Comparative Study

THE TRANSOSSEUS PULL-OUT AND SUTURE ANCHOR REPAIRING TECHNIQUE IN THE TREATMENT OF ACUTE ULNAR COLLATERAL LIGAMENT INJURIES OF THE THUMB A COMPARISON OF TWO DIFFERENT SURGICAL APPROACHES

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ABSTRACT

Injury of the ulnar collateral ligament (UCL) of the thumb represents a common condition that has frequently been described in athletes like skiers but also may occur in other sports such as soccer, volleyball, basketball and rugby. Many treatment choices exist; it depends on the severity of injury, timing of presentation, patient's comorbidity and associated soft tissue lesion. Grade I and II injuries may benefit from conservative treatment; a surgical approach is mandatory in case of a complete tear. The most used repair methods include the transosseous pull-out suture technique and reinsertion with a mini-anchor. This study aims to evaluate and compare the two surgical techniques in terms of functional and rehabilitative outcomes. From September 2020 to February 2022, 29 patients with a clinical and instrumental confirmed diagnosis of LCU injury of the thumb were recruited from the Orthopedics and Traumatology Unit of Policlinico of Bari. Sixteen patients underwent surgery with anchor repair; instead, 13 patients were treated with the pull-out technique. In the postoperative period, the patients were followed at first monthly, then at 6 months and at least 12 months. Sixteen patients (11 men, 5 women) underwent repair with an anchor; 13 patients (9 men, 4 women) underwent surgery with a pull-out technique. The anchor-treated cohort showed faster recovery of range of motion in flexion than the second group (P-value 0.046668). In contrast, no statistically significant difference was found in the extension recovery. At 6 months follow-up, the strange recovery was 94.4% for patients treated with anchors compared with 95.33% in patients operated with transosseous pull-out. The improvement of the pincer grip at 6 months in the anchor-treated cohort was 96.4%, while it was 94.96% in the other group. At least stability tests showed overlapping results. The two methods are found to be safe and effective for treating acute LCU injuries of the thumb. However, sutures with anchors allow earlier rehabilitation, which could eventually explain the better range of motion achieved by the patient treated with anchors 6 months after surgery compared with patients undergoing pull-out surgery. Despite the better functional and strength outcomes observed in the group of patients undergoing anchor repair, there is no significant

Received: 28 May 2023
Accepted: 02 July 2023

difference between the two groups to justify the superiority of one technique over the other from a prognostic point of view.

KEYWORDS: *ulnar collateral ligament, thumb, free tendon graft, rupture, avulsion fracture, surgery*

INTRODUCTION

The injury of the ulnar collateral ligament (UCL) of the thumb, also known as the skier's thumb, may occur due to a sharp joint sprain following trauma in violent hyperabduction. This sudden movement causes the ligament to rupture. The most common site of injury is the base of the proximal phalanx of the thumb, but in some cases, the injury may affect the head of the metacarpal or its intermediate tract (1, 2). In 1962, Stener pointed out that in the case of a complete laceration of the ulnar collateral ligament, the main problem was the absence of spontaneous scarring due to the interposition of adductor aponeurosis. Also referred to as Stener's injury, it is believed that this soft tissue interposition precludes healing (1, 2). That is why Stener's injury often requires surgery. It is now widely accepted that a complete lesion of the ulnar collateral ligament must be repaired to avoid laxity, weakness and chronic pain regardless of the presence or absence of a Stener injury (1, 3).

Different surgical techniques have been used for UCL rupture, such as the dynamic transfer of the adductor pollicis tendon, ligament reconstruction with tendon graft, MCP fusion or adductor advancement (4, 5).

The aim of the current study is to compare the functional outcomes of two different surgical techniques in two cohorts of patients with complete ulnar collateral ligament rupture of the metacarpophalangeal joint of the thumb after treatment with two different surgical techniques. The first group underwent surgery with anchor repair, while the second group was treated with an intraosseus pull-out suture technique. Afterwards, in both cases, the limb was immobilized in plaster.

Anatomy

The stability of the first metacarpophalangeal joint is provided by static and dynamic stabilizers and by the articular surface itself. The MCP is a diarthrodial joint that allows six degrees of movement: flexion-extension, abduction-adduction and rotation are enabled. Static stability is provided by bony anatomy, collateral ligaments, volar plate and dorsal capsule; dynamic stability is provided by extrinsic (extensor pollicis longus, extensor pollicis brevis, flexor pollicis longus) and intrinsic (abductor pollicis brevis, flexor pollicis brevis, adductor pollicis) muscle groups.

