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TRANSOSSEOUS TENODESIS OF THE EXTENSOR POLLICIS BREVIS AS TREATMENT FOR ACQUIRED METACARPOPHALANGEAL HYPEREXTENSION DEFORMITY OF THE THUMB: A PRELIMINARY REPORT

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Abstract:	Background: Hyperextension deformity of the metacarpophalangeal (MP) joint of the thumb contributes frequently to thumb pain and loss of function. Many treatments have been proposed, but none are universally accepted as ideal. Aims: To describe a new technique of tenodesis of the MP joint of the thumb using the extensor pollicis brevis (EPB) tendon and to analyze the results of a preliminary series with a minimum follow-up of one year. Methods: A descriptive study of a series of 12 symptomatic hyperextension deformities of the MP joint of the thumb in 10 patients who underwent a new method of tenodesis, with a minimum follow-up of 12 months. MP joint hyperextension and range of motion were assessed. Disability changes were evaluated by the QuickDASH score, the pain Visual Analogue Scale, the Kapandji opposition score, and pinch strength. The Wilcoxon test was used for statistical analysis. Results: The mean preoperative MP hyperextension deformity was 50.83+5.57º, which after the operation became a flexion attitude of 17.91+7.82º. The mean perceived pain went from 7.66 to 1.16. The QuickDash score was reduced by 34.4 points and the pinch strength increased by 50.42%. All changes observed after surgery were statistically significant. No major complications after the procedure were recorded. Conclusion: EPB transosseous tenodesis is a safe and mildly invasive option for achieving successful functional and cosmetic MP hyperextension deformity correction in posttraumatic and trapezio-methacarpal osteoarthritis-related cases. The advantage over MP fusion is that the functional range of flexion is maintained, even in deformities greater than 40º.
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EXTENSOR POLLICIS BREVIS TRANSOSSEOUS TENODESIS TECHNIQUE FOR TREATMENT OF ACQUIRED METACARPOPHALANGEAL HYPEREXTENSION DEFORMITY OF THE THUMB: A PRELIMINARY REPORT.

Running-title: EPB TRANSOSSEOUS TENODESIS.

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ABSTRACT

Background: Hyperextension deformity of the metacarpophalangeal (MP) joint of the thumb contributes frequently to thumb pain and loss of function. Many treatments have been proposed, but none are universally accepted as ideal.

Aim: Describe a new technique of tenodesis of the MP joint of the thumb using the *Extensor Pollicis Brevis* (EPB) tendon and analyze the results of a preliminary series.

Methods: We report a descriptive study of a series of 12 symptomatic hyperextension deformities of the MP joint of the thumb in 10 patients who underwent a new method of tenodesis, with a minimum follow up of 12 months. The technique consists in EPB tenotomy and tendon transfer trough two bone tunnels to the palmar aspect of the MP joint. MP joint hyperextension and range of motion was assessed. Disability changes were evaluated by the Quick DASH score, pain visual analogue scale, Kapandji opposition scheme and pinch strength. Wilcoxon test was used for statistical analysis.

Results: The mean preoperative MP hyperextension deformity was 50,83$\pm$5,57º that after the operation becomes a flexion attitude of 17,91$\pm$7,82º. The opposition of the thumb improved one point in Kapandji's scheme. The mean perceived pain went from 7.66 to 1.16. The Quick Dash score was reduced by 34.4 points and the pinch strength increased by 50.42%.

Conclusion: EPB transosseous tenodesis is a safe and little invasive option for achieving successful functional and cosmetic MP hyperextension deformity correction in posttraumatic and TM osteoarthritis associated cases. The advantage over MP fusion is that functional range of flexion is maintained, even

in deformities greater than 40º

Level of Evidence: III

Key Words: Thumb. Metacarpophalangeal joint. Hyperextension deformity. Extensor Pollicis Brevis. Tenodesis. Volar Plate. Trapezio-Metacarpal Arthritis.

INTRODUCTION

Hyperextension deformity of the metacarpophalangeal (MP) joint of the thumb contributes frequently to thumb pain and loss of function[1].

The incidence of MP joint hyperextension associated with TM osteoarthritis is unknown, but is frequently developed or intensified after trapeciectomy [2-4]. It is considered a poor prognostic factor[5] and many authors recommend simultaneous treatment of TM and MP joint[1,6-8].

Numerous methods have been proposed to treat MP joint hyperextension deformity, including Brachioradialis to Extensor Pollicis Brevis (EPB) tendón transfer[9,10], percutaneous transfixion of the joint[11], volar plate advancement and pull-out or bone anchors fixation[7, 12-14], sesamoidesis[15], capsulodesis[16], EPB tenotomy and tendon transfer[17], *abductor pollicis brevis* transfer to A1 pulley[18], percutaneous metacarpal osteotomy and external fixation[19] and MP arthrodesis[20]. However, none of them are universally accepted as ideal.

