Two Stage Flexor Tendon Reconstruction in Hand: Our Five Year Experience

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Abstract

Background: Secondary surgery of the flexor tendons of the hand is a very common entity in traumatology and carries significant risks up to total functional loss. This justifies the importance of the quality of this surgical repair which must be carried out under better conditions, with good anatomical knowledge. Flexor tendon injuries in the digital flexor sheath area (zone II) are the most difficult to treat and remain a focus of both clinical attention and basic investigations. This prospective study was designed to evaluate the results of staged zone II flexor tendon repair.

Methods: Hundred digits in sixty five patients were treated by Two Stage flexor tendon reconstruction and followed for an average of one and a half year. The procedure included placing a silicone catheter as an active implant and reconstruction of A2, A4 or both pulleys if damaged in first stage. During the second stage (performed three to eight months later), tendon graft replaced the silicone catheter. The proximal end of the transplanted tendon was fixed with flexor digitorum profundus tendon of respective finger, and the distal end of the graft was fixed with the distal stump of respective flexor digitorum profundus tendon.

Results: As per Buck Gramcko scale total active motion obtained was Excellent in 75%, Good in 15%, Fair in 6%, and Poor in 4% of patients.

Conclusions: Flexor tendon reconstruction using two stage tendon reconstructions is an effective way to restore digital tendon function in delayed zone II flexor tendon injuries.

Keywords: Flexor tendon injury, Tendon graft, Tendon sheath, Staged tendon reconstruction

INTRODUCTION

Flexor tendon injuries have severe functional consequences often underestimated by the patients, even sometimes by the treating doctors as well. Repairing these lesions is a real functional issue. Reconstruction of scarred flexor tendon system of hand remains a challenge for a hand surgeon because the healing tendon tends to adhere to its fibro-osseous tunnel. The zone 2 was termed “no man’s land” by Bunnell because of the poor outcome in range of motion (ROM) following tendon repair in this zone 1. The outcome is worse in chronic injuries. Two-stage flexor tendon reconstruction using a tendon spacer in the first stage and a free tendon graft through the pseudo sheath formed around the silicone rod in the second stage, as described in 1971 by Hunter and Salisbury 2-6 is the most widely accepted treatment for poor prognosis patients. This article presents our results of two stage flexor tendon reconstruction.

METHODS

This is a prospective study conducted from November 2015 to December 2020 in the department of Plastic and Reconstructive Surgery, GMC, Srinagar on 65 patients with delayed presentation of flexor tendon injury in zone II of digits who underwent 2-stage reconstruction. These included 48 men and 17 women, with an average age of 25 years (ranging from 14 to 50 years). A total of 100 digits...
(25 index fingers, 22 middle fingers, 30 ring fingers, 15 little fingers and 8 thumbs) were studied. The mechanism of injury included Tin cut in 35 patients, knife cut injury in 10 patients and glass cut injury in 20 patients. Average time elapsed since injury to stage I operation was six months (ranging from 2 to 28 months). All patients followed the same surgical and postoperative protocol. It was a two stage tendon reconstruction. All surgeries were performed under General anesthesia and tourniquet control. Patients underwent aggressive physiotherapy program before and after the first stage to overcome stiffness and achieve maximum passive motion.

Stage I

Brunner’s palmer zigzag incisions were made to provide wide exposure of the flexor tendon from the midpalm to the digital tip. The injured tendons and scar tissues were removed. About one centimeter of distal flexor digitorum profundus stump was preserved. Silicone catheter (cut to size) was inserted into the rudimental sheaths. The pulleys (A2 and A4) if injured were reconstructed over the implant using excised flexor digitorum superficialis tendon. The distal end of the implant was sutured to the distal stump of flexor digitorum profundus, and the proximal end of the implant was fixed to the proximal stumps of respective flexor digitorum profundus tendon in the palm. Passive motion exercises were started after one week of surgery. The goal was to achieve full passive flexion at Metacarpophalangeal and interphalangeal joints.

Stage II

Stage II surgery was performed two to six months (average four months) after stage I surgery. A lateral incision at the distal phalanx was used to retrieve the distal stump of the flexor digitorum profundus and the distal end of the silicone rod, and the connecting sutures were divided. An incision at mid of the palm was made to retrieve the proximal junction of the implant and flexor digitorum profundus. Palmaris longus tendon or plantaris tendon of proper length was procured using a tendon retriever or through multiple small incisions. One end of tendon graft was sutured temporarily to the distal end of the silicone catheter and pulled proximally through the pseudo sheath formed around the implant. The distal end of the tendon graft was sutured to the distal stump of flexor digitorum profundus using modified Kessler tendon suturing technique. The proximal end of the graft was sutured with respective proximal stump of the flexor digitorum profundus tendon using pulvertaft weave suturing method. The tension was adjusted so that the finger was rested in a position slightly more flexed than under normal circumstances. At this stage it will be necessary to test the course of the graft in its digital neo-sheath by flexion and extension of the wrist to ensure the absence blocking or jumping and thus the length of the graft and this by placing the wrist in the neutral position and restoring the natural cascade of long fingers in half-flexion. In general, the posture of the grafted digit should be approximately the same as the adjacent ulnar digit, and in the fifth finger, a position of flexion somewhat greater than that of the fifth finger on the opposite hand. At the end of surgery it was ensured that proximal tendon juncture should glide freely on extension of respective digit.

