Endoscopic Release of the Ulnar Nerve at the Elbow: Technique Description and Case Series

Liberação endoscópica do nervo ulnar no cotovelo: Descrição da técnica e série de casos

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Abstract

Objective The endoscopic release of the ulnar nerve reproduces a simple (*in situ*) procedure with smaller incisions, less soft tissue damage, and higher preservation of nerve vascularization. Endoscopy allows the clear visualization of the entire path of the nerve and surrounding noble structures. Moreover, it reveals any signs of compression and allows a safe release of 10 cm distally or proximally to the medial epicondyle.

Methods A retrospective survey revealed that 15 subjects (1 with a bilateral injury) underwent an ulnar nerve compression release at the elbow using the endoscopic technique with Agee (Micro-Aire Sugical Instruments, Charlottesville, VA, EUA) equipment from January 2016 to January 2020.

Results Symptoms of ulnar nerve compression improved in all patients; on average, they resumed their work activities in 26.5 days. There was no recurrence or need for another procedure. In addition, there were no severe procedure-related complications, such as infection and nerve or vascular injury. One patient had transient paresthesia of the sensory branches to the forearm, with complete functional recovery in 8 weeks.

Conclusion Our study shows that the endoscopic release of the ulnar nerve at the elbow with the Agee equipment is a safe, reliable technique with good outcomes.

Keywords
- ulnar nerve
- cubital tunnel syndrome
- nerve compression syndromes
- elbow
- paresthesia
- minimally invasive surgical procedures

Resumo

Objetivo A liberação endoscópica do nervo ulnar permite reproduzir uma liberação simples (*in situ*), mas através de incisões menores e com menor lesão de partes moles e

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uma maior preservação da vascularização do nervo. A visualização clara através da endoscopia permite observar todo o trajeto do nervo e das estruturas nobres circundantes, mostrando os sinais de compressão, possibilitando realizar a liberação de forma segura em um trajeto de 10 cm nos sentidos distal e proximal ao epicôndilo medial.

Método Foram encontrados, de forma retrospectiva, no período entre janeiro de 2016 e janeiro de 2020, 15 pacientes (sendo 1 com lesão bilateral) submetidos a liberação da compressão do nervo ulnar no cotovelo pela técnica endoscópica com equipamento de Agee (Micro-Aire Sugical Instruments, Charlottesville, VA, EUA).

Resultados Todos os pacientes tiveram melhora dos sintomas de compressão do nervo ulnar e o período de retorno ao trabalho foi de em média 26,5 dias. Não houve recidivas e não houve a necessidade de outro procedimento. Também não houve complicações graves decorrentes do procedimento, como infecção, lesão nervosa ou vascular. Em um paciente, houve parestesia transitória dos ramos sensitivos para o antebraço, com retorno completo da função em 8 semanas.

Conclusão Os resultados mostram que a liberação endoscópica do nervo ulnar no cotovelo com o equipamento de Agee é uma técnica segura, confiável e com bons resultados.

Palavras-chave
- nervo ulnar
- síndrome do túnel ulnar
- síndromes de compressão nervosa
- cotovelo
- parestesia
- procedimentos cirúrgicos minimamente invasivos

Introduction

Ulnar nerve compression at the elbow level is the second most frequent compressive neuropathy in the upper limb after carpal tunnel syndrome,[1–4] with an incidence of 25 cases per 100,000 inhabitants, being twice as common in men.[5] The most common symptom is paresthesia at the ulnar border of the hand and forearm. In addition, the subject may complain of pain in the medial region of the elbow irradiating to the forearm, weakness in the intrinsic muscles of the hand, and decreased pinch strength. The most severe and long-term cases may result in atrophy of the intrinsic musculature of the hand, especially of the first dorsal interosseous muscle.[3,4]

The superficial position of the ulnar nerve in the cubital tunnel and the increased tension and traction at elbow flexion account for its susceptibility to this compressive neuropathy. In most patients, the condition is idiopathic. However, it is critical to rule out potential lesions, including osteophytes, post-traumatic cubitus valgus, soft tissue tumors, post-traumatic contractures, and subluxation of the ulnar nerve at the medial epicondyle.[2,4]