The ulnar collateral ligament (UCL) is composed of two distinct bundles: the proper ulnar and the collateral ligament accessory (6).

The proper bundle of UCL originates below the metacarpal head and inserts at the base of the proximal phalanx. The accessory is more superficial, fused with the volar plate, and inserted at the proximal phalanx's base. The main function of the UCL is to provide resistance to stress in valgus and volar subluxation.

During extension, the accessory ulnar collateral ligament is in tension, while the proper bundle is lax. At about 30 degrees of flexion, the proper ulnar collateral ligament tightens up while the accessory bundle becomes lax (Fig.1a, b).

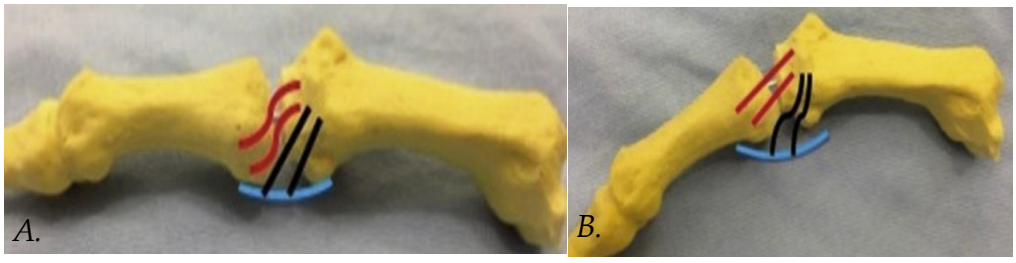


Fig. 1. *A and B):* The proper ulnar collateral ligament tightens up while the accessory bundle becomes lax.

Tolerable grades of laxity in physiological valgus are about 6 degrees in extension and 12 degrees in flexion (7-9) The UCL's primary function is to resist radial stress and volar subluxation (10, 11) (Fig. 2).

Fig. 2. *UCL's primary function is to resist radial stress and volar subluxation.*

Clinical presentation and imaging

The first assessment consists of an inspection of the joint. Ecchymosis, swelling, and oedema may be found; on palpation, the patient will experience pain as well as during extension and flexion of the thumb and weakness in the movement of prehension.

Radiographs should always be requested if patients have a history and clinical presentation suggestive of UCL injury. It may be useful to undergo stress views X-rays to evaluate the degree of laxity better.

Ultrasound (US) represents an additional noninvasive and inexpensive modality for the study of the UCL. This method shows accuracy ranging from 40% to 92%. A review of the literature on ultrasound examination of the UCL lesion shows a sensitivity of 76%, specificity of 81%, accuracy of 81%, positive predictive value of 74%, and negative predictive value of 87% (12).

Magnetic resonance imaging (MRI) can be very helpful in pursuing UCL injury, especially when ultrasound examination is not diriment or of unambiguous interpretation. Another method is arthrography, which is even more accurate than MRI alone. A sensitivity and specificity of 100% has been reported with MRI compared with 88% and 83% of ultrasound, respectively (13, 14).In order to describe the extent of the lesion, a UCL Instability Grading System is used:

- Grade 1: incomplete tear, sprain without instability
- Grade 2: incomplete tear with asymmetric joint laxity but endpoint present
- Grade 3: complete tear with joint instability without endpoint with more than 30-35° of joint space opening or 10-15° more than the contralateral thumb

Non-operative treatment

Immobilization in a splint or cast for 4 to 6 weeks could be considered a valid option in patients with Grade 1 and Grade 2 since these are partial injuries (4). Between the second and fourth week, physiotherapy can be started to recover movement while trying to avoid the valgus stresses of the MCF. In some cases, nonsurgical treatment has also been used with good outcomes in Grade III injuries. Some studies showed a good recovery of MCP function that appeared stable and pain-free in 85% to 90% of patients; however, the remaining patients continued to have pain and instability, eventually requiring surgical intervention. Therefore, nonsurgical treatment of grade III injuries should be considered cautiously (15, 16).

Regarding UCL lesions with an avulsion fracture, the literature appears quite conflicting. In cases of absence or minimal fragment displacement, conservative treatment with immobilization may be considered. The results, however, are very discordant: some studies show a recovery rate of 20% to 60% of cases, with total satisfaction of all patients not surgically treated; in other studies, however, patients reported persistent pain and instability after immobilization (17-19). Therefore, careful instrumental examination (X-ray and CT) is necessary to avoid misclassifying these fractures, leading to pseudoarthrosis and post-traumatic arthrosis with pain and stiffness (19).

