



Unconventional Tendon Advance for injuries in zones I and II New Surgical Technique.

Dr. Alberto Luis Garay M.D.

Instituto Dupuytren, Ciudad Autónoma de Buenos Aires. República Argentina.

Corresponding Author: Dr. Alberto Luis Garay M.D., Instituto Dupuytren. Ciudad Autónoma de Buenos Aires. República Argentina.

Received: September 17, 2025; **Published:** September 22, 2025

Abstract

Non-Conventional tendón flexor advancement in Verdan zones 1 and 2 is a simple technique that replaces primary sutures if necessary, especially when there are not ideal condition to perform them or good rehabilitation post surgery. It is also a better solution to tendon grafts in one or two stages.

Introduction

Injuries to the flexor tendons of the hand are prevalent conditions. When primary repair can be performed, better clinical results can certainly be achieved. But if early primary suture is not carried out, or a primary tenorrhaphy suffers a rupture, then graft tendon would be the most suitable treatment. Adhesion and breakage rates (main reported complications) in primary or secondary repair, as well as comorbidity inherent to the use of tendon grafts, whether from the forearm or the lower limb, are factors widely described respecting the logical rule that the greater the number of surgeries, the more the range of motion will be limited.

In present time, the variability of suture thread types among with the multiple passage assemblies makes tendon suture in the “no man’s land” a more predictable and reliable option.

In order to seek an alternative option to conventional treatments, reports from 1950s and 1980s decades described encouraging results of lengthening of the flexor pollicis longus in Verdan zone V in cases of flexor tendon injuries. Le Viet performed zetaplasties in profound flexors tendons when retraction of the proximal stump was present in order to achieve a primary suture.(6)

More recently, this unconventional tendon lengthening procedure was used to treat injuries of the flexor tendons of the triphalangeal fingers due to puling out (jersey finger).(7)

The purpose of this study is to describe a new surgical technique among with its clinical results in patients with primary tenorrhaphy tears or chronic profound flexor tendon injuries in zones I and II of Verdan, treated with unconventional tendon advancement.

Materials and Methods

A retrospective study was carried out to assess patients treated in our Hand Surgery Department between December 2012 and March 2023. The inclusion criterion was: age above 18 years with tear in zones I and II of Verdan in triphalangeal fingers in cases of primary profound flexor tenorrhaphy, or chronic untreated primary profound flexor injury, which were define as those injuries of this tendon beyond four weeks of the trauma.

Minimum follow-up was 36 months.

Patients with soft tissue defects, fractures, or active infectious process were excluded.

The sample was made up of 20 patients (16 men and 4 women), with an average age of 29 years (range 20-49). 75% of the cases (16 patients) had involvement of the dominant hand. The most affected finger was the little one (7 cases), followed by the index (7 cases), the middle (4 cases), and ring fingers (2 cases). In four cases (25%), a neurorrhaphy of injured collaterals was performed. This procedure delayed the rehabilitation period.

Surgeries were carried out by two hand surgeons and were performed under total anesthesia or plexual block in a single surgical time since no adhesion of the stumps was present, nor reconstruction of the pulleys was necessary.

Surgical techniques:

1. Z-lengthening in the distal third of the forearm of the affected tendon, for the purpose to lengthen it as much as necessary.

2. Union of the proximal end of the affected tendon (which has already been advanced and sutured to Distal) to the neighboring unharmed tendon (lateral end suture) in the distal third of the forearm. This procedure loses the individual flexion of both tendons, since they would flex simultaneously. For a musician, for example, it would not be advisable to use it.
3. Tendon graft. It is carried out similar to the previous procedures in the distal third of the forearm. Once advanced and sutured to distal, the graft is placed between the distal end and the next remnant of the affected tendon. The length of the graft will be similar to what needs to be advanced.

The sample was gathered in two groups according to the type of injury and the surgical technique used.

Group A included of patients with primary tenorrhaphy tears (9 cases). The surgical technique used consisted of a zetaplasty in zone V, in the proximal stump tendon, thus extending its length. In this way, it was possible to reach, in zones I or II of Verdan, the distal end and make an end-to-end suture. The advancement of the tendon is carried out through the pulleys corresponding to the tendon being repaired. The proximal stump can be sutured to the distal one or inserted into the distal phalanx using the pull-out technique.

Group B included patients with chronic untreated profound flexor injuries (11 cases). If the shortening of the proximal end is considerable and, therefore, the end-to-end suture cannot be performed initially, we propose zetaplasty on the proximal stump, advance and suture end-to-end to distal and suture to the undamaged neighboring deep flexor tendon in zone V with continuous suture (proximal). The reason for performing sutures in zone V is the lower rate of adhesions described. In this series, cases with palmaris minor graft as interposition were not included.

Post-operative care

After surgery, an above elbow cast was used for protection of the suture for 4 weeks.

Rehabilitation exercises began following the removing of the cast, and progressive load was applied to the hand 8 weeks after the surgery.

Strickland punctuation system was used to assess the results.