The most frequent compression site is within the cubital tunnel, formed by the medial epicondyle and the proximal ulna and covered by the Osborne arcuate ligament. In the proximal portion, the area of higher compression is the arcade of Struthers, located ~ 10 cm proximally to the medial epicondyle. In the distal region, the deep fascia, or the area between the two heads of the flexor carpi ulnar may compress the ulnar nerve. Potential compression sites often range from 8 cm proximally to 5 cm distally to the medial epicondyle (►**Fig. 1A**).[3,6]

Conservative treatment failure indicates the need for surgical release of the ulnar nerve. The endoscopic release

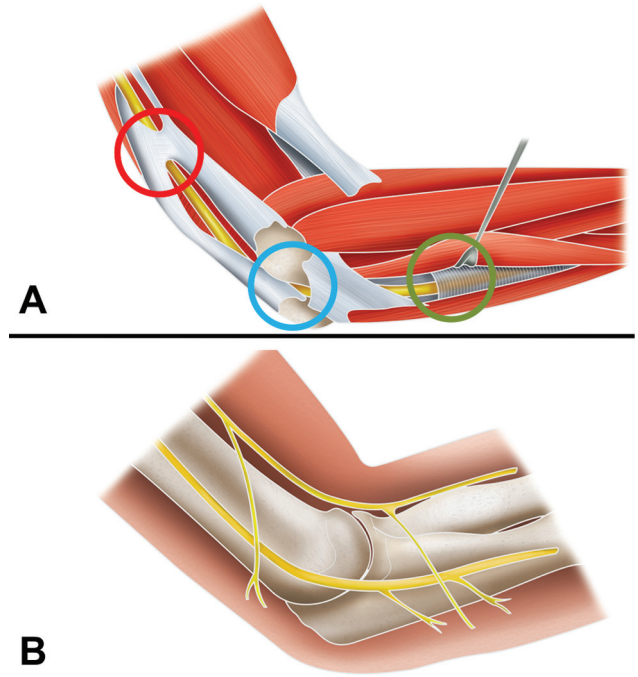

Fig. 1 Anatomy of the medial region of the elbow showing the most frequent sites of ulnar nerve compression. The main ulnar nerve compression sites include the arcade of Struthers (red circle) proximally, the cubital tunnel (blue circle) centrally, and the deep fascia or area between the two heads of the flexor carpi ulnaris (green circle) distally. Locations range from ~ 8 cm proximally to 5 cm distally to the medial epicondyle (**A**). Anatomy of the ulnar and medial cutaneous nerves of the forearm showing their superficial sensory branches passing obliquely at the elbow. Their protection is critical during the endoscopic release of the ulnar nerve (**B**). Source: Instituto da Mão.

Table 1 McGowan classification of cubital tunnel syndrome

Grade 0	No symptoms
Grade 1	Minimal symptoms with paresthesia and dysesthesia. No weakness or atrophy of the intrinsic musculature supplied by the ulnar nerve.
Grade 2	Moderate symptoms with weakness and atrophy of the intrinsic musculature supplied by the ulnar nerve. Preservation of some motor function.
Grade 3	Severe symptoms with paralysis of the intrinsic musculature supplied by the ulnar nerve. Marked hand weakness.

of the ulnar nerve reproduces a simple (in situ) procedure with smaller incisions, less soft tissue damage, and higher preservation of nerve vascularization. Endoscopy allows the clear visualization of the entire path of the nerve and surrounding noble structures. Moreover, it reveals any signs of compression and allows a safe release 10 cm distally or proximally to the medial epicondyle. Different studies and meta-analyses have concluded that simple (in situ) cubital decompression is comparable to the classically proposed anterior transposition but with fewer complications.[7–9]

Endoscopic surgery is contraindicated in subjects with space-occupying lesions, previous ulnar decompression (or transposition), severe elbow stiffness requiring treatment, symptomatic subluxation of the cubital nerve, and previous trauma with scar adhesion.[10,11]