Operative treatment

Surgical treatment is mandatory in case of acute Grade 3 injuries with more than 15° side to side variations of varus/valgus instability, more than >30-35° of opening and Stener lesion.

PATIENTS AND METHODS

Patients

From September 2020 until February 2022, 29 patients with a diagnosed lesion of the ulnar metacarpophalangeal collateral ligament (UCL) of the thumb were referred to the Orthopedics and Traumatology Unit of Policlinico di Bari. The patients mentioned above underwent surgical treatment for the repair of the injury. They were randomly divided into two groups: 16 patients underwent repair of the ULC with anchors, while the remaining 13 underwent repair by pull-out technique. After surgery, patients were followed up monthly for the first three months, then after six months, and at least annually. Follow-up data of the 29 patients included in the study were collected with a minimum latency of 6 months after surgery. This study did not consider patients with a follow-up of less than 6 months.

Methods

The same surgical team performed the postoperative evaluations in a dedicated clinic at each check. The surgical results were evaluated objectively, subjectively and radiographically. The objective evaluation consisted of stability by stressing the joint radically and ulnarly, range of motion of both extensor and flexor components of the thumb, and grip strength first of all fingers and then of the thumb individually. In our study, all patients underwent the Hand Grip Test, a specific test for hand grip strength. Patients were then objectively evaluated using a hand-held dynamometer n. EH101. These results were compared to the contralateral healthy hand. Subjective data consisted of pain and limitation of activity. For the first three months, patients were required to follow up radiographically with X-rays in two projections of the wrist and hand.

Statistic evaluation

Continuous variables were reported as means and standard deviations (SD); categorical variables, on the other hand, as numbers and percentages. A p-value <0.05 was statistically significant; analyses were performed using SPSS 22.0 (IBM Corp., Armonk, NY, USA).

Surgical technique

Twenty-nine patients in our study were divided into two groups according to the surgical technique they underwent: 13 patients treated with transosseous pull-out sutures and 16 patients treated with mini anchors.

Transosseus pull-out suture

A curvilinear cutaneous incision was made for access to the ulnar side of the first metacarpophalangeal joint, and then an incision of the aponeurosis of the adductors was made. Firstly, a capsulotomy and exploration of the ulnar collateral ligament of the first metacarpal phalange joint was performed, and the same joint was temporarily stabilized with transosseous K-wire (size 1.2 mm). Secondly, two transosseous tunnels were created in the proximal phalanx, and a pull-out of the UCL's accessory bundles was made. All patients underwent a fluoroscopic check. Then, the aponeurosis of the adductors and the overlying planes were sutured. At the end of the surgery, the limb was immobilized in a splint cast, and a postoperative X-ray was performed. The removal of the button in support of the suture was then carried out about 40 days after surgery after joint stability was assessed clinically, with specific tests, and radiographically.

Reinsertion with mini anchor

A curvilinear incision was made dorsally for access to the ulnar side of the first ray metacarpophalangeal joint. Then, an incision of the aponeurosis of the adductors was run. A capsulotomy and exploration of the ulnar collateral ligament of the first metacarpal phalange joint was performed, and the same joint was temporarily stabilized with transosseous K-wire (size 1.2 mm). At this point, with the aid of intraoperative fluoroscopy and after having assessed the joint instability in radial stress deviation, a 2.4 mm FASTack Arthrex anchor was inserted at the base of the proximal phalanx, and then the disengaged ulnar collateral ligament was retentioned. Afterwards, all patients were subjected to a fluoroscopic check with an assessment of the implant stability, and then they underwent adductors aponeurosis and overlying plane suture. At the end of the surgery, each patient was treated with immobilization in a cast and subsequent postoperative RX control.

RESULTS

Twenty-nine patients with UCL lesions of the thumb underwent surgical treatment; 16 (55.17%, of which 11 men and 5 women) were subjected to surgical treatment with mini-anchor repair and 13 (44.83%, of which 9 men and 4 women) instead, undergone surgery with pull out technique.

