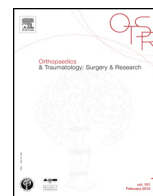




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Original article

Prognostic factors in two-stage flexor tendon reconstruction: Is it possible to predict surgical failure?



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ABSTRACT

Introduction: Two-stage surgical reconstruction of the flexor tendons by the Hunter technique is the salvage option in case of old tears or a severely damaged fibro-osseous canal.

Hypothesis: The identification of poor prognostic factors during the assessment of injuries at presentation could help determine indications and predict failures.

Materials and methods: We report a retrospective single center series of reconstruction of zone 2 of the flexor digitorum profundus of the long fingers between 2000 and 2012, in 22 patients, mean age 33 years old with a mean follow-up of 36.4 months.

Results: The total active range of motion (TAM) of the rays was 110° with a mean range of motion of the PIP and DIP of 71° and 39° respectively. Sixty-three percent of patients were satisfied and 73% returned to their professional activities. A group with good and fair results was determined based on the Strickland classification (68%, 15 patients, mean TAM 126°, mean QuickDASH 22.6) and a group with poor results (32%, 7 patients, mean TAM 77°, mean QuickDASH 43.4). The factors of a poor prognosis were associated injuries to the extensor apparatus, infection (phlegmon) ($P=0.023$) and joint injuries ($P=0.09$).

Discussion: There are no factors in the literature to predict a poor prognosis except for reconstruction of the flexor pollicis longus. A simplified procedure could provide better results in patients with associated injuries to the extensor apparatus, infection (phlegmon) or osteoarticular damage, in terms of the duration of physical therapy, additional surgery and overall socioeconomic cost. The results in the literature of superficialis finger reconstruction are significantly better ($P<0.001$).

Conclusion: Although the Hunter technique is still the reference procedure for the reconstruction of flexor tendons, our study identified prognostic factors of poor functional results such as infection and associated extensor apparatus damage, which should orient the surgeon towards a simplified technique such as the superficialis finger procedure.

Level of evidence: IV: retrospective study.

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1. Introduction

Two-stage surgical reconstruction of the flexor tendons by the Hunter technique is a challenge because of the difficulty of the surgical technique, the demanding postoperative physical therapy, and a less than perfect final outcome.

This technique, which was described by Bassett and Carroll in 1963 more than fifty years ago, was then developed by Hunter [1] who presented the first series in the literature in 1965 and 1971. Later, Paneva-Holevich [2,3] proposed a variation to the procedure using an intrasynovial graft with suturing of the flexor digitalis superficialis (FDS) to the flexor digitalis profundus (FDP) during

the first operation. This technique is still the gold standard for the reconstruction of and to restore function to the flexor tendons in case of recent or old tears with severe damage to the fibro-osseous canal [4].

The high rate of complications in the literature limits the results of this procedure, which may seem unpredictable. To our knowledge, there are no studies identifying good or poor prognostic factors of good or poor results or that propose alternative treatment for this type of injury [5].

The primary objective of this study was to identify prognostic factors of poor results to target the best indications and candidates for this procedure. The goal was to improve prediction of failures and prevent including a candidate that is ill-suited to this difficult surgical procedure and physical therapy protocol which requires significant personal investment and long treatment for an unpredictable result.

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Table 1
Initial injuries.

Initial injuries	Number of cases	% of cases
Neglected zone 2 volar injuries	9	40.9
Recurrent tears in zone 2 tendon injuries	6	27.2
Multiple soft tissue injuries (multiple digits or associated sectioning of the extensor apparatus)	5	22.7
Infectious (destruction of the fibro-osseous canal and tendon necrosis, due to severe phlegmon)	2	9.0
Injury to the dominant hand	14/22	63.6

2. Materials and methods

This single center retrospective study was performed between 2000 and 2012 in a unit specialized in surgery of the upper extremity.

Inclusion criteria were two-stage reconstruction of zone 2 of the FDP, after sectioning or tearing of the two-flexor tendons associated with incapacity and the need for repair of the fibro-osseous canal.

Patients who were under the age of 16, with an isolated tear in one of the two flexors and associated injuries to the thumb were excluded.

Twenty-two patients, 17 men and 5 women mean age 33 years old (28–55) were reviewed with a mean follow-up of 36.4 months (12–130).

The mean delay between the initial injury and the first stage of the operation was 15 months (15 days–96 months) and 9 weeks (8–12 weeks) between the two operations.