The present study describes the technique and outcomes of a series of patients with ulnar nerve compression at the elbow surgically treated with an endoscopic release using the Agee (Micro-Aire Surgical Instruments, Charlottesville, VA, USA) equipment.[12,13]

Materials and Methods

A retrospective survey revealed that 17 patients underwent an endoscopic ulnar nerve release at the elbow (LENUC, in the Portuguese acronym) between January 2016 and January 2020. The lack of adequate follow-up led to the exclusion of two patients. Therefore, we analyzed 15 patients. One subject had bilateral injuries, and the surgical treatment of each elbow occurred at different times. In total, we assessed 16 elbows for a minimum follow-up period of 9 months after surgery. The ethics committee of our hospital authorized the present study.

After history and physical examination suggested an ulnar nerve compression at the elbow, all patients had the diagnosis confirmed by electroneuromyography. Preoperatively, the modified classification proposed by McGowan[10] determined the degrees of disease severity (►**Table 1**).

We referred for LENUC patients with no improvement after 3 months of consistent conservative treatment with anti-inflammatory medication, physical therapy, and night orthotics use. We excluded patients with a history of fractures in the affected elbow, joint stiffness with a referral for arthrolysis, and those with associated cervical radiculopathy. We included only adult patients ($>$ 18 years old), with no restriction regarding the upper age limit.

Outcomes included clinical aspects and potential complications resulting from surgery. The evaluation used the modified Wilson et al. scale (►**Table 2**) and the Bishop scoring system (►**Table 3**).[2,10] In addition, we determined the time required to return to physical, daily, and professional activities. The same surgeon performed the procedure in all patients using the technique described below.

Endoscopic Ulnar Nerve Release Technique using Agee

Agee was designed for the endoscopic release of carpal tunnel syndrome and was adapted for the treatment of cubital tunnel syndrome.[12,13]

The patients were positioned in dorsal decubitus, with the upper limb supported on a hand table. We performed regional block anesthesia and sedation and placed a pneumatic tourniquet. Initially, the elbow was flexed, with external rotation of the shoulder, for an easier approach to the medial portion of the elbow. Less experienced surgeons may use a dermographic pen to mark the medial epicondyle, the olecranon, and the entire course of the ulnar nerve, which is immediately posterior to the medial epicondyle.

The 1.5- to 2-cm incision was oblique and located 1 cm proximal to the retroepitrochlear canal (►**Fig. 2**). We carefully dissected the area using this mini approach until

Table 2 Wilson and Krout criteria for postoperative outcome evaluation of patients with ulnar nerve compression at the elbow

Outcome	Description
Excellent	No pain on the incision site, with minimal sensitive or motor abnormalities.
Good	Improvement of compressive symptoms but with occasional sensitive abnormalities.
Regular	Improvement but with persistent sensitive or motor abnormalities, which are minor compared with the preoperative period.
Poor	No improvement or worsening of symptoms.

Table 3 Bishop scoring system

Evaluation	Score
Patient satisfaction	
Satisfied	2
Satisfied with restrictions	1
Not satisfied	0
Improvement	
Improvement	2
No alteration	1
Worsening	0
Intensity of residual symptoms (pain, paresthesia, weakness)	
Asymptomatic	3
Occasional	2
Moderate	1
Intense	0
Professional activity	
Working or able to resume work	1
Not working	0
Intensity of labor	
Limited	0
Unlimited	1
Grip and pinch strength	
$\geq$ 80% on both sides	2
$\geq$ 80% on one side	1
$<$ 80% on both sides	0
Static sensitivity and two-point discrimination	
Normal ($\geq$ 5mm)	1
Abnormal ($<$ 5mm)	0
	Total 12
Score	
Excellent	10–12
Good	7–9
Regular	4–6
Poor	1–3

reaching the deep fascia and the ulnar nerve. After localizing and protecting the ulnar nerve, we created a space between the deep fascia and the subcutaneous cellular tissue using Metzenbaum scissors. Differently from carpal tunnel syndrome release, here the medial cutaneous nerve of the forearm and its branches pass through the subcutaneous space around the cubital tunnel. So, we needed to create a space both inside the cubital tunnel and between the fascia and the subcutaneous tissue to protect sensory nerve branches (►**Fig. 1B**).