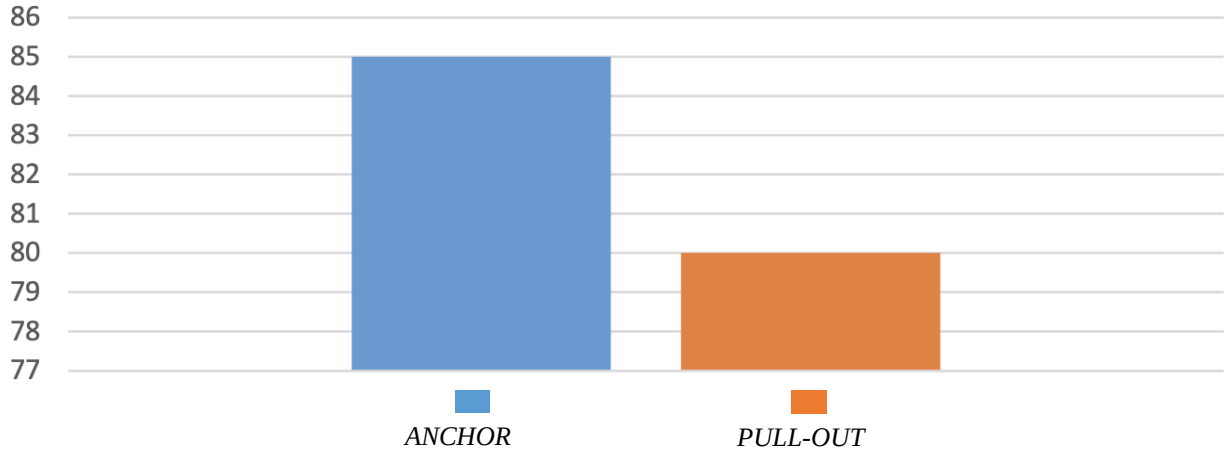
Patients' ages range from a minimum age of 23 to a maximum of 59 years, with an average age of 41.86 years. The average age of women at the time of surgery is 36.78 years, that of men over 44.15 years.

The lesion of the ulnar collateral ligament found among the patients is secondary in 79.31% to an established trauma; in 20.69% of the cases, it was impossible to find an objective cause, neither traumatic nor of other nature. In the sample of traumatized patients, 52.17% reported sports trauma, 43.48% following an accidental fall, and only in one case (4.35%) a car crash.

Range of motion

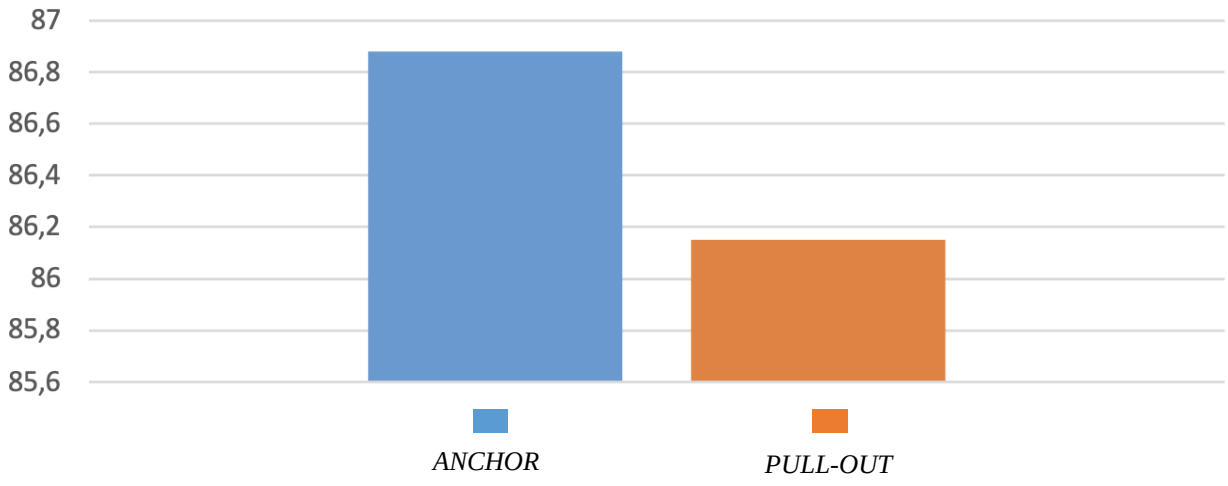
At the six-month follow-up, the range of motion (ROM) was evaluated individually in flexion and extension, from 0° to 90°, of all fingers and the thumb. Patients undergoing surgical treatment with an anchor recovered the range of flexion motion earlier than those treated with a pull-out technique (Table I).

Table I. *MCP flexion R.O.M at six month follow-up (85±6.32 vs 80±9.13, T-value 1.7395. P-value 0.046668).*



Regarding the range of motion in extension, a complete recovery was recorded in almost all patients 6 months after surgery; there was no statistically significant difference between the two groups, so the results could be considered comparable (Table II).

