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Research Article

Tenolysis of Stiff Fingers: Outcome Analysis of Our Technique

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Abstract

Background: Hand trauma invariably leads to stiffness and reduced range of motion which may be attributed to adhesions and fibrosis. Flexor tenolysis involves resection of all adhesive tissue around the tendon inside and outside the tendon sheath. Many methods have been described in the literature for tenolysis, and all have their pros and cons.

Objective: This study seeks to present findings from employing our approach to treat stiff fingers, which involves tenolysis of both flexor and extensor tendons in patients under local anesthesia whereby patients can actively move their digits to facilitate complete release.

Methodology: A retrospective analysis was done of the charts of all the patients who underwent tenolysis with this method during the 4-year study period. All demographic and clinical data was recorded, including the initial trauma mechanism. The pre-operative and post-operative total active motion (TAM), and flexion lag, were noted and compared. Any complications were also documented.

Results: 34 hands (in 30 patients) were operated upon in the given period. Average age was 41 years. 19 patients were males, 11 were females. Average pre-operative TAM was 102^{o} and average post-operative TAM was 210^{0}. This result was statistically significant ($p<0.05$). There were no surgical complications seen.

Conclusion: complete removal of all adhesions around the flexor and extensor tendons greatly improves the active range of motion of involved digits. Moreover, performing the procedure under local anesthesia allows thepatient to vigorouslymovetheirfingersper-operatively, whichfacilitatesacompleteandeffective release.

Keywords | finger stiffness, tenolysis, hand trauma, total active motion

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Introduction

Adhesions in the flexor tendons are most frequently seen with fractures involving the middle and proximal phalanges.[1] The possibility of the adhesions are very high if there is marked fracture displacement and malalignment. Mode of injury including crush and postoperativeprolongedsplintagewith volar angulation lead to excessive adhesion formation.[2]

Tendon adhesions occur when the surface of the tendon is damaged during the healing process. Adhesions commonly include the long length of the concerned tendon but may also involve the short segment. To counteract resulting adhesions, tenolysis is a known strategy to get the proper tendon slide and uninterrupted range of motion.[2,3] The operation is difficult, and the outcomes are unimpressive most of the times. There is a serious danger of further lowering the blood supply and innervation to an already compromised finger. Successful tenolysis requires a skillful surgeon, properly monitored hand physiotherapy, and a motivated patient.[4,5]

We explain our tenolysis technique using the active finger motion approach, which is performed in a consciouspatientundercontrolledsedationwhileaddressing both the flexor and extensor tendons and performing joint arthrolysis if necessary

Methodology

Between 2010 and 2013, all patients (of all ages and both genders) who underwent tenolysis using the active finger motion approach, were selected. Patients who hand completed at least 12 months of follow-up were included. Cases included injury due to any mechanism resulting in stiffness of fingers. Cases with Complex Regional Pain Syndrome (CRPS), Reflex Sympathetic Dystrophy, and those with severe comorbid diseases were excluded.

After obtaining approval from the intuitional review board, we performed a retrospective review of patient's notes on themechanism of the injury, the tissues involved, the type of fracture and the method of treatment. The length of time before requiring tenolysis was also documented, as well as any complications that occurred.

The primary outcomes assessed were; Total active motion (TAM) defined as the sum of active motion at Distal Inter-Phalangeal, Proximal Inter-phalangeal, and Metacarpo-phalangeal joints; and Flexion lag, defined as flexion deficit at PIPJ and DIP.

TAM and flexion lag were determined from the records of the follow-up visits. The findings were then rated using the criteria of the American society for Hand Surgery.[6] $P<0.05$ waschosenasthelevelofsignificance.

Surgical Technique

All patients were operated upon under regional block. Intravenous anesthesia was supplemented in four individuals. The flexor tendon sheath was explored via z-plasty like skin incision extending from the distal transverse crease of palm to the distal transverse crease of finger. A slit in the transverse manner was done in the flexor tendon sheath's A1 pulley, which was seen like an opening between the A1 and A2 pulleys in the middle third of the A2 pulley. The flexor tendons were carefully liberated using a fine periosteal elevator or via rounded knife blade. The tendon sheath strips were preserved to make pulleys.

Flexor tendon motion was evaluated after adhesions were released by asking patent to perform full active finger flexion. In patients under IV anesthesia, regional wrist tenodesis was used to evaluate range of motion. Complete tenolysis was only confirmed after both the activeandpassiveflexion wereseen to be same, (though active flexion could not be assessed in patient under IV anesthesia). If there was a lag in active flexion, additional maneuvers were required. These included more proximal release of tendon adhesions, removal of A2 pulley, release of joint, and release of adhesions around the extensor tendon.

On the first post-operative day, patients were advised to make a full fist and hold it for as long as possible. On the 3rd day, they were advised to perform passive and active movements to the fullest extent possible. Although exercises in motion were conducted, no specific rehabilitation program was suggested.

