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Arthroscopy and Tenoscopy in the Treatment of 6th Compartment Tenosynovitis: Technical Description and Series of Patients

Artroscopia y Tenoscopia en el Tratamiento de la Tenosinovitis del Sexto Compartimento: Descripción Técnica y Serie de Pacientes

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Abstract

We call tenoscopy the procedure where an endoscopic approach to tendon sheaths is performed. It has already been described for the treatment of ankle, elbow, shoulder, wrist, and hand disorders. We have treated with tenoscopy a series of eight wrists in six patients with chronic inflammatory processes of the sixth extensor compartment of the wrist with no improvement with initial conservative treatment. The procedure begins with an arthroscopy of the radiocarpal and midcarpal spaces to rule out other intra-articular causes of ulnar-sided pain in the wrist. Then, through the 6R portal, the capsule, and the deep portion of the sheath of the extensor carpi ulnaris are resected, gaining access to the inside aspect of the sixth compartment. With the full view of the inner sixth compartment, a specific portal is created for the extensor carpi ulnaris located two centimeters proximal to the joint. Then a wide synovectomy of the compartment is performed with a shaver, both proximal and distal to the joint. The dorsal sensitive branch of the ulnar nerve remains safe throughout the procedure. We have performed a tenoscopy of the sixth extensor compartment in eight wrists of six patients who had failed conservative treatment and obtained great improvement of symptoms with the procedure, with no serious complications or lesion recurrence. Tenoscopy of the extensor carpi ulnaris allows synovectomy of the sixth extensor

Keywords
- wrist pain
- extensor carpi ulnaris
- tenosynovitis
- wrist ulnar-sided pain
- arthroscopy portals
- wrist arthroscopy complication

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compartment, preserving the extensor retinaculum. With a minimally invasive approach, this procedure causes less local damage to soft tissues, with less scar tissue formation when compared with classic open procedures. By using a clear view of the compartment through tenoscopy, the risk of adhesions and injury to the ulnar extensor tendons is decreased.

Resumen

Denominamos tenoscopia al procedimiento en el que se realiza un abordaje endoscópico de las vainas tendinosas. Ya se ha descrito para el tratamiento de trastornos de tobillo, codo, hombro, muñeca y mano. Hemos tratado con tenoscopia una serie de ocho muñecas en seis pacientes con procesos inflamatorios crónicos del sexto compartimento extensor de la muñeca sin mejoría con tratamiento conservador inicial. El procedimiento comienza con una artroscopia de los espacios radiocarpiano y mediocarpiano para descartar otras causas intraarticulares de dolor en el lado cubital de la muñeca. Luego, a través del portal 6R, se reseca la cápsula y la porción profunda de la vaina del extensor carpi ulnaris, accediendo a la cara interna del sexto compartimiento. Con la vista completa del sexto compartimento interno, se crea un portal específico para el extensor carpi ulnaris ubicado dos centímetros proximal a la articulación. Luego se realiza una sinovectomía amplia del compartimiento con rasuradora, tanto proximal como distal a la articulación. La rama sensible dorsal del nervio cubital permanece segura durante todo el procedimiento. Hemos realizado tenoscopia del sexto compartimento extensor en ocho muñecas de seis pacientes en los que había fracasado el tratamiento conservador y hemos obtenido una gran mejoría de los síntomas con el procedimiento, sin complicaciones graves ni recidiva de la lesión. La tenoscopia del extensor carpi ulnaris permite la sinovectomía del sexto compartimento extensor, conservando el retináculo extensor. Con un enfoque mínimamente invasivo, este procedimiento causa menos daño local a los tejidos blandos, con menos formación de tejido cicatricial en comparación con los procedimientos abiertos clásicos. Al utilizar una visión clara del compartimento a través de la tenoscopia, se reduce el riesgo de adherencias y lesiones en los tendones extensores cubitales.