Table II. *MCP extention R.O.M at six month follow-up* (86,88±4,79 vs 86,15±5,06, T-value 0.39319. P-value 0.348633.



Grip and pinch strength

The grip strength (expressed in kilogram) was evaluated 6 months after the surgery, both for the mini-anchor treated group (Table III) and for the pull-out treated cohort (Table IV).

Table III. *Recovery of Grip and pinch strength in the affected arm vs contralateral healthy side in patient undergone surgical suture anchor at six-month follow-up (41.93 vs 44.42).*

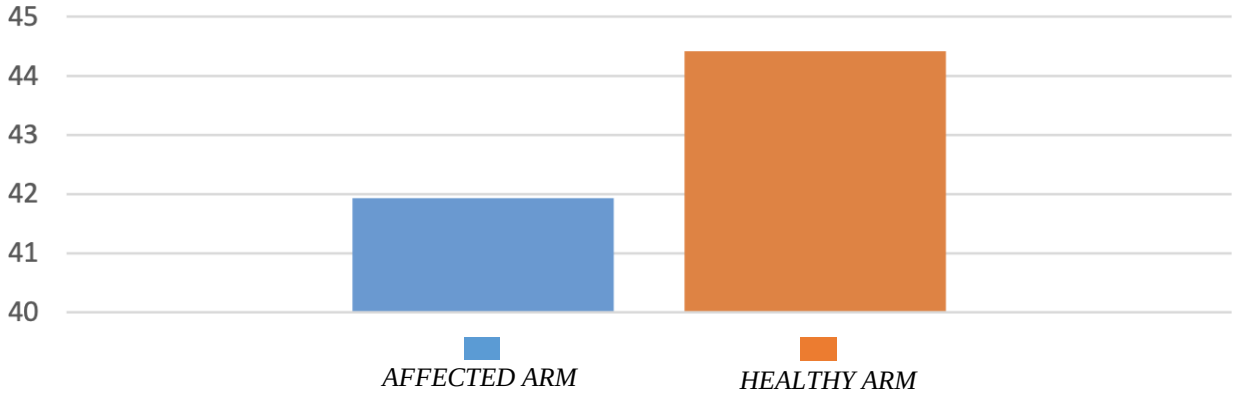
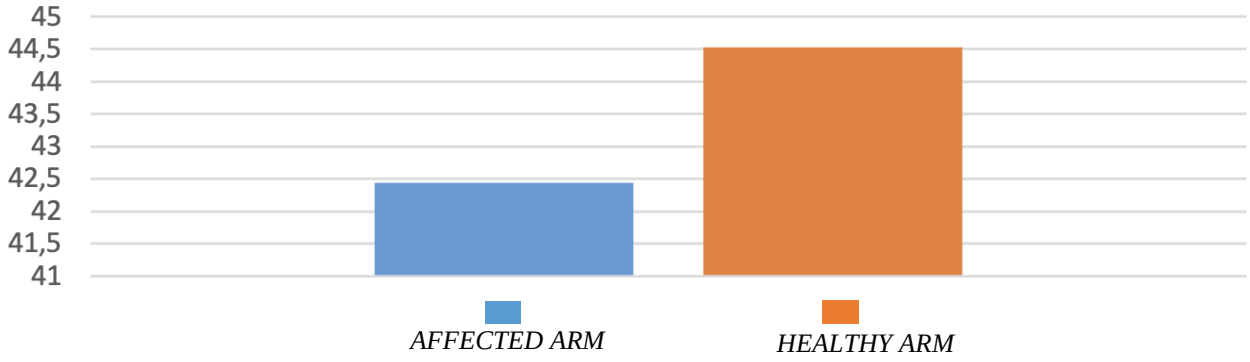


Table IV. *Recovery of Grip and pinch strength in the affected arm vs contralateral healthy side in patient undergone surgical transosseus pull-out suture at six month follow up (42.44 vs 44.52).*



Due to the significant heterogeneity of data (gender and age particularly), a comparison between the strength of both limbs was preferred. Both groups showed a progressive recovery of strength, equal to 94.4% in patients operated with an anchor and 95.33% in patients with transosseous pull-out. However, no statistically significant differences were found between the two groups. Six months after surgery, neither technique effectively recovered the grip strength and the pinch strength (p-value 0. 474862 with $p<0.05$). All data collected among the patients undergoing the study align with those described in the literature. Regarding the grip strength related only and exclusively to the thumb, the recovery of strength at 6 months in patients who underwent operation with an anchor was 96.4%, while it was 94.96% in patients operated with the pull-out technique (Tables V and VI).

