Artículo original

# Distal radius fracture. What we do not see with conventional approach? The role of wrist arthroscopy

## Fracturas del radio distal. ¿Qué no podemos ver con los abordajes convencionales? Papel de la artroscopía de muñeca

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## Información del artículo

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## Abstract

**Introduction:** Distal radius fractures are very common and they can frequently be associated with cartilage or ligament injuries. The purpose of this study is to identify and evaluate the incidence of associated injuries in intra-articular distal radius fractures diagnosed by wrist arthroscopy.
**Methods:** This is a descriptive epidemiological study done on patients with intra-articular distal radius fractures treated with open reduction and internal fixation (ORIF) with a volar locking plate assisted by wrist arthroscopy. Patients were included from January 2017 to December 2021 according to the Excel surgical database of Elbow and Hand Unit of Hospital. Patients with different lesions of distal radius fractures, intra-articular fractures without arthroscopy assistance and extra-articular fractures were excluded.
**Results:** We identified 148 patients (81 men and 67 women) with an average age of 47 years (16-82). Concomitant lesions were observed in 99 patients (66%). The most frequent one is TFCC injury in 70 patients (47%). We observed lesions of an interosseous ligament in 62 patients (42%), 51 of scapholunate (SL) ligament and 37 of lunotriquetral (LT) ligament. Isolated injury of a structure was identified in 15 patients (10%) and both of them in 14 cases (9%). These lesions were treated in the arthroscopy procedure when that was indicated.
**Conclusions:** concomitant lesions were found in most of patients with intra-articular distal radius fractures. The first one is TFCC injury, followed by intrinsic midcarpal ligament lesions. Wrist arthroscopy is necessary method to evaluate and treat associated lesions of TFCC and intrinsic ligaments.

## Resumen

**Introducción.** Las fracturas del radio distal son muy frecuentes en la población general y en muchos casos pueden asociarse con lesiones cartilaginosas y ligamentosas.
**Objetivos**. Identificar y evaluar la incidencia de lesiones asociadas en fracturas del radio distal mediante el uso de la artroscopia de muñeca.
**Material y métodos.** Estudio retrospectivo y descriptivo realizado en pacientes con fracturas del radio distal intraarticulares tratadas con cirugía asistida por artroscopia. Se incluyeron pacientes registrados entre 2017 y 2021 en la base de datos de Excel de la Unidad de Codo y Mano del Hospital Universitario 12 de Octubre de Madrid, España. Se excluyeron aquellos con lesiones de muñeca distintas a fractura del radio distal, a los que presentaron fracturas extraarticulares y a quienes sus fracturas fueron tratadas con cirugía sin artroscopia.
**Resultados.** Se identificaron 148 pacientes con una edad media de 47 años (rango entre 16 y 82 años), de los cuales el 54.72% eran hombres. Durante la artroscopia se observaron lesiones asociadas en 99 pacientes (66%), siendo la más frecuente la del complejo del fibrocartílago triangular (CFCT) (47%), seguida de la de los ligamentos mediocarpianos (42%.) En 15 pacientes (10%) se observó lesión aislada del ligamento escafolunar o lunopiramidal y en 14 pacientes (9%) ambos estaban dañados. Dichas lesiones fueron catalogadas según la clasificación de Palmer y Atzei en el caso del CFCT, y la de Geissler para los ligamentos intrínsecos. El tratamiento con artroscopia se realizó según su gravedad y las implicaciones posteriores.
**Conclusiones.** La presencia de lesiones asociadas se observó en el 66% de las fracturas del radio distal intraarticulares, siendo la principal lesión la del CFCT, seguida de la de ligamentos intrínsecos mediocarpianos. Estos hallazgos demuestran la importancia del uso de artroscopia de muñeca para el diagnóstico adecuado y el tratamiento de las lesiones cartilaginosas y ligamentarias asociadas.

## Introduction

Distal radius fractures are the most common occurring fractures.[1] There are two peaks of prevalence, first one includes young people with high energy trauma and high functional demand; second one is elderly people (over 65 years old) who fall on an outstretched hand that is considered low energy trauma. The algorithm of treatment depends on fracture stability, functional demands and patient's needs.[2] In geriatric patients, last evidence supports that operative management does not lead to improve outcomes compared to no-noperative treatment with cast immobilization. Nevertheless, in patients younger than 65, better outcomes were demonstrated with operative treatment. The surgery allows early recovery of function in the short term.[3]

Wrist arthroscopy was described in 1979.[4] In the last decades, arthroscopy joint surgery underwent an exponential evolution[5] and several authors have investigated the benefit of arthroscopy in the distal radius fractures treatment.[6] Nowadays, arthroscopy evaluation is superior to assessment to the intra-articular step-off as well as rotation of articular fracture fragments. It can be considered the gold standard in diagnosis and management of the associated soft-tissue injuries.