The aim of this study is to describe a new technique of transosseous tenodesis of the MP joint of the thumb with the EPB tendon for treatment for acquired hyperextension deformity of the MP joint of the thumb.

MATERIAL AND METHODS

We report a descriptive study of a prospective series of 10 patients with 12 symptomatic hyperextension deformities of the MP joint of the thumb. There were eight women and two men. Mean age was 53,75±12,21 years. Eight cases combined ipsilateral TM osteoarthritis (all were corrected in a second operation after trapeciectomy). Three patients developed hyperextension after trauma and one in the context of joint hyperlaxity. Mean Follow-up was 18,16 m.

The technique consists in EPB tenotomy at the wrist (eliminates a deforming force) and tendon transfer trough two bone tunnels to the palmar aspect of the MP joint. The tendon that is tautened and fixed to the back of the metacarpal has now a flexor effect (Fig. 1-4).

All patients were operated under loco-regional anesthesia, ischemia and received a single dose of Cefazolin. No drainage was used. All patients were discharged in the first 24 hours. The thumb and wrist were immobilized in a cast splint for four weeks.

MP joint hyperextension and range of motion were measured. Disability changes were evaluated with Quick DASH score[21]. Pain was scored using a visual analogue scale (VAS). Range of opposition was evaluated with the Kapandji scheme[22]. Pinch strength was estimated as mean of three measures using Jamar Dynamometer. All variables were recorded preoperatively and at the final follow-up. Complications were registered.

Statistical Analysis

The values of preoperative and postoperative measures were analyzed using the Wilcoxon test for related samples.

A 5 % alpha error was assumed with 95 % confidence intervals, accepting the statistical significance at $p \leq 0.05$. (SPSS 23.0; IBM SPSS Inc., Chicago, IL).

RESULTS

The mean preoperative MP hyperextension deformity was 50,83$\pm$5,57º that after the operation and the follow-up becomes an attitude in flexion of 17,91$\pm$7,82º ($p=0.002$). The average postoperative range of motion of the MP joint was 25.84º. The opposition of the thumb improved one point in Kapandji's

scheme. The mean perceived pain improved from 7.66 to 1.16 (p=0.002) on the visual analogue scale. The mean Quick Dash score reduce was 34.4 points and the pinch strength increased by 50.42%.

There were no loss of correction, infection, phalange or metacarpal fracture, or complex regional pain. All patients were very satisfied and if necessary, they would accept to be operated again by the same technique. The range of motion of the IP joint was reduced by 23.33º on average, but in no case was it a reason for complaint in any patient.

DISCUSSION

The preliminary results of this new technique of MP joint tenodesis shows hyperextension deformity correction, with preservation of MP flexion and improving thumb opposition, perceived pain decrease and pinch strength increasing, that resulted in a quick DASH reduction of 34,40 points at 1-year follow-up. Furthermore, no major complications were observed.

Many authors suggest that MP joint hyperextension of < 40 degrees without arthritis at the MP joint can be treated with soft tissue reconstructions[7,17,23,24], while arthrodesis has been recommended for deformities greater than 40 degrees or those cases with or those cases with osteoarthritis of the MP joint[6,10]. However, these indications are stablished on studies[12,14,15,17,18, 24] that provide little evidence to guide clinicians.

It is mostly accepted that thumb MP joint arthrodesis is safe and provides good pain relief and functional results with few complications, but some authors have questioned the patient-satisfaction following thumb MP joint arthrodesis[25, 26,27].

We do not believe that hyperextension passing 40 degrees necessitates MP arthrodesis, unless it combines degenerative joint changes and/or complex

instability. We have observed corrections higher than 50º with our technique without recurrence, retaining an acceptable range of motion at MP joint. Similar results have been published in range of motion and low rate of recurrence of the deformity with capsulodesis[14], Sesamoid arthrodesis[28, 29], or other tenodesis[30].

MP joint tenodesis of the thumb has previously been performed with EPB tendon[17, 30] and with palmaris longus free graft[31].

The use of EPB tendon has at least two advantages over the free graft of palmaris longus, which is absent in almost 20% of patients. First, the proximal tenotomy of the EPB eliminates a deforming force and secondly, the retention of its distal insertion makes unnecessary to use an implant to fix the tendon to the phalanx.

We have observed a decrease in the mobility of the IP joint of the thumb in our patients, although without clinical significance. We believe that it is secondary to local postoperative fibrosis. Similar reductions in the mobility of the IP joint have been published in MP arthrodesis for this reason[20, 32].

We do note several limitations in our study. Descriptive studies have limited evidence, small patient numbers and short time follow-up limit the conclusions that can be drawn. Nevertheless, the data we present here seem to support that EPB transosseous tenodesis is a safe option for achieving successful functional and cosmetic MP joint hyperextension deformity correction and advantageous over MP fusion, as a functional range of flexion is maintained, even in deformities greater than 40º, on the premise that no articular degenerative changes or valgus instability are present.