Palabras clave
- dolor de muñeca
- extensor carpi ulnaris
- tenosinovitis
- dolor en el lado cubital de la muñeca
- portales de artroscopia
- complicación de la artroscopia de muñeca

Introduction

Pain on the ulnar side of the wrist is a common symptom of several diseases such as tendinitis of the extensor carpi ulnaris (ECU) and flexor carpi ulnaris (FCU), arthrosis between the pisiform and the triquetrum, lesion of the triangular fibrocartilage complex (TFCC), ulnocarpal impingement syndrome, instability of the distal radioulnar joint (DRUJ), and lesion of the lunotriquetral ligament, among others. The complexity of the structures and the proximity of the anatomical sites make the diagnosis difficult, even when high-definition imaging exams are available.[1–3]

Stenosing tenosynovitis of the sixth extensor compartment of the wrist (SECW) was first described in 1927, comprising a disease that is like the first compartment lesion as described by De Quervain. It is a tendon inflammatory process that may be caused by rheumatic diseases, bone friction after ulnar styloid process fracture, impact by a prominent styloid process, distal ulnar instability, or overload generated by repetitive activities in pronation and ulnar deviation of the wrist. Thus, the ECU tendon sheath becomes inflamed, generating tendon swelling and compression within the compartment.[4–8] Initial treatment is performed with conservative measures, being effective in most patients. However, unresponsive lesions or those with chronic involvement may require surgical treatment, and open tenosynovectomy is the standard treatment, with the release of the compartment and resection of inflammatory tissue from both the tendon and adjacent structures.

Tenoscopy can be used to perform an endoscopic exploration of the inside aspect of the tendon sheath, and this procedure has been described for the treatment of ankle, elbow, shoulder, wrist, and hand diseases.[9–12]

We report a series of eight wrists operated with ECU tenoscopy in six patients with chronic tenosynovitis of the ECU, along with description details of the technique and results.

Methods

Retrospectively, from January 2018 to December 2021, all patients treated with SECW tenoscopy with tenosynovitis of the ECU refractory to conservative treatment for at least four

months were assessed and included in the study. We have included in the series eight tenoscopies in six patients.

Patients who presented instability of the ECU tendon within the sixth compartment, patients who underwent associated bone procedures, and patients who presented degenerative changes of the DRUJ associated with tenosynovitis were excluded. For this purpose, all patients were submitted to radiographs and magnetic resonance imaging before surgery.

Anatomy and Biomechanics

Omokawa et al.[13] divided the ECU tendon into three zones. Zone I is located at the ulnar groove; zone Il at the ulnar styloid; and zone III at the triquetrum. The anatomical differences of the sheaths and stabilizing structures in each zone are considerable and must be taken into consideration when treating diseases and synovitis of the ECU.

In Zone I, the tendon of the ECU runs onto a groove at the distal ulna and is stabilized by the extensor retinaculum that attaches to the radius, ulna, and to the carpal bones. In its deep portion, the ECU tendon has a sheath, which is a connective tissue structure attached to the retinaculum and the floor of the sixth compartment.

A little more distal, leaving the ulnar bone groove, at zone II, the sheath is more tense and connects the ECU tendon to the ulnar styloid process and to the dorsal radioulnar ligament. There is also at this point a structure of parallel-oriented collagen fibers that connect the extensor retinaculum to the ulnar styloid called "*linea jugata*," which is important for tendon stabilization.

On the other hand, zone III, the most distal part of the ECU, in its path before inserting onto the base of the fifth metacarpal, is devoid of a deep sheath. However, there are extensions of the retinaculum in this area called retinacular septa, which can be ulnar and radial and are variably present in the population, keeping the ECU tendon near the triquetrum in a relatively stable position.

Another important anatomical aspect is the presence of accessory extensions of the ECU tendon that insert into different parts of the fifth metacarpal base and other dorsal structures. These anatomical variations may be an additional cause of pain seen in ECU tendinopathies, in addition to limiting wrist and little finger motion.[14,15]

Bone groove anatomy at the distal ulna is also variable.[16] Patients with shallow sulci have been associated with a higher risk of instability and, consequently, ECU tendinopathy. In such cases, when this change is confirmed, sulcus deepening may be a step in the treatment.[17]

Flexion and extension of the wrist and forearm rotation also influence the stability of the ECU tendon. Ghatan et al.[18] have shown the importance of the deep sheath of the ECU for stability. They have also pointed out that forearm supination and wrist flexion tend to generate a force that displaces the ECU tendon out of its groove. On the other hand, forced pronation, especially with wrist extension, squeezes the distal part of the subsheath, thus increasing pain in patients with an inflammatory process in the ECU and SECW.