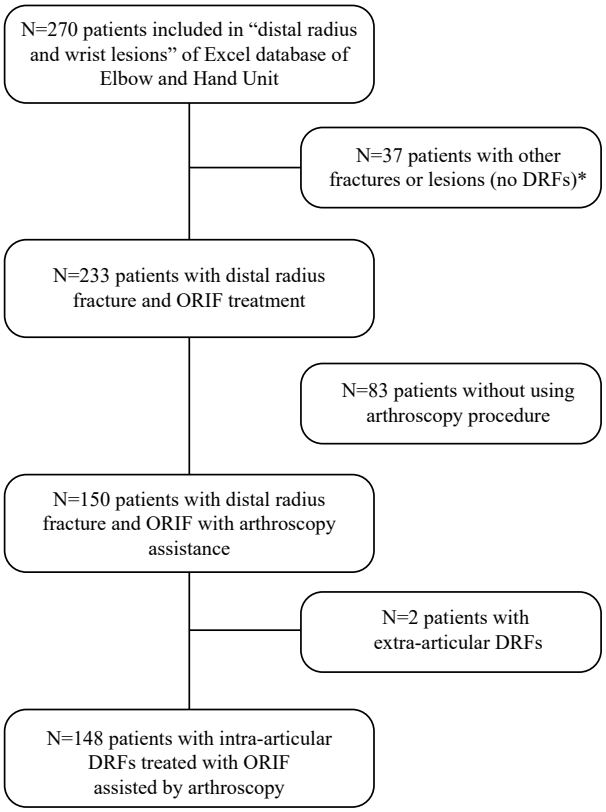
Outcomes of surgical treatment are successful in most cases. However, they may be a source of persistent pain with or without disability when the fracture has healed. Numerous studies[7-9] have shown that persistent joint deviation after an intra-articular distal radius fracture may predispose to the development of post traumatic osteoarthritis. Arthroscopy promotes the ability to examine and to treat intra-articular abnormalities. Displaced fractures in non-osteoporotic patients have a high incidence of associated lesions which are often adverse by affecting the long-term results.[10]

The purpose of our study is to identify and evaluate the incidence of concomitant injuries in the intra-articular distal radius fractures diagnosed by arthroscopy evaluation. We hypothesize that intra-articular distal radius fractures can usually be associated with lesions of the wrist, including the triangular fibrocartilage complex, intrinsic midcarpal ligament, as scapholunate and lunotriquetral ligaments.

## Material and methods

This is a descriptive retrospective epidemiological study of patients with intra-articular distal radius fracture treated with surgery of internal fixation assisted by wrist arthroscopy. We included all patients from 1st January 2017 to 31st December 2021 according to the "distal radius and wrist lesions" sheet of Excel database of Elbow and Hand Unit of Hospital. Of a total of patients collected, only distal radius fractures that were treated with open reduction and internal fixation (ORIF) and arthroscopy assistance were selected.

Exclusion criteria include any lesions other than distal radius fractures and those have been treated with open reduction and internal fixation without arthroscopy use. We also excluded cases with extra-articular fractures due to a small number of patients (Figure 1). Patient's information was analyzed from hospital software Health Care Information System (HCIS) and surgery information about management and associated lesions were searched in surgical protocol.




*Other lesions in database patients are scaphoid fracture, peri-implant fracture, ulnar isolated fracture and lunate, perilunate dislocations and scapholunate dissociation without radius fracture. N= number of patients

Figure 1 Flow chart of patients included in the study and main exclusion criteria.
Source: own elaboration.

The study was approved by the Clinical Research Ethics Committee (CREC) of Hospital with number 22/487 and Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines have been used. The retrospective nature of the study and the anonymization of patients' data made unnecessary to have a signed consent form.

Demographic and clinical variables of the patients were collected in an Excel database for their analysis. We included sex, age, laterality, arthroscopy date, articular affectation, using of Computerized Tomography scan (CT scan) for diagnosis, presence of fracture or luxation associated.

The decision of surgical treatment with arthroscopy assistance were determined by following criteria. First, ORIF were carried out according to functional demands of the patient and instability factors presence in the initial management, such as dorsal comminution and angulation more than 20º, radial shortening more than 1cm, intra-articular involvement and associated ulnar fracture. Type and characteristic of distal radius fractures were determined at first evaluation with anteroposterior and lateral radiography (Figure 2).

