

Case series

Two stage flexor tendon reconstruction: experience on 11 cases



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Abstract

Secondary surgery of the flexor tendons of the hand is a very common entity in traumatology and carries significant risks up to total functional impotence. This justifies the importance of the quality of this surgical repair which must be carried out under better conditions, with good anatomical knowledge. Our work is a retrospective study of 11 patients who underwent secondary hand flexor tendon repair during the period of 8 years. The age of the patients varies between 18 and 61 years, with an average of 40 years and a notable male predominance (9 men and 2 women). Assault with a sharp object was the predominant etiology. The right side was the most common in our patients (9 patients). The average time taken to treat (heal) patients was 7 months; with a delay between the two operating times of one month on average. All patients had received a two-fold hand flexor tendon repair. According to Hunter, the tendon spacer that was used in for all our patients was a Redon drain or naso-gastric tube. The small palmar muscle was the tendon graft used in 8 patients. As for the small plantar muscle, it was used in a single patient because of the absence of the small palmar muscle. Moreover, in 2 patients the small palmar muscle was used in association with the superficial common flexor tendon. The functional results of our series were evaluated according to the La Salle and Strickland score, with 20% excellent results, 30% good results, 40% average results and only 10% poor results. Among the rare complications noted in our patients, there was a single case of digital stiffness noted in a single patient, a case of blockage of the graft in a patient and a case of bow string effect. Flexor tendon reconstruction using two stage tendon reconstructions is an effective way to restore digital tendon function in delayed zone II flexor tendon injuries.

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Introduction

The flexor tendon lesions have a functional gravity often underestimated by the patients, even the doctors themselves. 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 unheeded 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], is the most widely accepted treatment for poor prognosis patients. This article presents our results of two stage flexor tendon reconstruction by using the Redon drain or the nasogastric tube like a spacer.

Methods

This is a retrospective study conducted from June 2009 to June 2017, we gathered the files of 11 patients included all patients with neglected rupture of one or more flexor tendons in the hand and patients who had undergone primary repair of flexor tendon lesions with secondary rupture, as well as all patients who had failed repair with secondary failure, adhesions, bow string effect, all this group benefited from tendon repair in 2 steps. These included 9 men and 2 women, with an average age of 40 years (ranging from 18 to 61 years). A total of 11 patients, in 8 cases, these were old or neglected tendon lesions. In 3 of the cases, it was a primary repair failure including secondary rupture as well as adhesion formation. The mechanism of injury included tin cut in 4 patients, knife

cut injury in 4 patients and glass cut injury in 3 patients, zone 2 in all of our series. Average time elapsed since injury to stage of operation was seven months (ranging from 4 to 12 months). All patients followed the same surgical and postoperative procedure. The evaluation was based on the quotation adapted by the Strickland method [3] given the multitude of series that adopted this method.

Operative procedure: it was a two stage tendon reconstruction. Ten patients were performed under axillary block of limb and only 1 patient needs general anesthesia to harvest the small plantar muscle with tourniquet at the root of the member (Figure 1).

Stage I: Brunner's palmer zigzag [4] incisions were made to provide wide exposure of the flexor tendon from the midpalm to the digital tip (Figure 2). The injured tendons and scar tissues were removed. About one centimeter of distal flexor *digitorum profundus* stump was preserved. The tendon spacer that was used in patients was the Redon drain or the nasogastric tube. This used in a spacer makes it possible to recreate a sliding space that will receive the tendon graft during the second hour of grafting. The injured pulleys (A2 and A4) were reconstructed over the implant using excised flexor *digitorum superficialis* tendon (Figure 2). 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. For a very severe case of trauma, distal interphalangeal arthrolysis was performed to restore the joint extension. Passive motion exercises were started after one week of surgery. The goal was to achieve full passive flexion at the metacarpo-phalangeal and interphalangeal joints.

Stage II: stage II surgery was performed two to three months after stage I surgery (Figure 3). 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 tendon spacer

and the connecting sutures were released. An incision at mid of the palm was made to retrieve the proximal junction of the spacer and flexor digitorum profundus.

By multiple incisions in the wrist fold and the anterior aspect of the forearm, a good length of the Palmaris longus tendon or the small palmar was obtained (musculus plantaris or small plantar muscle was used in a single patient) (Figure 4). One end of the tendon graft was temporarily sutured at the distal end of the probe and pulled proximally through the pseudo-channel formed around the implant to exit downstream of the A4 pulley. The distal end of the tendon graft was sutured to the distal stump of the deep flexor tendon using the modified Kessler tendon suture technique. The proximal end of the graft was sutured using the Pulvertaft technique [5]. 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.