Surgical Technique

Clinical aspects (►**Fig. 1**) and radiological findings (►**Fig. 2**) are revised before the procedure starts. With the patient supine and a pneumatic tourniquet applied to the proximal arm, the upper limb is positioned on the table for hand surgery. As in all wrist arthroscopies, the procedure is performed with the aid of a wrist traction tower, along with surgical finger traps (►**Fig. 3**).

The procedure begins with an inspection of the radiocarpal joint (RCJ) using portals ¾ and 6R to rule out other intra-articular diseases that may cause pain on the ulnar side of the wrist, such as ruptures of the TFCC, of the lunotriquetral

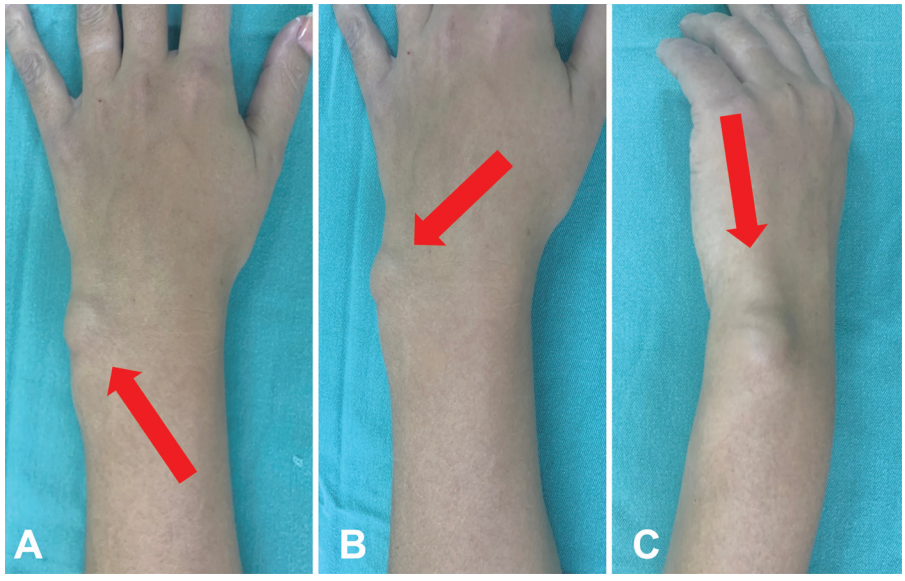

Fig. 1 A 38-year-old patient with chronic tenosynovitis of the sixth extensor compartment of the wrist (red arrow) due to rheumatoid arthritis (**A**, **B**, and **C**).

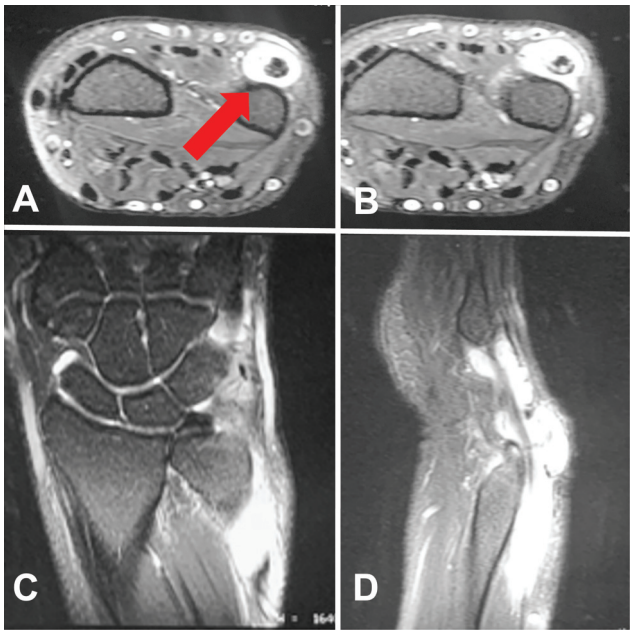

Fig. 2 MR images demonstrate tenosynovitis of the ECU (red arrow) with little intra-articular involvement. Transverse (**A** and **B**), coronal (**C**), and sagittal (**D**) views.