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FIGURE LEGENDS

Fig 1. Surgical technique scheme and incisions: 1. A. *Extensor Pollicis Brevis* (EPB) tendon is severed proximal to radial styloid process preserving its phalangeal insertion and the distal part is transferred anterior to the metacarpophalangeal volar plate through 2 bone tunnels, and fixed to the back of the metacarpal (IS: interference screw), with a flexor effect. It converts hyperextension deforming force into corrective. 1.B. Three little wounds are required in the dorsum, at the level of radial styloid process, distal part of the metacarpal and base of the first phalanx. A transverse accessory incision is made at the palmar crease of the metacarpophalangeal joint of the thumb.

Fig. 2. Tendon harvesting and bone tunnel creation. 2.A. *Extensor Pollicis Brevis* (EPB) tendon is identified in all dorsal incisions before being sectioned at the wrist. 2.B. The tendon is now retrieved in the distal wound. 2.C. Two Kirschner wires are passed from the back of the metacarpal and phalanx converging in a palmar direction to the anterior aspect of metacarpophalangeal joint. 2.D. A radioscopic control is necessary before making the bone tunnels with a 3.0 mm cannulated drill guided by the Kirschner wires.

Fig. 3. Passage of EPB tendon through bone tunnels. 3. A. straight microsuture lasso is used to recover a polypropylene loop from palmar to dorsal through the distal tunnel. 3.B. The loop grasps the tendon and then it is pulled in volar direction to harvest the plasty in the palmar wound 3.C. The microsuture lasso is used again, now to cross the proximal tunnel in back to palmar direction to link the EPB tendon, taking care to separate and protect the *Flexor Pollicis Longus* tendon and collateral vasculonervous bundles of the thumb. Vessel-

loops are very useful for handling these structures. 3.D. The tendon is finally retrieved on the back of the metacarpal.

Fig. 4. Tension and fixation of the tenodesis. 5.A. While the tendon is pulled from the dorsum, the vasculonervous bundles and the *Flexor Pollicis Longus* tendon should be protected in the palmar wound, so that the plasty is directly applied on the volar plate without the interposition of any structure. 4.B. Tugging the tendon of the EPB induces metacarpophalangeal flexion. 4.C. Now, the tenodesis is fixed with the desired degree of metacarpophalangeal joint flexion by introducing an 3x8 mm interference screw in the metacarpal tunnel. 4.D. Surgical wounds closure.

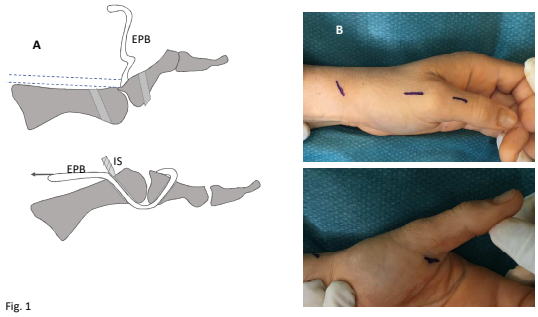

Fig. 1

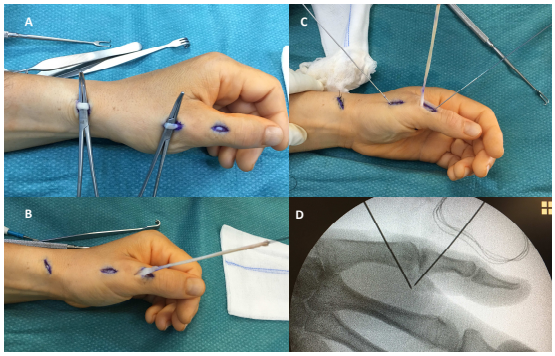

Fig. 2

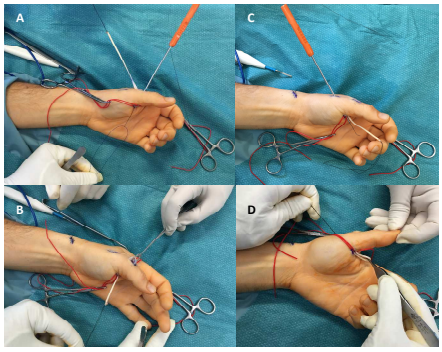

Fig. 3

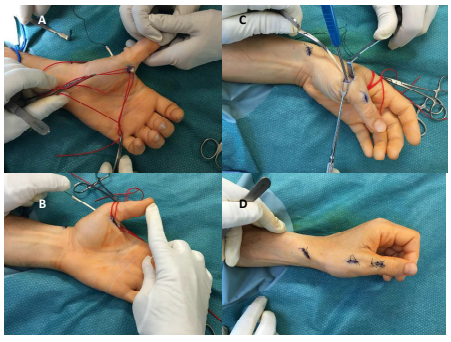

Fig. 4