Forty percent of the cases were neglected injuries that were managed late, with collapse of the fibro-osseous canal and incapacity of the flexor pulley system.

We report two Michon classification stage 3 infections (phlegmon) of the flexor sheath with necrosis of the flexor tendons and the fibro-osseous canal. In these two cases, the necrotic tissue was first debrided and abundantly rinsed followed by postoperative dual antibiotic therapy. We performed the first operation of the Hunter technique with placement of a silicone rod and reconstruction of the A2 and A4 pulleys 15 days later.

The dominant hand was involved in 14/22 cases. The causes of the initial injuries are reported in [Table 1](#).

The initial injuries were also classified according to the Boyes and Stark classification in relation to the type of associated lesions ([Table 2](#)).

2.1. Surgical technique

2.1.1. First stage ([Fig. 1](#))

The goals were:

- reconstruction of a fibro-osseous canal;
- restore passive articular range of motion;
- preparation of the graft and proximal suture.

Table 2
Boyes and Stark prognostic classification according to preoperative clinical status.

Stage	Preoperative lesions	Our study
1	Simple wound	9
2	Extensive wound, trophic skin disorders	2
3	Associated joint injury	2
4	Associated injury of the collateral nerves	6
5	Several injured digits or several injuries	3

The surgical approach follows a zig zag incision that extends along the finger and into the palm for pulley repair. We did not have any trouble with skin coverage requiring flap reconstruction. In case of significant flexion contracture during the first operation, certain local reconstruction techniques may be used to cover the silicone rod and the fibro-osseous canal (Z, Hueston, Colson – reconstructions...), which we are preferable to regional flaps (cross-finger) which complicate postoperative mobilization.

Fibro-osseous canal reconstruction was performed in all cases: in 16/22 cases A2 and A4 pulleys were reconstructed simultaneously and in the 5 remaining cases one of the main flexor pulleys, A2 or A4, were reconstructed. Reconstruction with the distal stump of the FDP/FDS was performed in 11 cases and the palmaris longus in 5 cases. These reconstructions were performed by either direct suture of the tendon to the remaining pulley tissue, or by passing a graft around the phalanx, with a risk of secondary osteolysis of the phalanx due to shear stress.

Associated arthrolysis of the PIP joint was performed by volar approach during this stage of surgery in 6 patients (27%). The same sequence was followed for anterior PIP arthrolysis until full extension was obtained: the check rein ligaments were cut (release/expansion of the volar plate), then the anterior capsule and the collateral ligaments were cut.

In 9 cases, the tendon graft was prepared by the Paneva-Holevich technique with suturing of the FDP to the FSP in the palm above the lumbrical insertions.

In the 13 other cases, a palmaris longus graft was used with a proximal suture in the palm as well. A classic 4-strand suture with PDS 3-0 and a peritendinous overlock suture with PDS 5-0 was chosen rather than a Pulver-Taft type suture [6], which we feel can result in thickening of the tendon and block the fibro-osseous canal. Preparation of the FDP stump using the fish-mouth technique limits the size of the suture and facilitates passage in the fibro-osseous canal [4].

The silicone rod, whose diameter was slightly larger than the native FDP was placed, while making sure that there was no proximal impingement with the rod during mobilization of the digital chain, or excess tension of the reconstructed pulleys during perioperative passive flexion and extension of the fingers. The rod was secured distally under the native insertion of the FDP on P3. Two cross-stitches were then made with non-absorbable 3-0 suture thread between the FDP tendon stump and the silicone rod. Proximally the rod was beveled so that it would glide under the flexor sutures during full flexion of the finger but still remain visible outside the fibro-osseous canal when the finger was in full extension [1,7].

Vigorous passive range of motion exercises were begun immediately at a physical therapy center to maintain total passive range of motion with the hand in a simple protective splint with the wrist and the finger held straight. This protective splint is often left in place for the first three weeks after the first operation mainly for comfort and to protect the hand following associated procedures such as pulley repair and PIP arthrolysis. However theoretically there is no formal indication to immobilize the operated finger.

2.1.2. Stage 2 ([Figs. 2 and 3](#))

The second operation was performed three months later, allowing recovery of total passive range of motion and healing of the operated finger with no pain in all cases. Thus, there was no need to prolong this delay. We empirically consider that three months are necessary to obtain a new digital pseudosheath around the silicone rod, making it possible to glide the tendon graft along it.

A distal incision is performed at the distal interphalangeal joint to retrieve the distal end of the silicone rod.

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