Table V. *Recovery of Grip strength in the affected thumb vs contralateral healthy side in patient undergone surgical suture anchor at six-month follow-up (11.79 vs 12.23).*

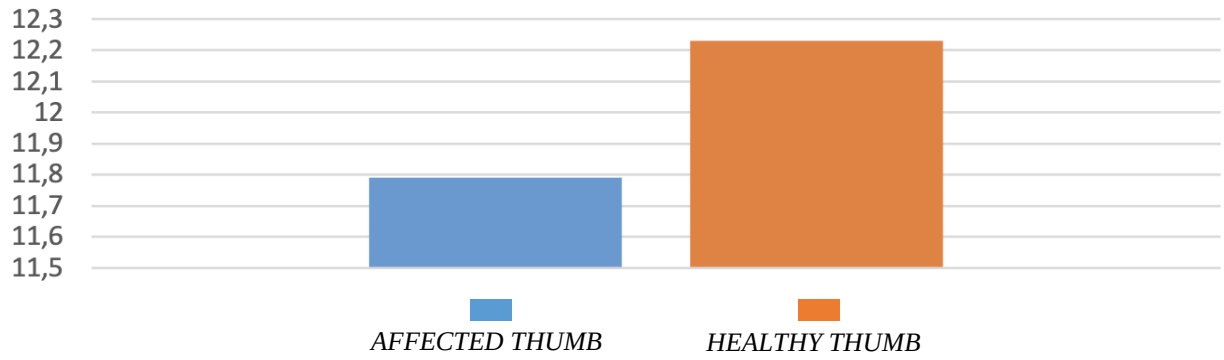
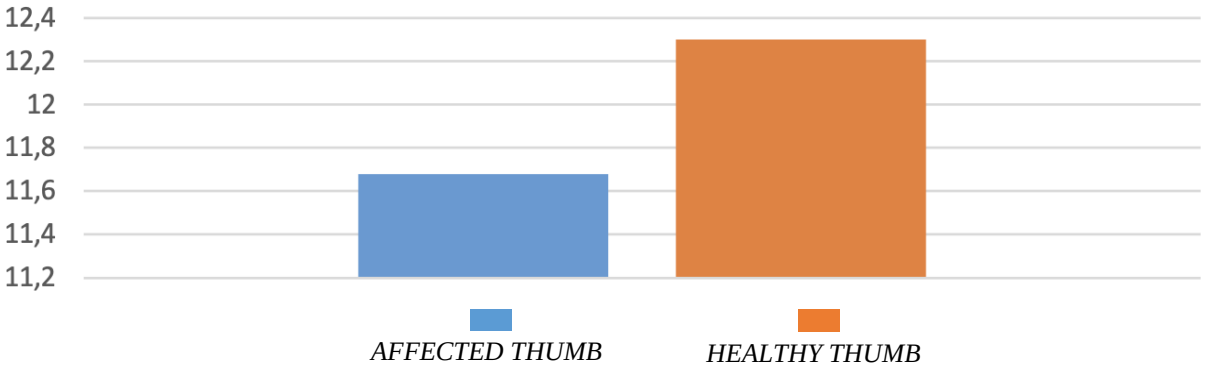


Table VI. *Recovery of Grip strength in the affected thumb vs contralateral healthy side in patient undergone surgical transosseus pull-out suture at six month follow up (11.68 vs 12.30).*



However, no statistically significant differences were found between the two groups (p-value 0. 212868 with $p<0.05$).

Stability

Joint stability was assessed by exerting ulnar stress at the metacarpophalangeal joint of the first finger. Data were collected from 10° to 30° (1 patient in both groups). No statistically significant differences were found between the two groups examined.

In addition to the clinical evaluation six months after the surgery, an evaluation questionnaire (Table VII) was administered regarding the patient's quality of life. The team used the questionnaire for the upper limb DASH (Disability of the Arm, Shoulder and Hand), suitably modified to adapt to the anatomical district considered and the type of surgery performed. The questionnaire is based on a total of 31 items.

Patients expressed numerical evaluation for each item from a minimum value of 1 (no difficulty) to a maximum value of 5 (unable).

