



# Ulna Shortening Osteotomy Combined Arthroscopy augmentation for Ulnar Impaction Syndrome: A prospective Analysis

## *Osteotomia de Acortamiento del Cúbito Combinada con Artroscopia para el Síndrome de Impactación Cubital: Un Análisis Prospectivo*

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### Abstract

**Purpose** This study aimed to show the clinical and patient-reported outcomes achieved with USO combined arthroscopy augmentation of UISs in active patients.

**Materials and Methods** In this prospective clinical study, 13 patients were assigned to undergo definitive ulnar shortening osteotomy (USO) combined arthroscopy augmentation to ulnar impaction syndrome (UIS). The grip strength, range of motion (ROM), Disabilities of the Arm, Shoulder, and Hand (QuickDASH) outcome measure, visual analog scale (VAS) score for pain, and radiographic characteristics were evaluated at 6 and 12 months.

**Description of Technique** A longitudinal incision is used to expose the ulna. A specific ulna shortening system is predrilled to performing osteotomies separated by the desired shortening length. After, performing wrist arthroscopy to perform microfracture technique in lunate, triquetrum, and ulna head with a specific puncture (Chondro Pick, 20° by Arthrex®, Naples, USA). TFCC and LT (luno triquetrum) were repaired.

**Results** VAS 2.77. The mean QuickDASH was 4. Two patients showed delayed union and solved with non-surgical treatment.

**Conclusion** USO with arthroscopy augmentation were found to be safe and reliable definitive treatment methods for UIS in active patients. The VAS and grip strength results predict the restoration of the ability of active patients to independently perform ADLs.

### Keywords

- ▶ ulnar impaction syndrome
- ▶ triangular fibrocartilage complex
- ▶ ulnar shortening osteotomy
- ▶ arthroscopic debridement

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## Resumén

**Objetivo** Este estudio tuvo como objetivo mostrar los resultados clínicos y reportados por los pacientes obtenidos con osteotomía de acortamiento cubital (OAC) combinada con artroscopia en síndromes de impactación cubital (SIC) en pacientes activos.

**Materiales y Métodos** En este estudio clínico prospectivo, se asignó a 13 pacientes a someterse a osteotomía de acortamiento cubital (OAC) definitiva combinada con artroscopia para el síndrome de impactación cubital (SIC). La fuerza de agarre, el rango de movimiento (ROM), la medida de resultado de discapacidades del brazo, el hombro y la mano (QuickDASH), la puntuación de la escala analógica visual (EVA) para el dolor y las características radiográficas se evaluaron a los 6 y 12 meses.

**Descripción de la técnica** Se utiliza una incisión longitudinal para exponer el cúbito. Se preperfora un sistema de acortamiento de cúbito específico para realizar osteotomías separadas por la longitud de acortamiento deseada. Posteriormente, realización de artroscopia de muñeca para realizar técnica de microfractura en el semilunar, piramidal, cabeza de cúbito con punción específica (Chondro Pick, 20° by Arthrex®, Na-ples, USA). Se reparó complejo del fibrocartilago triangular (CFCT) y lunopiramidal (LP).

**Resultados** EVA 2.77. La media de QuickDASH fue de 4. Dos pacientes presentaron retraso en la consolidación y se resolvieron con tratamiento no quirúrgico.

**Conclusión** Se encontró que la OAC con artroscopia es un método de tratamiento definitivo, seguro y confiable para SIC en pacientes activos. Los resultados de la EVA y la fuerza de prensión predicen la restauración de la capacidad de los pacientes activos para realizar las actividades de la vida diaria (AVD) de forma independientes.

## Palabras clave

- ▶ síndrome de impactación cubital
- ▶ complejo de fibrocartilago triangular
- ▶ acortamiento cubital
- ▶ osteotomía
- ▶ desbridamiento artroscópico

## Introduction

The surgical procedures to treat idiopathic Ulnar Impaction Syndrome (UIS) are an Ulna Shortening Osteotomy (USO) or wafer resection (AWP) and TFCC (triangular fibrocartilage complex) debridement and no consensus regarding the preferred method in active patients with a degenerative and progressive ulnar-sided wrist lesion.