First, we proceeded to the proximal release of the ulnar nerve. We introduced the cannula into the space between the ulnar nerve and the fascia, advancing carefully without forcing the entry or injuring the nerve. At the same time, we placed a long soft tissue retractor between the superficial part of the fascia and the subcutaneous tissue to avoid damage to the superficial sensory nerve branches and vessels during the release (►**Fig. 3**). After cannula, it was easy to see the fascial fibers covering the cubital tunnel with the blade between the nerve and the fascia. Next, we activated the trigger, projecting the 3.5-mm blade into the device tip. Then, a retrograde movement of the pistol held by the surgeon sectioned the ligament. A single, continuous movement is usually enough to open the ligament in its entirety. Even so, we must check if the entire ligament was released because the pistol may need triggering again (►**Fig. 4**).

We performed the exact same procedure at the proximal path for distal release. Initially, using retractors, we created a space between the nerve and the roof of the cubital tunnel. We introduced the cannula superficial to the nerve and deep to the fascia; with the superficial soft tissue retractor, we created a space between the (deep) fascia and the (superficial) subcutaneous cellular tissue. Then, we confirmed the absence of nerve branches and superficial vessels at the release site. We introduced the cannula with the optics and located the distal course of the ulnar nerve. Next, under direct visualization of the fascia, we opened the distal portion of the fascia when we were sure that the nerve was totally below the cannula. Occasionally, blunt dissection with scissors may be required to put the cannula below the fascia, removing potential nerve adhesions that may hinder the introduction and advancement of the device. Then, we removed the cannula and viewed the tissues with the help of the retractors, leaving space for introducing the optics that show the path of the released nerve, both proximal and distal to the medial epicondyle. The ease of following the path of the ulnar nerve with both proximal and distal optics, with no compression points, confirmed its complete release. Any potential compression point can be treated with scissors, completing the release under endoscopic view.

We released the tourniquet and proceeded to hemostasis before closing the incision with sutures and an elastic compressive dressing. This surgery is usually performed on an outpatient basis. The patient is encouraged to keep the hand elevated and to mobilize the fingers. Gentle active mobilization of the elbow is allowed starting on the 1st postoperative day. We recommended putting ice over the surgical site. The first dressing change occurred 3 to 5 days after surgery, when a Band-Aid (Johnson & Johnson, New Brunswick, NJ, USA). replaced the elastic immobilization. As a general rule, joint mobility was complete within 1 week. We removed the sutures 10 to 12 days after surgery. We instructed the patient to avoid physical exertion for 2 weeks and allowed work activities according to their tolerance. We educated our patients that discomfort in the medial region of the elbow is common for 2 to 3 months after the procedure.

Results

We analyzed 16 operated elbows (15 patients; 7 female and 9 males) with LENUC, followed prospectively, following them