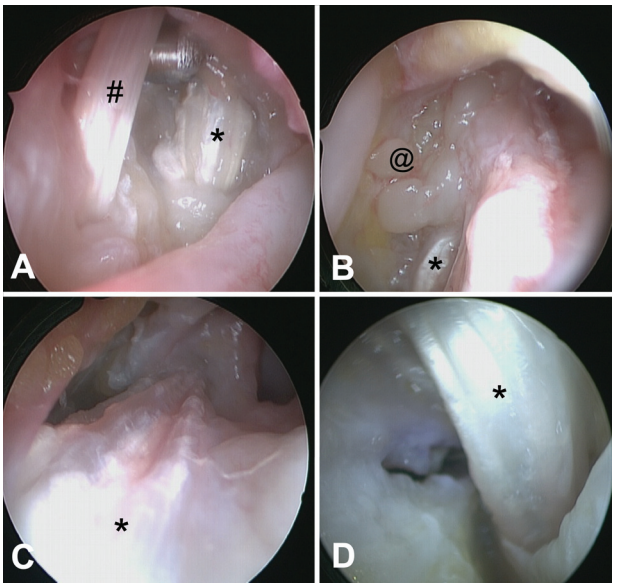

Fig. 4 Radiocarpal joint view, with the scope in portal ¾ and the shaver in portal 6R, between the tendons of the ECU and EDQ (**A**). View inside of the sixth extensor compartment, with the scope in portal 6U. There is extensive synovitis with inflammatory *pannus* throughout the region (**B**). Distal view of the extensor compartment after tenosynovectomy (**C**). Proximal view of the compartment after tenosynovectomy (**D**). # Extensor digiti quinti *Extensor carpi Ulnaris @ sinovite.

ligament and ulnocarpal impingement. Then, the midcarpal joint (MCJ) is evaluated for the same reason.

Next, using the shaver through the 6R portal, capsule resection is performed ulnar to the 6U portal along with the deep portion of the ECU sheath, allowing ECU tendon visualization and subsequent optics entry within the sixth extensor compartment (►**Fig. 4**). Then, with the optics in the 6R portal, a proximal ECU portal is created, located two centimeters proximal to the distal end of the ulna. We can use a needle to define the correct position of this portal, looking with the scope inside the compartment, thus using the outside-in technique. In this location, by using the 6R and proximal ECU portals, we were able to directly visualize the inside of the compartment, preserving the extensor retinaculum that is fixed on the most distal part of the ulna, and the ECU tendon. Moreover, due to portal placement, the sensory branches of the ulnar nerve are protected, as they are more distally and ulnarly located to the portal of the ECU. In case of a very extensive synovitis, a second specific portal to the ECU may also be created at two centimeters distally to the distal ulna, the so-called distal ECU portal.

After the portals are created, the synovectomy of the ECU tendon and the internal sheath of the sixth compartment is performed both proximally and distally to the joint (►**Fig. 5**).

Before portal closure, the tourniquet is released to check the integrity of the vascular bundles. The incisions are stitched with 5–0 monofilament nylon sutures. Note the