This impaction starts in TFCC perforation, condromalacia of the lunate, triquetrum, distal ulna, and disruption of the intrinsic carpal ligaments - lunotriquetral (LT) - in whom the treatment timing and method can have a strong social and psychological impact.<sup>1</sup>

Ulna shortening osteotomy associated arthroscopy augmentation (TFCC approach, nano, or micro-fractures) as a definitive treatment for (UIS) in active patients may be a good strategy to promote precise surgical procedure to avoid damage articular surface of the uno carpal side.<sup>2-4</sup> This approach is a convenient, safe, and reproducible method, allowing immediate rehabilitation protocol, restoration of ADLs and work-related activities.

The primary goal was to evaluate the visual analogue score (VAS) of active patients with UIS treated with ulna shortening osteotomy and augmentation arthroscopy methods. The secondary objective was to check the functional and radiographic outcomes.

## Patients and Methods

A single-center, prospective, clinical study was conducted at the Department of Surgery IV, Centro Universitario FMABC, Santo Andre, Brazil. The specific ulna shortening plate is pre-drilled (2.5 Trilock Ulna Shortening Plate by Medartis®, Basel, Switzerland.). The protocol was approved by the institutional research ethics committee (no. ETIK 509173159.0000.5484). Written informed consent was obtained from all patients prior to their enrollment. The exclusion criteria were injuries in the ipsilateral limb, ongoing chemotherapy or radiotherapy, and patients with rheumatic diseases, mental illnesses, or alcohol abuse. The inclusion criterion was active patients (aged  $\geq 45$  years) with a diagnosis of UIS who were treated with USO and arthroscopy augmentation (TFCC approach, nano microfractures).

From January 2018 to March 2022, a total of 13 patients were included. The mean age was 45 years (range: 38–60), 9 were men and 4 were women. The UIS was classified with clinical/radiographic signs findings: DRUJ stable/unstable, sigmoid notch and ulna head morphology, chondromalacia location, and lunotriquetral ligament or no.<sup>5-7</sup> (► **Table 1**)

## Surgical Technique

The surgical approach was a longitudinal incision over the border of the ulna used to expose the distal and middle third of

**Table 1** Demographic characteristics and injury details

	(n = 13)
Age (years) <sup>a</sup>	45.15 (36–56)
Gender <sup>b</sup>	
Female	5 (38.5)
Male	8 (61.5)
Hand dominance <u>b</u>	
Right	9 (69.2)
Left	4 (30.8)
Dominant extremity abutment <sup>b</sup>	10 (76.9)
Sigmoid notch shape by Tolat <sup>b</sup>	
C	3 (23)
S	0 (0)
Flat	7 (53.84)
Ski slope	3 (23)
Preoperative radiograph ulna variance <sup>b</sup>	
> 5mm	8 (61.5)
< 5 mm	5 (38.5)
Associated lesions <sup>b</sup>	
Chondromalacia	13 (100)
DRUJ unstable	6 (46.1)
LT unstable	1 (3.33)

Abbreviation: DRUJ, distal radio ulnar joint; LT, luno triquetrum.

<sup>a</sup>Data are presented as mean (range).

<sup>b</sup>Data are presented as frequency (percentage).

the ulna shaft (immediately proximal *pronator quadratus* insertion). A goal of shortening is –2 mm ulna variance in the AP view and neutral in the PA view. A specific ulna shortening plate is predrilled (2.5 Trilock Ulna Shortening Plate by Medartis®, Basel, Switzerland.) to do two transverse or oblique osteotomies separated by the desired shortening length. To avoid DRUJ incongruence after treatment, it checked sigmoid notch and ulna head morphology, reducing rotation and translation of the fragments and using a compression guide system (by Medartis®, Basel, Switzerland.). In oblique osteotomy, a compression screw is used. After, performing wrist arthroscopy to confirm diagnosis and treatment of osteochondral defects associated with TFCC and other ligament injuries. (See **video 1**) Now, to

perform nano fractures in the lunate, triquetrum, ulna head, and hamate with a specific tool (Chondro Pick, 20° by Arthrex®, Naples, USA). (See **►Video 2**)

### Video 2

Nano fractures in lunate, triquetrum, and ulna head with a specific tool (Chondro Pick, 20° by Arthrex®, Naples, USA) assisted by wrist arthroscopy. Online content including video sequences viewable at: <https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0043-1769600>.