Statistical analysis was carried out with a IBM SPSS Statistics 19.0". This analysis was developed with a non-parametric median test.

Results

The average follow-up was 51 months (range 41-62). The mean interval between breakage or injury and surgery was 11.7 weeks (range 2-24). According to Strickland's Classification, in group A five patients had an excellent total active range of movement, one good and another, regular. Meanwhile, in group B five patients obtained excellent results and four good. Demographic data, average follow-up, and Strickland Classification of Both groups are summarized.

The average advancement achieved for the treated tendons was 37 mm (range 19-55 mm) in both groups.

Group A recorded an average advancement of 22.5 mm, and group B, 39 mm. These differences were statistically significant ($p = 0.029$). The data are summarized. No complications nor reoperations were recorded in any of the groups.

Discussion

Reconstruction of the profound flexor tendon is indicated when primary repair fails, when the diagnosis of proximal sump retraction is done late, and in the presence of complex injuries with soft tissue defect.

In this study the functional outcome of two techniques in which non-conventional tendon advancement for injuries in Verdan zones I and II in triphalangeal fingers was assessed. In both cases, good total active range of motion was achieved at the end of the follow-up, regardless of different diagnosis.

The prognosis in reconstructions is determined by the delay in treatment, the rate of tendon retraction, its state of vascularization, the soft tissue environment, the indemnity of the superficial flexor tendon, and the surgeon's experience.

Prior surgical options included tendon advancement, grafts in one or two stages, tendon transfers and silastic prostheses. Other widely used rescue surgeries are arthrodesis, capsulodesis and tenodesis.

According to the literature, grafts in all their variants are the most chosen. However, there is no consensus on which tendon would be the best graft. For its selection it is necessary to consider the diameter, length and resistance. The most used are the flexor palmaris brevis, the extensor digiti quinti, the extensor digiti indicis and the toe extensors. (9-11) Allografts have also been proposed.(12)

In a series of 71 cases, Guimberteau et al. proposed vascularized grafts of flexor tendons and report encouraging results. Follow-up time was short, though.(13)

Likewise, the implementation of synthetic implants as a tool has been described to treat flexor injuries, as long as they are well tolerated. (13-16)

Sita-Alb and Durand proposed the reconstruction of flexor tendons in zones I and II using transfer of half of the superficial flexor tendon adjacent to the profound flexor tendon injured.(17)

There are previous publications on tendon lengthening in the forearm.6 Chanel et al.7 evaluated the advancement of the deep flexor tendon when performing a zetaplasty as a treatment for the jersey finger injury. This tendon advancement was limited due to the presence of the lumbrical muscle and synovial adhesion. The same entity faced with the situation of having to carry out a advancement of greater length, in our experience, total removal of this muscle for a correct sliding of the flexor tendon through the pulley system, it did not manifest as a limitation for final digital mobility. This undoubtedly reduces the chances of increasing friction in the pulley system and possible causes of adhesion.

If necessary, the lumbrical corresponding to the affected tendon can be removed to be able to perform all the necessary elongation.

Eventually in chronic injuries where a gap of more than 50 mm in length is present, a valid option is to perform a palmaris longus graft, enhancing a Pulvertaft type suture at both ends of the gap on the forearm. It would allow us fast mobilization to avoid adhesion.

The strength of the proposed technique lies mainly in its lower complexity compared with a tendon graft conventional, since it dispenses the mentioned graft and, in this way, considerably reduces morbidity and time surgery. Another virtue of this technique is its versatility, because it can be performed in one or two steps (determined by the surgeon whenever there are adhesions or the requirement for pulley reconstruction).

Regarding this technique, we consider among its advantages, the minor complexity, the lower co-morbidity, and the decrease in surgical time. These benefits might be greater in case more fingers are needed of repair.

The proposed technique can be applied in 1 or two steps.

Since the tendon original blood supply is preserved, and the anatomic diameters of the stumps are similar, the glide through the pulleys shall not be restricted.

A weakness in the tendon after the zetaplasty, which can be reinforced by inter tendon suture, might be a disadvantage of the technique.

This technique also allows us early controlled mobility at the interphalangeal and

early mobilization 48 hours after surgery to avoiding this edema, stiffness and adhesions, thereby allowing to begin treatment with protected controlled mobility together with our medical team rehabilitation.

We consider as limitations of this study its retrospective design, the limited number of patients, the heterogeneity of the injuries (primary tenorrhaphy tears and untreated injuries of the deep flexor), and possible biases in the interpretation of the results.

Conclusions

The non-conventional tendon advancement technique for injuries in Verdan zones I and II in triphalangeal fingers of the hand in patients with primary tenorrhaphy tears or chronic deep flexor injuries was a reproducible and effective treatment. Having said this, we could say that it would not be necessary to make primary sutures in the pulley area. Tendon grafts in the palm of the hand would not be necessary. The resection of the corresponding lumbrical muscle does not affect the metacarpophalangeal joint. This allows the tendon to advance as much as necessary.

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