The comparison between the two groups did not provide a statistically significant difference at six months. However, the patients who were operated on with anchor showed a higher level of satisfaction (average value 4.05) compared to patients who had undergone surgery with the pull-out technique (mean value 3.85) (Table VII).

Table VII. *Evaluation questionnaire.*

• To unscrew the lid of a tightly closed jar
• Writing
• To turn a key
• To prepare a meal
• To open a heavy door by pushing
• Doing heavy housework (e.g. washing floors or windows)
• Gardening
• Making the bed
• To carry a shopping bag
• To lift a heavy object (over 5 kg)
• To wash or dry your hair
• Using a knife
• Leisure activities requiring little effort (e.g. playing cards, knitting)
• Recreational activities
• How much the hand problem interfered with normal social activities with family, friends, etc.
• How much the hand problem has limited the work or other routine daily activities
• Pain
• Hand pain in any specific activity
• Tingling
• Weakness
• Stiffness
• How difficult it was to sleep due to hand pain
• How less capable it was to feel, less confident or less useful due to hand problem
• Difficulty in using the usual technique to work
• Difficulty in doing normal work due to hand pain
• Difficulty in doing the job well
• Difficulty in devoting the usual amount of time to work
• Any difficulty playing the musical instrument or playing sports
• Any difficulty in playing musical instruments or playing sports because of hand pain?
• Difficult playing the musical instrument or playing sports as well as you would like
• Difficulty in devoting the usual amount of time to the musical instrument or sport

DISCUSSION

The purpose of the study was to compare two surgical techniques for the repair of acute ulnar collateral ligament injury of the thumb. The groups were divided randomly by age and sex. Specifically, the repair of UCL with anchor and the transosseous pull-out have been considered. The parameters that the study focused on at 6 months follow-up were the thumb's range of motion in flexion and extension, the joint's stability, the grip and pinch strength of the hand and of the thumb itself, objectified by the dynamometer.

The technique with anchors has proved more manageable in the execution, with lower ischemia times and no intra-operative and postoperative complications. The pull-out technique has also been shown to be free of adverse events; despite everything, the surgical time with the latter technique lengthens considerably the times of ischemia, however,

without any complication at the six-month follow-up. In scientific literature, only two works have considered the comparison between these two surgical methods (1, 19).

Both works considered parameters similar to our study, such as joint range of movement, grip strength, overall patient satisfaction, costs, and documented ischemia times. The statistically significant differences found in these two studies relate to two parameters: the thumb range of motion in flexion at 6 months of follow-up, which establishes superiority in the short term of the group undergoing surgery with anchor and the time of ischemia, significantly higher in patients undergoing surgery with a pull-out technique. In addition, many adverse events have also been reported and documented in patients undergoing surgery with pull-out (e.g., erythema, infections) (1).

The pull-out technique presents greater difficulty in execution, longer time and more accurate surgical preparation (1, 19); it is usually a surgical procedure that requires more surgical experience.

In the above studies (1, 19) and ours, the presence of the button in the transosseous pull-out suture technique seems less welcome by the patient. Its maintenance in place for a minimum period of 30 days post-surgery has thus adversely affected the beginning of physiotherapy, delaying the healing. This last aspect could determine a statistical significance regarding the best recovery at six months of the thumb range of motion in flexion in patients undergoing treatment with anchor repair.

Partial data at 1-year follow-up (not included in the study because they affect a very small percentage of the patients under study) appear to show the disappearance of the above discrepancies with complete recovery of joint ROM fully comparable to the healthy limb.

CONCLUSION

Both methods are safe and effective for treating acute ulnar collateral ligament injuries of the thumb. However, suture with anchors allows an earlier rehabilitative protocol, which could explain the better range of motion achieved at 6 months postoperatively by the patient treated with anchors, compared with patients undergoing surgery with the pull-out technique. Further conclusions could be drawn from the prosecution of the present study and the addition of new evaluative parameters.