### Video 1

Ulna shortening osteotomy combined arthroscopy augmentation. Online content including video sequences viewable at: <https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0043-1769600>.

Ligament debridement (TFCC and lunotriquetrum), repair, or reinsertion was performed in the same time. General anesthesia is used in all patients. The criteria for osteotomy healing is defined as callus formation in all views, and painless at the fracture site.

Grip strength (see **►Table 2**) was measured and classified according to their inability to perform activities of daily living (ADLs).<sup>8–10</sup>

Parameters are reviewed to determine Clinical-functional patient-reported outcomes: Range of motion (ROM), Visual Analog Scale (VAS) pain score, Disabilities of the Arm, Shoulder, and Hand (QuickDASH) Questionnaire.<sup>11–13</sup>

Complications were assessed at 12 months. (15.38%).

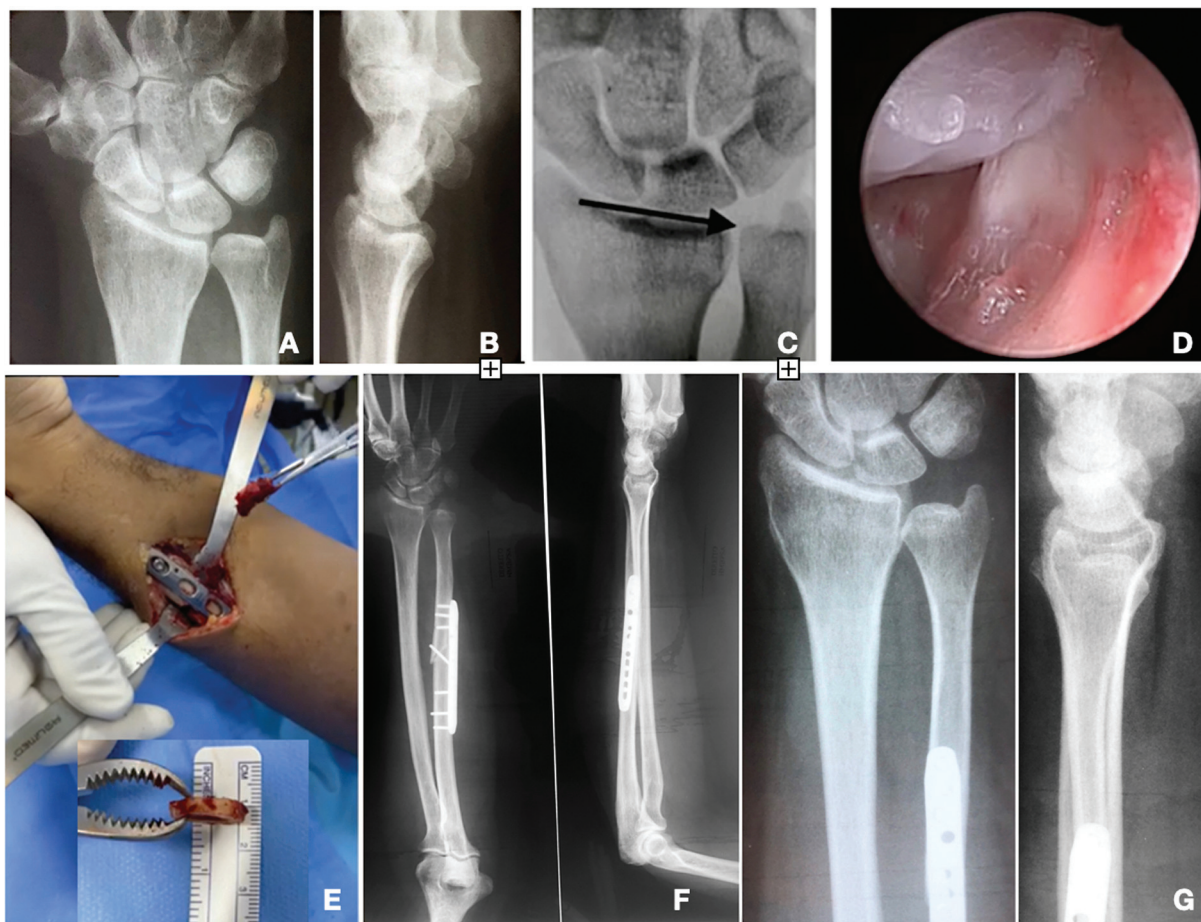
Radiographic parameters were evaluated immediately 1, 6 and 12 months after surgery. (See **►Figure 1**): Ulnar variance distance was measured using PA view (from the distal radial to distal ulnar surfaces). The mean fracture healing period was 6.94 weeks.