Results

A total of 34 Surgeries were done in 30 patients using this method, over a 4-year period from January 2010 to December 2013. Mean age was 41 years. Nineteen patients were male (63%), while 11 were female (37%). The majority of the cases (n=22, 65%) had a history of fracture, caused by high energy impact injury (Table 1). The average time between fracture fixation and mobilizationwasfourweeks(range 3-7 weeks). Themean time between the first procedure and secondary tenolysis was 15 months (range 3-75 months).

All patients had completed a minimum follow-up of 12 months. At the 12-month follow-up, the average preoperative TAM was 102°, whereas post-operatively it improved to 210°. Flexion lag reduced from 90° to 20°. Both these results were statistically significant (Table 2). According to the American Society for Surgery of the Hand criteria, the outcome was poor in 2, fair in 8, good in 12 and excellent in 6 (Table 3).

There was no tightening of the extensor tendon, and the average decrease in the angle of extension at all the finger joints including proximal and distal interphalangeal joints, and metacarpophalangeal joints was about 5° (range 0- 10).

Adhesions were most commonly present between the A1 and A4 pulleys. The adhesions were never encountered beyond A5 or in the carpal tunnel. The A2 pulley was totally removed in two and preserved in rest of the individuals, while the A4 pulley was preserved in all. 3 patients required pulley reconstruction, and two required joint release. In four cases, extensor tenolysis was also required.

There were no incidences of tendon rupture in any of the patients. During the follow-up period, 5 patients experiencedrecurrenceleading to loss of activemobility, and a second tenolysis was considered. Digital neuropraxia and Infection were not reported as surgical consequences.

Table 1: *fracture patterns and their management in the patients that had a history of fracture at initial trauma (n=22)*

	n	%
Fracture type		
Comminuted	17	77.3
Transverse	5	22.7
Fracture location		
Distal phalanx	4	18.2
Middle phalanx	6	27.3
Proximal phalanx	12	54.5
Treatment		
Percutaneous K wire	18	81.8
ORIF	4	18.2

Table 2: *Pre- and post-operative TAMandflexionlag*

	Pre tenolysis Mean (range)	Post tenolysis Mean (range)
Total active motion (TAM)	102 (35-160)	210 (175-270)
Average flexion lag	90 (50-160)	20 (5-35)

Table 3: *Improvement in Range of Motion according to the American society for surgery of the handcriteria*

Percentages of improvement	No. of cases (n=30)
Excellent (75 -100%)	6
Good (50-75%)	12
Fair (25-50%)	8
Poor (0-25%)	2

Discussion

Flexor tendon tenolysis is regarded to be very effective in counteracting the stiffness caused by phalangeal fractures. We observed a similar scenario as evidenced by a statistically significant difference between preoperative TAM and postoperative TAM after complete tenolysis.

Previousresearchesfound no relationbetweentheresults of the tenolysis and different types of hand fractures. In a study by Kulkarni et al, flexor tenolysis produced good outcomes regardless of the injury type, structures affected or the period between injury and mobilization.[7] In this study, the pre-operative Total passive motion was a good indicator of effective TPM achieved after tenolysis.

Agee (1992) proposed that even slight flexor epitenon abrasions at a fracture site, could form focal site for adhesions.[2] Furthermore, if the fracture fragment make hole in the flexor sheath's dorsal wall, then it would be exposed to the sharp edges of the broken bone.

Jin Bo Tang has documented his use of wide awake anesthesia technique in which the surgeon asks the patient to flexandextendthedigit to assess activegliding.[8] If there was any difficulty in tenolysis, further scar release was performed, or in some cases tendon reconstruction as well as pulley reconstruction with tendon grafting was performed by the surgeon.

F Ahmad from Chicago orthopaedic institute proposed traction tenolysis method in which tendon was put on traction by use of Allis forceps and consequently an alternative minimal invasive method of tenolysis was proposed.[9] The result of TAM was in good to excellent range, comparable to our study.

Schneider in his paper about tenolysis post replantation has shown comparison of TAM and TPM post tenolysis.[10] He has demonstrated this to be a very goodoutcome tool to assess the effectiveness of tenolysis.

The position and density of adhesions varies greatly and is related to immobilization period, fracture type, and time between fracture and tenolysis.[11] This is most likely owing to edema and fibrin production after the original injury. Also, post-injury hemorrhage within the flexor sheath also contributes to development of adhesions. Long immobilization period as a result of injuryallowstheadhesions to becomemoredense. Following a number of studies, surgeons around the world now recommend early mobilization after stabilization ofphalangealfractures,preferablywithin24to48hours.

Conclusions

Tenolysis is an effective method of treating stiffness of fingers as a result of blunt trauma. Timely intervention is crucial in preventing permanent disabilities. Complete removal of all adhesions around the flexor and extensor tendons greatly improves the active range of motion of involved digits. Moreover, performing the procedure under local anesthesia allows the patient to vigorously move their fingers per-operatively, which facilitates a complete release and better long-term outcomes.

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