REFERENCES

1. Weiland AJ, Berner SH, Hotchkiss RN, McCormack RR, Jr., Gerwin M. Repair of acute ulnar collateral ligament injuries of the thumb metacarpophalangeal joint with an intraosseous suture anchor. *J Hand Surg Am.* 1997;22(4):585-591. doi:https://doi.org/10.1016/S0363-5023(97)80113-X
2. Stener B. Hyperextension injuries to the metacarpophalangeal joint of the thumb: rupture of ligaments, fracture of sesamoid bones, rupture of flexor pollicis brevis. An anatomical and clinical study. *Acta Chir Scand.* 1963;125(275-293.
3. Arranz Lopez J, Alzaga F, Molina J. Acute ulnar collateral ligament injuries of the thumb metacarpophalangeal joint: an anatomical and clinical study. *Acta Orthop Belg.* 1998;64(4):378-384.
4. Samora JB, Harris JD, Griesser MJ, Ruff ME, Awan HM. Outcomes after injury to the thumb ulnar collateral ligament--a systematic review. *Clin J Sport Med.* 2013;23(4):247-254. doi:https://doi.org/10.1097/JSM.0b013e318289c6ff
5. Fusetti C, Papaloizos M, Meyer H, Borisch N, Della Santa D. The ECRL bone-tendon ligamentoplasty for chronic ulnar instability of the metacarpophalangeal joint of the thumb. *Chir Main.* 2005;24(5):217-221. doi:https://doi.org/10.1016/j.main.2005.08.003
6. Johnson JW, Culp RW. Acute ulnar collateral ligament injury in the athlete. *Hand Clin.* 2009;25(3):437-442. doi:https://doi.org/10.1016/j.hcl.2009.05.014
7. Scarano A, Orsini T, Di Carlo F, Valbonetti L, Lorusso F. Graphene-Doped Poly (Methyl-Methacrylate) (Pmma) Implants: A Micro-CT and Histomorphometrical Study in Rabbits. *Int J Mol Sci.* 2021;22(3):doi:https://doi.org/10.3390/ijms22031441
8. Mogensen BA, Mattsson HS. Post-traumatic instability of the metacarpophalangeal joint of the thumb. *Hand.* 1980;12(1):85-90. doi:https://doi.org/10.1016/s0072-968x(80)80036-2
9. Moberg E, Stener B. Injuries to the ligaments of the thumb and fingers; diagnosis, treatment and prognosis. *Acta Chir Scand.* 1953;106(2-3):166-186.
10. Cooney WP, 3rd, Chao EY. Biomechanical analysis of static forces in the thumb during hand function. *J Bone Joint Surg Am.* 1977;59(1):27-36.
11. Palmer AK, Louis DS. Assessing ulnar instability of the metacarpophalangeal joint of the thumb. *J Hand Surg Am.* 1978;3(6):542-546. doi:https://doi.org/10.1016/s0363-5023(78)80003-3

12. Hergan K, Mittler C, Oser W. Ulnar collateral ligament: differentiation of displaced and nondisplaced tears with US and MR imaging. *Radiology.* 1995;194(1):65-71. doi:https://doi.org/10.1148/radiology.194.1.7997584
13. Papandrea RF, Fowler T. Injury at the thumb UCL: is there a Stener lesion? *J Hand Surg Am.* 2008;33(10):1882-1884. doi:https://doi.org/10.1016/j.jhsa.2008.09.025
14. Ahn JM, Sartoris DJ, Kang HS, et al. Gamekeeper thumb: comparison of MR arthrography with conventional arthrography and MR imaging in cadavers. *Radiology.* 1998;206(3):737-744. doi:https://doi.org/10.1148/radiology.206.3.9494494
15. Landsman JC, Seitz WH, Jr., Froimson AI, Leb RB, Bachner EJ. Splint immobilization of gamekeeper's thumb. *Orthopedics.* 1995;18(12):1161-1165. doi:https://doi.org/10.3928/0147-7447-19951201-06
16. Pichora DR, McMurtry RY, Bell MJ. Gamekeepers thumb: a prospective study of functional bracing. *J Hand Surg Am.* 1989;14(3):567-573. doi:https://doi.org/10.1016/s0363-5023(89)80026-7
17. Kuz JE, Husband JB, Tokar N, McPherson SA. Outcome of avulsion fractures of the ulnar base of the proximal phalanx of the thumb treated nonsurgically. *J Hand Surg Am.* 1999;24(2):275-282. doi:https://doi.org/10.1053/jhsu.1999.0275
18. Sorene ED, Goodwin DR. Non-operative treatment of displaced avulsion fractures of the ulnar base of the proximal phalanx of the thumb. *Scand J Plast Reconstr Surg Hand Surg.* 2003;37(4):225-227. doi:https://doi.org/10.1080/02844310310016395
19. Dinowitz M, Trumble T, Hanel D, Vedder NB, Gilbert M. Failure of cast immobilization for thumb ulnar collateral ligament avulsion fractures. *J Hand Surg Am.* 1997;22(6):1057-1063. doi:https://doi.org/10.1016/S0363-5023(97)80049-4