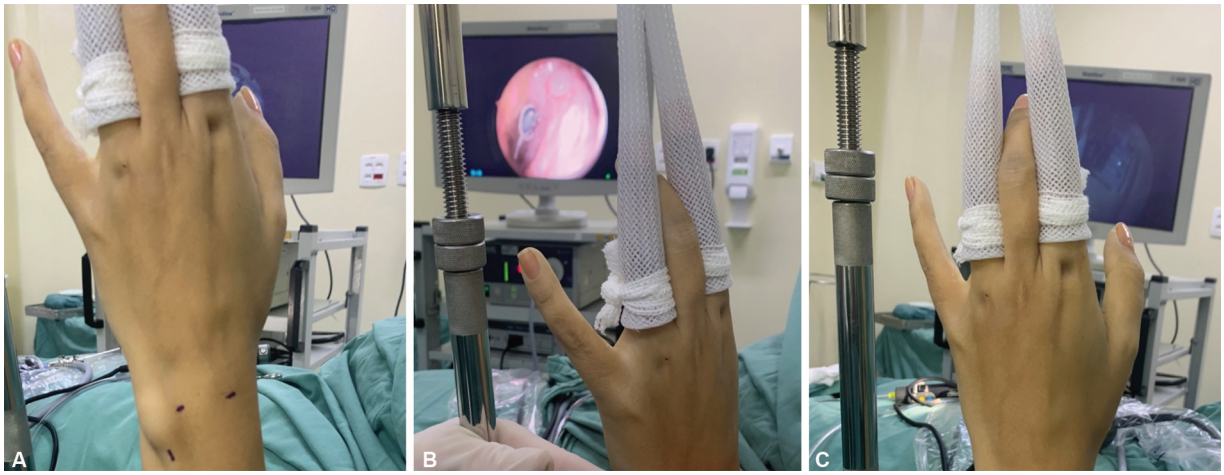

Fig. 3 Initial treatment with classic arthroscopy technique (**A**). Tenoscopy proceeds with the scope in the 6R portal. Treatment is performed with the scope inserted through the 6R portal and instrumentation through the proximal portal of the specific ECU (proximal ECU) portal (**B**). Complete resolution of the increased volume due to synovitis (**C**).

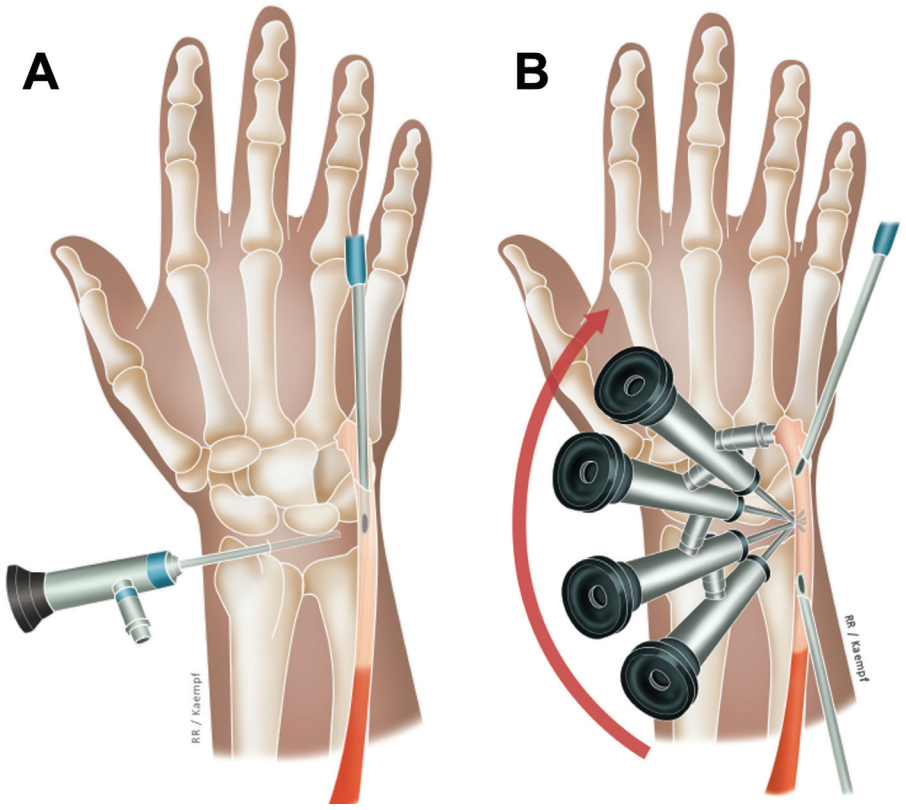

Fig. 5 Schematic drawing of the technique for ECU synovectomy. The scope is in the portal ¾ showing the deep portion of the sheath of the ECU during a shaving procedure of the ECU synovitis with the shaver in the portal 6R (**A**). Subsequently, with the scope in the 6R portal, it is possible to visualize the inner part of the sixth compartment and the proximal and distal ECU sheath. The shaver can then be positioned in ECU-specific portals (proximal or distal) for synovectomy (**B**).