Postoperative Care

In the postoperative period, Kleinert’s splint was applied with wrist in 30° flexion, Metacarpo-phalangeal joint in 40° flexion and inter-phalangeal joints kept in neutral position. After 24 hours Kleinert’s early active motion protocol was started, ten times every hour. At bed time, inter-phalangeal joints were splinted in extension to prevent development of flexion contractures. Four weeks postoperatively, active flexion was started without resistance and dorsal blocking splint was discontinued during day time but continued for night time splintage. Six weeks postoperatively, the splint was discontinued during night as well, and active flexion with progressive resistance exercises was started, and the results were assessed.

RESULTS

Patients were followed on an average for one and a half year (ranging from 6 to 24 months). The results were measured six months after the stage II surgery. Assessment of cases was made based on the total active motion system of evaluation.13 Of the 100 digits operated; excellent results were seen in 75 percent, Good in 15 percent, Fair in 6 percent and Poor in 4 percent (Table 1). Infection was observed in two patients after stage I surgery. In first patient the silicone rod was removed and in the other patient,
the infection responded well to conservative treatment. Silicone rod got exposed in 2 patients. In both patients silicon rods were removed. None of our patients had any skin necrosis, proximal or distal graft tenorrhaphy rupture.

**Table: 1**

<table>
<thead>
<tr>
<th>Range of motion</th>
<th>No of digits</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 - 100 (Excellent)</td>
<td>75</td>
<td>75%</td>
</tr>
<tr>
<td>70-84(Good)</td>
<td>15</td>
<td>15%</td>
</tr>
<tr>
<td>50-69(Fair)</td>
<td>6</td>
<td>6%</td>
</tr>
<tr>
<td>0-49(Poor)</td>
<td>4</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**DISCUSSION**

Old flexor tendon injuries, especially in zone II, are usually associated with complications such as retraction of proximal and distal ends of tendon, adhesion formation and collapse of the osseo-fibrous canal. Therefore, tendon grafting is usually needed to restore the flexion function of digits.

In the 1950s, Basset and Carroll began using flexible silicone rubber rods to build a pseudo-sheath in badly scarred fingers and the method was later refined to a staged reconstruction of the digital flexor tendons by Hunter and Salisbury.2,8,9 This procedure was used for patients who had their flexor digitorum profundus, flexor digitorum superficialis, and tendon sheath all severely injured, especially in zone II, and it effectively decreased adhesion formation. Hunter’s technique is worthwhile for delayed flexor tendon injury in zone II to prevent adhesion formation.2-11

The main complications of staged flexor tendon reconstruction include adhesion formation, infection, skin necrosis, rod buckling, silicone synovitis, tenorrhaphy rupture and silicone rod exposure. In our series, the infection rate was 2%.

Adhesion formation after stage II can be minimized by strictly following early active motion protocol.10,11 After tendon repair, two mechanisms for healing are involved: extrinsic and intrinsic. The extrinsic mechanism is predominantly mediated by an influx of synovial fibroblasts and inflammatory cells from outer sheath, while intrinsic healing occurs via fibroblasts and inflammatory cells from the epitenon. Extrinsic mechanism of healing is mainly responsible for adhesion formation. Early active controlled exercise protocols promote tendon healing through intrinsic mechanism and thus prevent adhesion formation.

The pseudo-sheath formed after stage I around the silicone rod implant provide a smooth tunnel for tendon graft to glide, so chances of adhesion formation within this tunnel are minimal. In our series, all patients received early controlled exercise protocol and hence good results were achieved.

To retain good digital function, pulley reconstruction is important. The pulley system, especially A2 and A4 pulleys, are responsible for preserving digital motion and finger strength. Loss of the integrity of these pulleys results in bowstringing.12 In our study we reconstructed A2 and A4 pulleys using remnants of flexor digitorum superficialis tendon in first stage of tendon reconstruction.

**CONCLUSION**

Two-stage flexor tendon reconstruction technique is an effective method of reconstruction of a scarred flexor tendon system in zone II of hand, yielding a high rate of excellent and good results with fewer complications.

**REFERENCES**


2. Hunter JM, Salisbury RE. Flexor-tendon reconstruction in severely damaged hands. A two-