Patients used forearm bracing, thus allowing complete forearm pronation and supination. The first dressing change occurred the first week postoperatively and could start ADLs for about 4 months.

**Table 2** Hazard ratio analysis predicting 7-year incidence of any ADL limitation form

Hand grip strength quartiles	Men, HR 95% CI, N = 979	Women, HR 95% CI, N = 1,310
1st: Men (<22 kg) women (<14 kg)	1.90 (1.14–3.17)	2.28 (1.59–3.27)
2nd: Men (22.01–30 kg) women (14.01–18.20 kg)	1.83 (1.12–2.98)	1.72 (1.21–2.45)
3rd: Men (30.01–35 kg) women (18.21–22.50 kg)	1.25 (0.75–2.11)	1.41 (1.00–2.02)
4th: Men (>35.01 kg) women (>22.51 kg)	1.00	1.00

Abbreviations: ADL, activities of daily living; CI, confidence interval; HR, hazard ratio.



**Fig. 1** (A, B, C) 53-year old female showing positive ulnar variance on a preoperative anteroposterior and lateral radiograph. (D) wrist arthroscopy (3-4 portal view) findings of a sinflammetry aspect of triangular fibrocartilage complex and chondromalacia in the ulnar border of the lunate in ulnar impaction syndrome. (E) Intraoperative aspects of the ulna plate position and bone resection. (F) An anteroposterior and lateral radiograph was made after ulnar shortening osteotomy alone and fixation with a specific ulna shortening plate system and screw. (G) A 12-month final follow-up anteroposterior and lateral radiograph.

**Statistical Methods**

Data are presented as mean or median according to the type of variable and distribution. Parametric variables were assessed using the Mann-Whitney U test, and  $p < 0.05$  was considered indicative of a statistically significant difference. The Statistical Package for the Social Sciences (SPSS) version 24.0 (SPSS Inc.) was used for data analyses.

**Results**

Demographic characteristics and injury details after 12 months are presented in ►Table 1. Grip strength is shown in (►Table 2-3, ) and Clinical-functional outcomes at the 12 months are presented in ►Table 4. On X-ray examination, an ulnar variance was observed at -0.3mm. Complications

**Table 3** Mean grip strength at 12 months

	(n = 13)	Quartile position	p-Value
Male	(n = 9)		
Affected side (kg)	34.17	3/3 degrees	0.53
Normal side (kg)	37.5	4/4 degrees	0.51
% Normal wrist	91.11	-	-
Female	(n = 4)		
Affected side (kg)	20.65	3/3 degrees	0.52
Normal side (kg)	22.45	3/3 degrees	0.73
% Normal wrist	92	-	-