postoperative appearance demonstrating complete resolution of the edema (►**Fig. 6**). Sterile dressings with sterile gauze and bandages are applied and a short-arm plaster slab is used, immobilizing the wrist for a short period of time until the dressing is changed, which occurs three to seven days after surgery. After the immobilization period, the operated wrist is left with free motion, and patients are instructed to use a removable orthosis on the dependence of their pain.

Patients were followed on an outpatient basis, with weekly consultations for a month and then with quarterly assessments. In general, patients are not submitted to a specific rehabilitation protocol with a hand therapist. They are oriented to perform stretching exercises and gain mobility and strength at home.

Case Series

We have treated eight wrists of six patients in the last four years using the tenoscopy technique as described above. Most patients had a previous diagnosis of rheumatoid arthritis or another chronic rheumatic disease, were treated with disease-modifying antirheumatic drugs, and with no previous invasive procedures performed on the wrist.

Clinical and epidemiological data of the patients are summarized in ►**Table 1**. There were five female patients and one male patient. The mean age on the day of the procedure was 54.6 years, ranging from 38 to 68 years. Of the eight operated wrists, six were on the right side and two on the left side; two patients underwent bilateral procedures at different times (wrists ½ and ¾). Four patients had rheumatoid arthritis, one patient had lupus and one had hypothyroidism. The mean time of conservative treatment for wrist tenosynovitis prior to surgery was 5.1 months, ranging from 4 to 6 months. The mean postoperative follow-up was 17.9 months, ranging from 12 to 30 months.

To analyze pain, a visual analog scale was used on a ruler, ranging from zero (no pain) to 10 (maximum pain already experienced). Before surgery, patients reported an average of 7, ranging from 5 to 9. Postoperatively, the average pain was 1, ranging from zero to two. Thus, among the eight wrists operated, two remained with mild pain (score two on the scale) and have controlled pain symptoms with medication.

There were no cases of infection, hypertrophic scarring, complex regional pain syndrome, or complications requiring a second procedure. There was also no recurrence of the lesion during follow-up. Regarding motion, all patients displayed complete recovery as compared with the motion before the procedure.

Regarding the treatment outcome reported by the six patients, we asked them to choose among the following options: very satisfied, satisfied, not very satisfied, and not satisfied. Of the total number of patients, five considered themselves very satisfied and one regarded to be satisfied.

Discussion

Ulnar-sided wrist pain is a common feature of many disorders, such as ECU and FCU tendinitis, arthrosis and DRUJ instability, TFCC injuries, ulnocarpal impingement syndrome, and lunotriquetral ligament injury, among others. Structure complexity and their proximity make diagnosis difficult, even when state-of-the-art imaging tests are available.[19]

Moreover, there may be a disease association. Kakar and Garcia-Elias[20] defined an algorithm named "Four-Leaf Clover" to diagnose and treat ulnar wrist lesions, showing that pathology at this region may be secondary to bone deformity, ECU instability, chondral defects, and TFCC lesions, and the association among them is common.

Another less frequent problem that may also create pain on the ulnar side of the wrist is ECU tenosynovitis. There has been growing interest in identifying, understanding, and treating this ECU pathology, which can often be resolved through minimally invasive procedures and surgeries that impose less damage upon healthy structures.