Postoperative care: in the immediate postoperative period, Kleinert's splint was applied with 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, with patient doing active extension and passive flexion using rubber band traction, 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.

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. In our series, the evaluation was based on the score adapted by the Strickland method given the multitude of series that adopted this method. Of the 11 digits operated, excellent results were seen in 20 percent, good in 30 percent, fair in 40 percent and poor in 10 percent (Table 1). During the postoperative follow-up of the 11 patients in our series, the complications were marked by a "bow-cord" effect noted in a single professional military patient, which necessitated a repair of the pulley and the carrying out of an intra-phalangeal plasty. In addition, a second female hairdresser presented postoperative stiffness of IPP and IPD, which required the performance of a tenolysis. The other 9 patients in our series had no complications during the postoperative period.

Discussion

Older flexor tendon lesions, particularly in Zone II, are generally associated with complications such as retraction of the proximal and distal tendon ends, adhesion formation and collapse of the osseofibrous canal. Tendon grafting is usually required to restore the flexing function of the fingers. In the 1950's, Bassett and Carroll used flexible silicone rubber rods to construct a pseudo-sheath in poorly scarred fingers [6,7] and the method was then refined for progressive reconstruction of the flexor apparatus by Hunter and Salisbury [2]. This procedure was used in patients whose deep flexor fingers,

superficial flexor and tendon sheath were severely harmed, particularly in Zone II. Hunter's technique is worthwhile for a neglected flexor tendon injury in Zone II to prevent the formation of adhesions. The main complications of progressive flexor tendon reconstruction [8-10] include adhesion formation, infection, skin necrosis, anastomosis rupture and spacer exposure. In our series, there was only one case of digital stiffness in a single case, a case of blockage of the graft and chord effect in a single case. Adhesion formation after phase II can be minimized by strictly following the early active motion protocol [10,11]. Two healing mechanisms are involved: extrinsic and intrinsic. The first protocols of active controlled exercises promote the healing of the tendons through an intrinsic mechanism and thus prevent the formation of adhesions (extrinsic mechanism). In our series, all patients followed an early exercise protocol and therefore good results were achieved. To maintain a good numerical function, rebuilding the pulley is important. The pulley system, particularly the pulleys A2 and A4, are responsible for preserving digital movement and finger strength [12]. In our study, we reconstructed A2 and A4 pulleys using superficial flexor digitorum tendon remnants at the early stage of tendon reconstruction only in one case where we used the technique of reconstruction described forward as Lister's technique [13].

Conclusion

The secondary surgery of the flexor tendons of the hand remains a demanding technique hence the interest and great importance of the primary repair. Many factors can influence the prognosis of flexor tendon repair in the hand, including the patient's profile, socio-economic conditions as well as the characteristics of the trauma. The technique remains inexpensive, with at the same time satisfactory functional results similar to those of the literature.

What is known about the topic

- Various technique of flexor reconstruction;
- Unclear prognosis

What this study adds

- Explain the hunter technique of flexor reconstruction;
- Non-expansive technique;
- Tracing the experience of the Department of Traumatology and Orthopedics of University Hospital Center Hassan 2 B4 of Fez.

Authors' contributions

Mohammed Lahsika (Principal author): planning the study, exploitation of the archives, analysis of the results and writing of the manuscript; Said Senhaji, Abdelhafid El Marfi and Benchekroun Seddik: exploitation of the archives, analysis of the results; Mohammed El Idrissi, Abdelhalim El Ibrahimy and Abdelmajid El Mrini: critical review and final approval. All the authors have read and agreed to the final manuscript.

Table and figures

Table 1: range of motion achieved after 6 months of stage II tendon reconstruction

Figure 1: stiffness in flexion of IPD and IPP caused by neglected flexor tendon section

Figure 2: stage I tendon reconstruction in progress with release on the spacer's site, reconstruction of pulleys A2 and A4

Figure 3: scar of a Brunner type incision 3 weeks after the first hunter's time

Figure 4: palmaris longus tendon grafts harvested during second stage tendon reconstruction

