups, 32% patients was found in 30-40 years age groups, 12% patients was found in 40-50 years age groups and 4% patients was found in >50 years age groups. Mean age was 30.6 years.

Female was 20% and male was 80%. Trauma and assault by sharp object were found higher than other subjects. Right (88%) side was found higher side than left (12%) 60% cases have associated neurovascular injuries. No associated injuries were recorded in the study.

Third zone of injury (28%) was found than fifth zone of injury (24%) and fourth (16%) zone of injury Mean no of core sutures was 2.45. Complete type of cut was found in 76% and partial type of cut was found in 8%. 84% patients have repaired within 24 hours and 2% patients have repaired within 48 hours. Only one patient has pallor

Table 1: POST OP STRIKLAND SCORING WISE DISTRIBUTION OF THE STUDY

		Mean	Std. Deviation	P value
Pair 1	At discharge	68.16	12.233	0.001 (S)
	3 weeks	75.76	11.752	
Pair 2	At discharge	68.16	12.233	0.001 (S)
	6 weeks	81.08	10.480	
Pair 3	At discharge	68.16	12.233	0.001 (S)
	3 months	86.08	8.631	

Strikland scoring was decreased form baseline (68.16) to 3 weeks (75.76), 6 weeks (81.08) and 3 months (86.08). Comparison of strikland scoring with different time interval was showed statistically significant results.

Table 2: STRIKLAND SCORING WISE DISTRIBUTION OF THE STUDY

	Frequency	Percent
Excellent	10	40
Good	15	60
Fair	0	0
Poor	0	0

Excellent score was found in 40% case and good score was found in 60% cases.

Discussion

Flexor tendon injury especially is a problematic case for a surgeon. Despite the optimal treatment that we perform, there are still risks for complications that may affect the functional outcome and affect the patient's daily living activity.[13] Early active mobilization has been a priority for postoperative rehabilitation to reduce the rate of adhesions.[14] But on the other hand, we need a suture technique that is easy to perform, not time-consuming, yet has a good suture tensile strength, good gliding, and a good gap formation.[15]

In the present study a total of 25 subjects were included in the study, out of which 16% patients was found in < 20 years age groups, 36% patients was found in 20-30 years age groups, 32% patients was found in 30-40 years age groups, 12% patients was found in 40-50 years age groups and 4% patients was found in >50 years age groups. Mean age was 30.6 years. Similarly in a study by M.R. Saleh et al,[16] the patient's age ranged between 24 and 48 years old (mean: 34.5 ± 8.2). However in a study by Mary Rose C Gonzales[17] Twenty freshly harvested porcine flexor digital tendons from the hind leg were used for their biomechanical experimental study.

In the present study, there was significantly high predominance of male in the presence of tendon injury as compared to female. It was observed that injury among Female was only 20% as compared to higher incidence in male with 80%.

Similar male predominance of injury was observed in various other studies carried out by de Jong JP et al[18] and Manninen M et al.[19]

In the present study injury caused by trauma and assault by sharp object were found higher than other subjects. In the study, it has been noted that there is reduced incidence of injury by Accidental trauma , Assault, Self inflicting suicidal, Trauma by grinder machine, Trauma due to fall from bike, Trauma due to fall on glass, Laceration by Grinder . The results of the study are in conjugation with study by de Jong JP et al and Manninen M et al. Wherein it has been noted that the injury was higher among subjects working in physical construction jobs using saws, glass or getting metal lacerations. Also injury is common in people working in food preparation with knife injuries.[20]