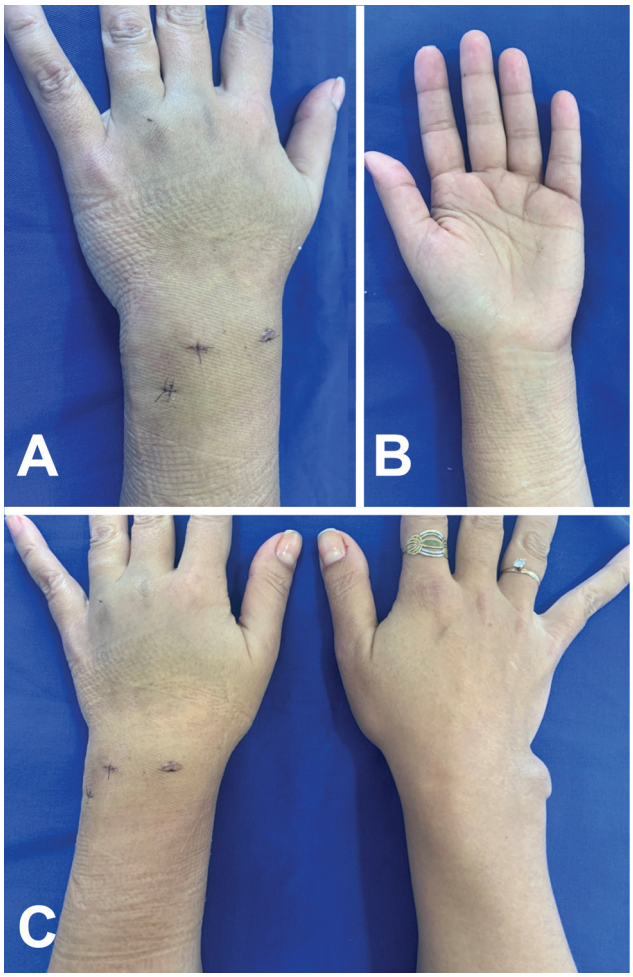

Fig. 6 Twelve days postoperatively from arthroscopy and tenoscopy showing access portals ¾, 6R, and proximal ECU. There is a complete disappearance of the increased volume caused by synovitis of the ECU, more evident when compared with the contralateral side that was operated on a few months later.

Table 1 List of treated patients, demographics and clinical data

Patient (wrist*)	Age	Gender	Dominance	Affected side	Underlying pathology	Time of conservative Treatment (months)	Time of follow up (months)	Pain VAS (pre op)	Pain VAS (post op)	Associated orthopedic conditions
1	67	F	R	R	RA	4	30	5	1	RL arthritis
2	67	F	R	L	RA	5	12	5	1	RL arthritis
3	38	F	R	R	RA	5	20	9	1	–
4	38	F	R	L	RA	6	18	9	1	–
5	43	F	R	R	RA	4	18	6	0	–
6	55	F	R	R	–	6	12	7	2	–
7	60	F	R	R	RA	5	15	8	0	–
8	68	F	R	R	HT	6	18	8	2	–

Abbreviations: F, female; HT, hypothyroidism; L, left; M, male; R, right; RA, rheumatoid arthritis; RL, radiolunate; VAS, visual analogue scale.
*some patients had bilateral involvement.

De Torres et al. described a safe and feasible way to visualize the ECU tendon and the inside aspect of SECW through ECU-specific arthroscopic portals, proposing that during a wrist arthroscopy that aims to investigate ulnar-sided pain, an important step to take is the assessment of ECU, as well as the deep sheath and the extensor retinaculum of the sixth compartment.[21]

As our series have shown, most patients with tenosynovitis of the ECU carry some rheumatic pathology, such as rheumatoid arthritis and lupus. In these patients, inflammatory pannus formation occurs within the SECW, which can compress and invade the ECU tendon and may even evolve to its rupture if left untreated.[9]

Other diseases such as gout, mycobacterial infections, and amyloid deposition diseases may also manifest as tenosynovitis of the sixth compartment.[9] Another possible cause for the appearance of an inflammatory process is the stenosing tenosynovitis of the ECU, generated by the thickening of the deep sheath of the sixth compartment, a collagen-rich structure that surrounds the entire tendon connecting to the ulnar sulcus, the dorsal radioulnar ligament, and the triquetrum and pisiform bones.

Treatment of patients with tenosynovitis of the ECU begins with conservative measures, with the use of drugs, orthotics, and ice. Chronic lesions that have not responded to conservative treatment may require surgical treatment. Synovectomy is the goal of the procedure, and the open technique is still the standard of care, with a wide release of the compartment and resection of inflammatory tissue, both from the ECU tendon and the adjacent structures located inside the sixth compartment.