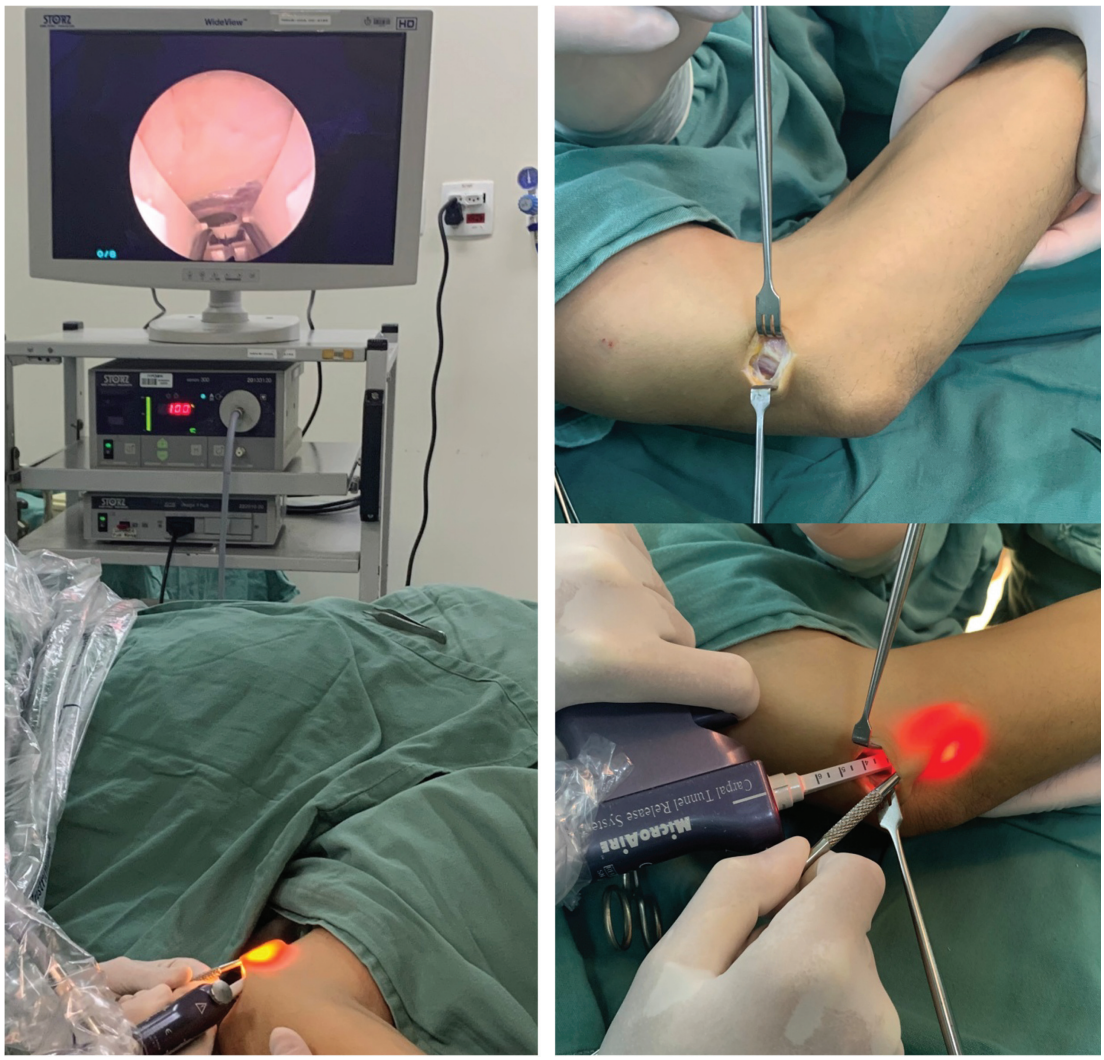

Fig. 2 The 1.5- to 2-cm incision was oblique and located 1 cm proximal to the retroepitrochlear canal (**A**). We carefully dissected the area using this mini approach until reaching the deep fascia and the ulnar nerve. Release of the ulnar nerve began proximally (**B**), extending to the distal region (**C**). Source: Instituto da Mão.

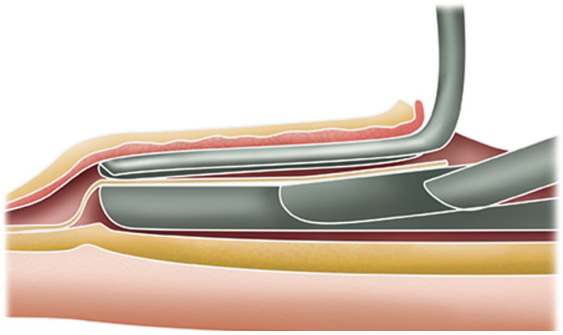

Fig. 3 Schematic drawing of the relationship between the anatomical structures and the instruments used for the procedure. From top to bottom, a long soft tissue retractor pulled the skin apart, revealing the fascia underneath. The retractor protected the superficial sensory branches of the ulnar nerve. We introduced the cannula immediately below the fascia to section it, decompressing the nerve. The bottom of the cannula protected the ulnar nerve throughout the procedure. At the end of the surgery, it can be visualized by directing it to the opposite side.

up from surgery until the patients resumed work and sports activities (►**Table 4**). We operated on seven right elbows and nine left elbows. The age at surgery ranged from 26 to 66 years old, and the mean age was 45.81 years old. The condition was present for 6 to 24 months, with a mean period of 11.87 months. All patients underwent electroneuromyography, which showed moderate compression in nine patients and severe compression in seven subjects. Clinically, 11 patients were type II and 5 were type III according to the classification by McGowan.