References

1. David G, Robert S. Flexor tendon injuries and reconstruction. Saunder Elsevier. 2006:352.
2. Hunter JM, Salisbury RE. Flexor-tendon reconstruction in severely damaged hands, a two-stage procedure using a Silicone-dacron reinforced gliding prosthesis prior to tendon grafting. *J Bone Joint Surg Am.* 1971;53(5):829-58. **PubMed | Google Scholar**
3. Strickland JW. Development of flexor tendon surgery: twenty-five years of progress. *J Hand Surg Am.* 2000;25(2):214-35. **PubMed | Google Scholar**
4. Bruner JM. The zig-zag volar-digital incision for flexor-tendon surgery. *Plast Reconstr Surg.* 1967;40(6):571-4. **PubMed | Google Scholar**
5. Tubiana R. Lésions des tendons flechisseurs: traité de chirurgie de la main. Tome. 1986;III:184-206.
6. Bassett CAL, Carroll RE. Formation of tendon sheaths by silicone rod implants, proceedings of American Society for Surgery of the Hand. *J Bone Joint Surg Am.* 1963;45:884. **Google Scholar**
7. Courvoisier A, Pradel P, Dautel G. Surgical outcome of one-stage and two-stage flexor tendon grafting in children. *J Pediatr Orthop.* 2009;29(7):792-6. **PubMed | Google Scholar**
8. Alnot JY, Dufour G. La réparation des lésions anciennes des tendons fléchisseurs: à propos d'une série homogène de 17 greffes en deux temps. *Ann Chir Main.* 1980;34(9):675-682. **PubMed | Google Scholar**
9. American Society for Surgery of the Hand (ASSH). Clinical Assessment Committee Report. Rosemont. 1976.
10. Khanna A, Friel M, Gougoulas N, Longo UG, Maffulli N. Prevention of adhesions in surgery of the flexor tendons of the hand: what is the evidence. *Br Med Bull.* 2009;90:85-109. **PubMed | Google Scholar**
11. Khanna A, Gougoulas N, Maffulli N. Modalities in prevention of flexor tendon adhesion in the hand: what have we achieved so far. *Acta Orthop Belg.* 2009;75(4):433-44. **PubMed | Google Scholar**
12. Rispler D, Greenwald D, Shumway S, Allan C, Mass D. Efficiency of the flexor tendon pulley system in human cadaver hands. *J Hand Surg Am.* 1996;21(3):444-50. **PubMed | Google Scholar**
13. Lister GD. Reconstruction of Pulleys employing extensor retinaculum. *J Hand Surg Am.* 1979 Sep;4(5):461-4. **PubMed | Google Scholar**

Table 1: range of motion achieved after 6 months of stage II tendon reconstruction

Range of motion	Number of digits	Percentage
75-100O (Excellent)	2	18
50-74O (Good)	3	27.5
25-49O (Fair)	5	45.5
0-250O (Poor)	1	9
TOTAL	11	100



Figure 1: stiffness in flexion of IPD and IPP caused by neglected flexor tendon section

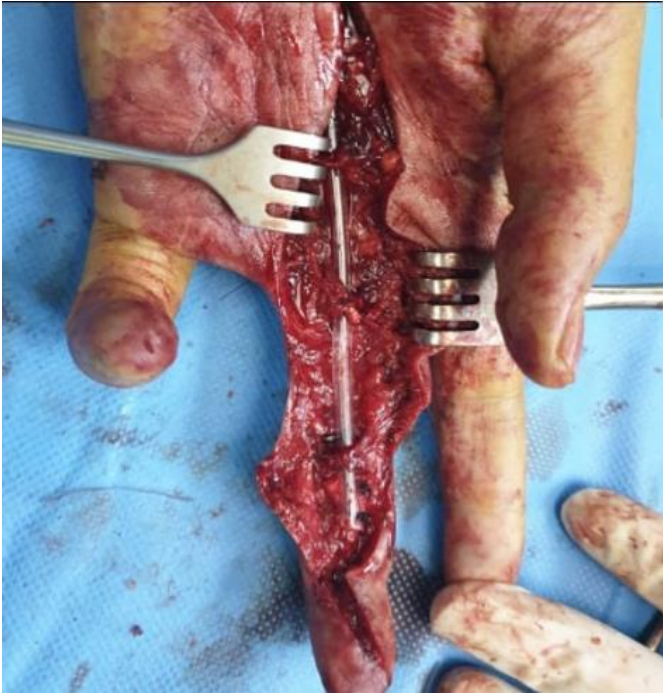


Figure 2: stage I tendon reconstruction in progress with release on the spacer's site, reconstruction of pulleys A2 and A4



Figure 3: scar of a brunner type incision 3 weeks after the first hunter's time



Figure 4: palmaris longus tendon grafts harvested during second stage tendon reconstruction