It is very significant to understand the zone of injury before determining the treatment protocol for the patient. The associated injury may be elicited through any mode of injury. The examination and understanding of the zone of tendon is imperative as it plays an essential role in determining the requirement of suture. It also is imperative in drafting the treatment protocol related to the treatment outcomes associated with the suture technique to be applied. So in the present study we have arranged the data and have drawn information about the zones of injury and also the frequency involved. In the present study, when the study participants were distributed according to the zone of injury, it was found that Third zone of injury (28%) was found higher than fifth zone of injury (24%) and fourth (16%) zone of injury. We have understood the categorization as described by Verdan who have classified the zones of tendons according to the regions in which they lie. Classically 5 zones have been described for the fingers. They are as follows: Zone I: Distal to the insertion of the flexor digitorum superficialis tendon. Only the FDP is present here. Moiemen & Elliot[21]have further classified this zone into three subzones. Zone II: Within the flexor sheath extending from the insertion of the flexor digitorum superficialis tendon distally to the A1 pulley proximally. This zone contains both the FDS and the FDP within the narrow confines of the digital flexor sheath and has been subdivided by Tang into four subzones.[22] Zone III: From A1 pulley distally to distal edge of the flexor retinaculum proximally. The lumbricals arise from the FDP tendons in this zone. Zone IV: Within the carpal tunnel under the flexor retinaculum. All digital flexors, along with the median nerve, are in close proximity to each other here. Zone V: Proximal to the flexor retinaculum. This includes the muscle level injuries in the forearm as well. To tailor the management according to specific site, this zone has been subdivided further by Sabapathy and Elliot.[23]

The study by Griffin M[24] reported that the most common signs of a flexor tendon injury include: An open injury, such as a cut, on the palm side of your hand, wrist, or forearm, It also involves An inability to bend one or more joints of your finger. The other signs include pain when you attempt to bend your finger and also a prominent feature and sign is Tenderness along your finger on the palm side of your hand Numbness in your fingertip. However in our study the most prominent and symptomatic sign recorded was pallor which was observed in 24 subjects out of 25 subjects. The sign of pallor may be associated to the fact that majority of the subjects in our study were the reported patients who had burns and there is positive correlation between burn and pallor. So the source of injury in form of burns may the reason for the presence of pallor as pallor is associated with burns.

In the present study it is observed that 84% patients have repaired within 24 hours and 2% patients have repaired within 48 hours. Similarly it has been reported by Brotzman SB[25] that the timing of flexor tendon repair influences the rehabilitation and outcome of flexor tendon injuries. The Primary repair is done within the first 12 to 24 hours after injury. Delayed primary repair is done within the first 10 days after injury. If primary repair is not done, delayed primary repair should be done as soon as there is evidence of wound healing without infection. Secondary repair is done 10 and 14 days after injury. Late secondary repair is done more than 4 weeks after injury. After 4 weeks it is extremely difficult to deliver the flexor tendon through the digital sheath, which usually becomes extensively scarred. However, clinical situations in which the tendon repair is of secondary importance often make late repair necessary, especially for patients with massive crush injuries, inadequate soft tissue coverage, grossly contaminated or infected wounds, multiple fractures, or untreated injuries. If the sheath is not scarred or destroyed, single-stage tendon grafting, direct repair, or tendon transfer can be done. If extensive disturbance and scarring have occurred, two-stage tendon grafting with a silicone (Hunter) rod should be performed.

In our study Strikland scoring was decreased form baseline (68.16) to 3 weeks (75.76), 6 weeks (81.08) and 3 months (86.08). Comparison of strikland scoring with different time interval was showed statistically significant results. This result was in accordance with the result of the study by Savvidou C and Tsai TM[26] where the majority of patients ended up with excellent and good results (81 %). These results are comparable with the literature and our impression it that is not feasible to regain 100 % of motion after flexor tendon zone II repair regardless of the technique used.

The strength and stiffness of the running peripheral suture can be increased with deeper suture grasps[27] by increasing the suture purchase from 1 to 2 or 3 mm[28] and by increasing the number of suture passes.[29] Peripheral suture is used not only in total ruptures, it is also used in partial ruptures to support core suture if the cross-section exceeds 50% as well.[30] In the study, M. Uslu et al[31]peripheral suture increased especially 2-mm gap-formation force and 2-mm gap strength in each group. Peripheral sutures are an important component of flexor tendon repair and contribute significantly to the strength of the repair.

Several in vitro studies have confirmed the superior tensile properties of multi-strand core sutures.[32,33]

Conclusion

Tendon repair using different suture techniques, we have evaluated the functional outcome of primary flexor tendon repair in different zone of injury with injury by sharp subjects are better and superior. We have found better results in early mobilization but to be need more sample size to justify out results.

It was discovered that the Fait type of GC was present in the majority of patients, and it was also noticed that the majority of patients had healed themselves within 24 hours.

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