Tenosynovitis of the ECU may also occur after traumatic or degenerative lesions of the structures responsible for ECU stability, such as the extensor retinaculum and its deep sheath. We know that the extensor retinaculum is fixed to the radius, ulna, triquetrum, and pisiform bones, restricting excessive motion of the ECU tendon during activities requiring wrist flexion and extension, as well as in lateral tilts, and forearm pronation-supination motion. In addition, in this region, there is a structure called "*linea jugata*," which is a connection of dense and longitudinally oriented collagen fibers connecting the deep sheath of the ECU and ulnar styloid process. Its injury generates instability of the ECU tendon, with pain on the ulnar side of the wrist, mainly during forced activities of supination, flexion, and ulnar deviation of the wrist; the patient may also notice a tendon snapping or giving way as it moves in and out of the ulnar groove during motion.[18] Patients with these symptoms were not included in our series and for them, in addition to synovectomy, some type of ECU stabilization is warranted. Thus, during the ECU tenoscopy procedure, one of the steps of the surgery should be to test the stability of the tendon, which can be done by moving the wrist in all planes and under the direct view of the tendon mobilized with the aid of a probe.

Another common cause of pain in this region is the rupture of the ECU tendon due to chronic and repeated friction onto bone irregularities, either caused by osteophytes or fracture sequelae. In these cases, the tendon must be repaired during the procedure and so must also the bone lesion.

During a tenoscopy of the ECU, it is important to perform a complete synovectomy of the entire inner part of the sixth extensor compartment, as residual synovitis may be a cause of postoperative pain. The potential risks of ECU tenoscopy, which include injury to the tendon, its subsequent instability, and damage to the dorsal sensory branches of the ulnar nerve are reduced upon the proper performance of the technique procedure. The proximal portal specific to the ECU tendon is safe and does not cause damage to the extensor retinaculum because it is created two centimeters proximal to the retinaculum. In addition, the dorsal sensory branch of the ulnar nerve is located distal and ulnar to the portal, remaining unharmed during the procedure. Because of that, we have not had any serious complications related to the procedure in our series.

Conclusion

The use of tenoscopy for the treatment of chronic tenosynovitis of the ECU proved to be a feasible and effective procedure. It is a reproducible, safe technique that leads to satisfactory outcomes. If the technique is correctly performed, the synovectomy is done safely, with no increased risk of ECU and to the dorsal sensitive branch of the ulnar nerve lesion and neither generates instability nor lesion of the extensor retinaculum.

It is a minimally invasive procedure with low morbidity, low risk of complications, and there were no recurrences in our series. We thus present good results with the treatment of tenosynovitis of the ECU through synovectomy by tenoscopy, which creates little scarring, the patient is immobilized for a short time, with rapid return to work and functional recovery. Considering the cost and learning curve, we emphasize that this technique is a good alternative to the classic open technique.

The advantage of this endoscopic and minimally invasive technique is the possibility of performing an extensive and safe tenosynovectomy with less scar tissue formation and less dissection, creating good cosmetic results. We observed less postoperative pain and stiffness during clinical follow-up, minimizing the risk of dystrophy and the formation of adhesions. In addition, simultaneous evaluation of differential or additional diagnoses can be performed, such as the assessment of TFCC, ulnar ligaments of the wrist, chondral surfaces of the carpus, and distal ulna, among others.

We thus advocate the use of ECU tenoscopy for the treatment of chronic tenosynovitis, as our series have shown excellent clinical results regarding motion maintenance and pain resolution, without significant complications or recurrences, and with high rates of patient satisfaction.

Declaration of Ethical Approval

The present study was submitted and approved by the Ethics Committee of our Institution.

Informed Consent Statement

There is no information (names, initials, hospital identification numbers, or photographs) in the submitted manuscript that could be used to identify the patients.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with institutional and/or national research committee ethical standards and the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards.

Declaration of Funding

This study did not receive any financial support for developing this work.

Conflict of Interest Declaration

The authors have no potential conflicts of interest regarding this article.

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