**Table 4** Clinical and functional outcomes at 12-month follow-up

	Pre operative (n = 13)	Post operative (n = 13)	p-Value
12 months			
ROM (in degrees) <u>b</u>	300,82 (85%)	342.09 (96.66%)	0.58
QuickDASH score (points)	9.09	4.00	0.97
VAS pain (mm/10 mm)	6.53	2.08	0.62
Ulnar variance (mm)	5	-0.3	-
Complication rate (delayed union)	-	15.38%	-

Abbreviations: DASH, Disabilities of the Arm, Shoulder, and Hand; ROM, range of motion; VAS, visual analog scale.

were observed in two patients (15.38%). These included delayed union (about six months) and to maintained-sided pain until ulna healing.

## Discussion

USO was originally described by Milch in 1941. Studies demonstrated that wafer procedures (Arthroscopy or open) may be viable alternatives to USO, but the best clinical functional result is yet to be established.<sup>3,14</sup>

Of note, VAS is a stronger parameter to evaluate the treatment outcomes of UISs, before and after the USO with improved results: 6.53 (pre) versus 2.08 (post-operative). In a study by Doherty et al VAS was significantly reduced: 7.9 versus 3.1, ( $P < 0.0001$ ).<sup>1</sup>

Grip strength shows the patient's risk of disability of ADLs in the lowest (first or second) quartile and in the highest (third or fourth) hand grip strength quartile. All patients, in that present study, are in the third or fourth quartile and improvement 60 - 91%. Moermans et al reported an improvement in grip strength (67 to 75%) after USO for ulnar impaction syndrome.<sup>9,15</sup>

Chun and Palmer demonstrated the best results in VAS and ROM after USO and all ulna are healing. Fricker et al also report 100% ulna healing osteotomy with comparable functional outcomes. In our study, two patients developed complications, these included delayed union (about six months) and to maintained wrist ulna sided pain until ulna healing. Solved after non-surgical treatment.<sup>16</sup>

Won-Taek Oh et al. reported patients who underwent the AWP (Arthroscopy wafer procedure) were evaluated with better grip strength and DASH scores at 3 months after surgery but, at the 2-year follow-up, the results were similar in the group treated by USO.<sup>17</sup>

The disadvantages of the traditional AWP of UIS treatment are the inability and precision of longitudinal ulna shortening and to remove the cartilage surface of the ulna head. Kim and Song concluded USO combined arthroscopic augmentation improved clinical and functional outcomes in the patients treated for ulnar impaction syndrome. This present study demonstrates that USO combined with wrist arthroscopy augmentation (TFCC approach, nano micro fractures) shows DRUJ stability and congruence, precision in ulna

abutment correction, and can achieve ulna osteotomy healing. Only 15.38% of the patients showed delayed union.<sup>18</sup>

Currently, the paradigm of USO envisages early definitive surgery of patients with UIS. According to this present study, using a specific ulna shortening system, plate position in the palmar face to the ulna, check DRUJ congruency (if necessary, translate ulna osteotomy to avoid ski slope impaction), to perform LT ligament repair, TFCC foveal reinsertion, nano, and micro-fractures in lunate, triquetrum, all assisted by wrist arthroscopy. Such an approach is convenient, safe, and reproducible method that avoids the degenerative lesions around the DRUJ, allows early rehabilitation protocol and restoration of ADLs and work-related activities.

There is a strong trend toward the use of AWP in active patients, although the results found with USO were similar and to maintain the cartilage surface of the ulna head. However, further randomized trials and systematic reviews are required to determine the method of choice.

## Conclusion

USO combined with arthroscopy augmentation is safe and reliable definitive treatment method for UIS in active patients and clinical functional results predict restoration to perform ADLs.

### Ethical Approval

The research here presented was approved by and was in accordance with the ethical standards of the Faculdade de Medicina do ABC Ethics Committee on human experimentation by No 509173159.0000.5484.

### Informed Consent

An informed consent document was provided to all research participants, who read and signed it according to their will.

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### Conflict of Interest

Authors hereby declare that they have no conflicts of interest to disclose.

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