The mean follow-up time was 17.25 months, ranging from 9 to 36 months. According to the Wilson et al. scale, outcomes were excellent in 11 patients, good in 4 patients, and regular in 1 subject. All patients presented improved ulnar nerve compression symptoms, and the mean time until return to work was 26.56 days, ranging from 10 to 60 days.

There were no recurrences or need for another procedure. In addition, there were no severe procedure-related complications, such as infection, nerve, or vascular injury. One

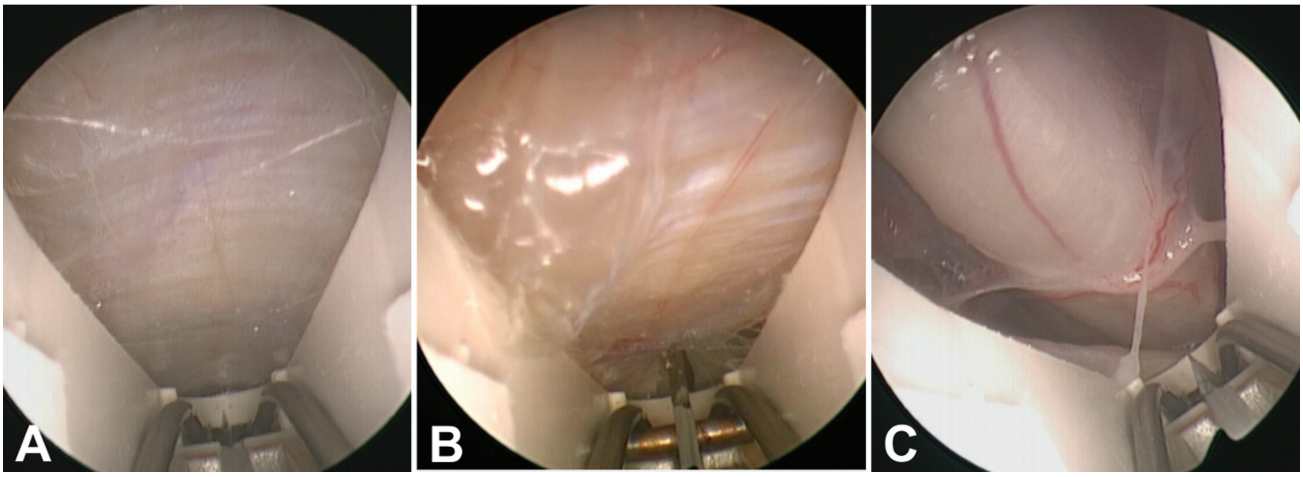

Fig. 4 Endoscopic view of the fascia fibers closing the cubital tunnel (**A**). The trigger was pulled, projecting the 3.5-mm blade into the device tip. A retrograde movement of the pistol held by the surgeon sectioned the ligament. A single, continuous movement is usually enough to open the ligament in its entirety (**B**). Confirmation of nerve release throughout its course (**C**). Source: Instituto da Mão.

Table 4 Patient series and postoperative outcomes

Elbows	Gender	Age (years old)	Side	Onset (months)	ENMG	McGowan	Wilson & Krout	Resume working (days)	Follow-up (months)	Bishop
1	Male	34	Left	8	Moderate	2	Excellent	30	12	Excellent
2	Female	49	Left	12	Moderate	2	Excellent	15	24	Excellent
3	Male	39	Right	18	Severe	2	Good	60	18	Good
4	Male	33	Left	6	Moderate	2	Excellent	15	12	Excellent
5	Male	66	Left	24	Severe	3	Good	30	12	Regular
6	Male	26	Right	12	Severe	2	Excellent	20	18	Excellent
7	Female	52	Left	8	Moderate	3	Excellent	15	24	Excellent
8	Male	44	Left	9	Moderate	2	Excellent	30	18	Excellent
9	Female	52	Right	9	Moderate	2	Excellent	45	24	Excellent
10	Female	53	Left	15	Moderate	2	Excellent	30	36	Excellent
11	Male	38	Right	18	Severe	3	Good	15	9	Excellent
12	Male	47	Left	12	Moderate	3	Excellent	10	12	Excellent
13	Female	60	Left	12	Severe	2	Regular	30	18	Regular
14	Male	41	Right	12	Moderate	3	Good	45	18	Good
15	Female	51	Right	6	Severe	2	Excellent	20	12	Excellent
16	Female	48	Right	9	Severe	2	Excellent	15	9	Excellent

Abbreviation: ENMG, electroneuromyography.

patient had transient paresthesia of the sensory branches to the forearm, with complete functional recovery in 8 weeks.

Discussion

The management of ulnar compressive neuropathy in the elbow must be nonsurgical in patients with a mild injury (McGowan type I) of short duration.[14,15] We refer patients with conservative treatment failure or more advanced lesions (McGowan types II and III) to surgery. Several techniques were described, but there is no consensus on which is the best.[10,16,17] From a didactic point of view, these techniques include in situ ulnar nerve decompression or medial epicondylectomy and those for anterior transposition of the nerve and its positioning at the subcutaneous, intramuscular, and submuscular tissues. Most of these techniques have good outcomes with a low rate of complications.[3,18–20]

Dellon[21] performed a meta-analysis of 50 articles with $>$2,000 patients and different surgical techniques. They concluded that most surgeries have satisfactory outcomes in 90% of patients with minimal compression symptoms. In prospective studies, Gervasio et al.,[22] Biggs et al.,[23] and

Bartels et al.[24] showed that the in situ release of the ulnar nerve is at least as effective as its submuscular or subcutaneous transposition. This realization led to the recent development of increasingly less invasive techniques with satisfactory outcomes.

Tsai et al.[25] was the first to propose an endoscopy-assisted technique in 1989. Subsequently, other authors described several similar techniques.[12,26–28]

The latest published reviews state that the open technique and endoscopic surgery had similar clinical outcomes, patient satisfaction levels, and relapse rates.[29] However, endoscopic ulnar nerve release offers several benefits over open surgery, including lower morbidity in the surgical area, minimal risk of injury to adjacent noble structures, a significant reduction in complication rates, faster recovery, and better aesthetic results with greater patient satisfaction due to the smaller incision.[29]

None of our patients required a second procedure for a new release because our technique reached very proximal and distal levels, preventing the formation of potential compression points. In addition, there were reports of injuries at cutaneous sensory nerves.

The endoscopic procedure is more expensive than the traditional open surgery, which may be a limitation in some circumstances. However, an earlier return to work activities may compensate for this higher cost.[4]

One author (Carratalá V.) has published two articles with a series of patients with ulnar nerve compression at the elbow treated with the technique described by Cobb et al.[26] using the Endoscopic Cubital Tunnel Release System (Endorelease system, Integra LifeSciences, Plainsboro, NJ, USA) and a standard 4-mm optic. These papers report good outcomes consistent with our series conducted with the Agee device.[10,11,26]

The use of endoscopic ulnar nerve release techniques at the elbow through a minimal incision is increasing, and most published articles show a significant benefit to the patient.[1] However, like most publications, our study is limited by the lack of control groups due to the small sample size and nonstandardized outcome measures.

Conclusions

Our study provides consistent data that the endoscopic release of the cubital tunnel with ulnar nerve decompression is a safe, reliable technique with good outcomes. It has a high rate of patient satisfaction, fast improvement, and aesthetic advantages. We emphasize, however, that this technique requires previous training with arthroscopic procedures.

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Conflict of Interests
The authors have no conflict of interests to declare.

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