The surgical technique and arthroscopy evaluation were performed as standardized procedures in our Hospital, previously published in the literature.[11]

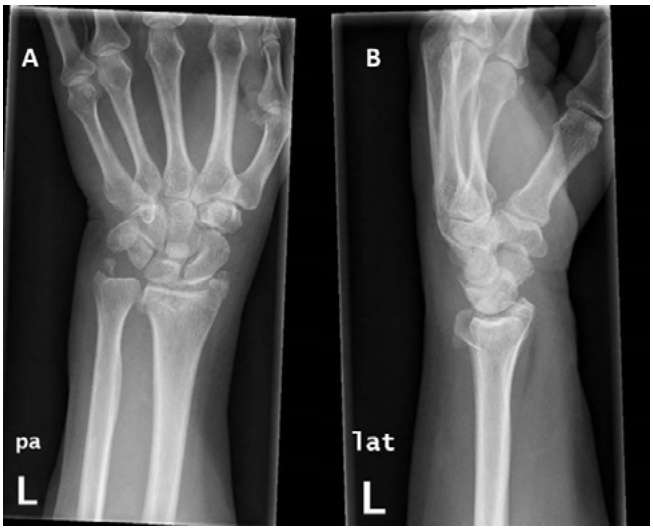



Figure 2 Initial anteroposterior (AP) (A) and lateral (B) left wrist radiographs of young patient with high energy trauma. They show a complex intra-articular distal radius fracture with instability factors.
Source: Document obtained during the course of the study.

Surgical procedure were performed by two surgeons with regional anesthesia consisted on brachial nerve block or general anesthesia. The patients are in supine position and tourniquet on the arm is inflated for exsanguination. We start with volar approach to distal radius fractures, which allows open reduction and internal fixation with volar locking plates, using intraoperative fluoroscopy.

After platting presetting, we continue with "dry" wrist arthroscopy technique. We placed the patient with fingers hanging by the use of extension sleeves, traction was applied by 10 N and 2.3 mm with 30º field of view were used. The radiocarpal joint is assessed using 3-4 and 6R portals and midcarpal joint with midcarpal ulnar (MCU) and radial (MCR). Any fracture gaps, TFCC or chondral lesions were assessed with radiocarpal portals, while intrinsic midcarpal SL and LT ligaments were assessed via midcarpal portals. Finally, once the reduction has been completed, distal screws were positioning checking with direct visualization

Arthroscopy were indicated in fractures with intra-articular step-off of more than 1 mm after an attempted closed reduction, based on CT scan images measurement; in cases with associated scaphoid fractures and/or obvious ligament injuries with radiological signs; radial styloid fractures with may be part of an incomplete greater arch injury; and impacted such as diepunch fractures.[12]

Concomitant TFCC injuries were classified according to Palmer[13] and Atzei[14] classifications. The decision about treatment depends on arthroscopy evaluation signs. Inspection may reveal central or radial tears and probe was inserted to evaluate the tension applying compressive force: Trampoline test; and traction was applied to the ulnar-most border for identifying foveal detachment: hook test.[14] Central and radial tear are usually not repaired but we can debride synovitis. Palmer IB lesions, with a positive hook test, were repaired with suture or reattachment.

The degree of scapholunate (SL) and lunotriquetral (LT) ligament injury were assessed with Geissler classification (Figure 3).[15] We repaired them with Kirschner-wire temporal fixation. These injuries have the potential to proceed to SL dissociations and secondary carpal instability.

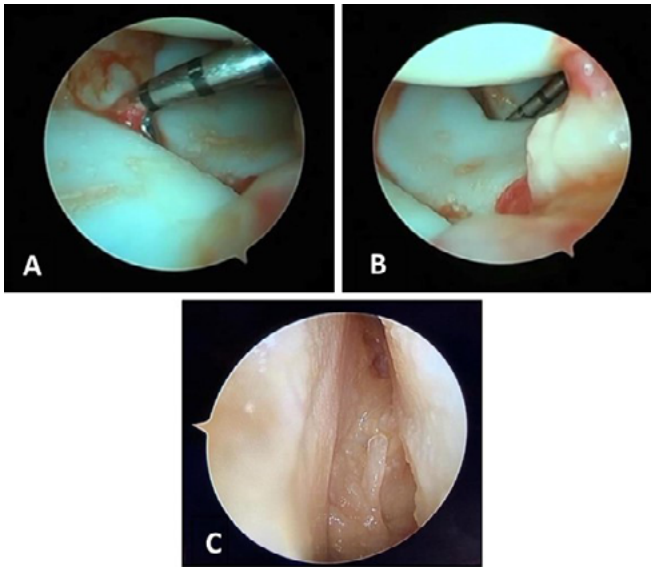



Figure 3 Arthroscopic images demonstrating different types of midcarpal ligament lesions according to Geissler classification. (A) Probe can be inserted between scaphoid and lunate bones, which represents Geissler III of SL ligament lesions. (B) Geissler III lesion of LT ligament, with probe inserted between lunate and triquetral bones. (C) Grade IV of SL ligament. We can introduce arthroscope between scaphoid and lunate bones. Radiocarpal joint can be visualized from midcarpal portals.
Source: Document obtained during the course of the study.

About the postoperative, patients were followed-up in 2 weeks, 6 weeks, 3, 6 and 12 months with physical examination, plain radiographies and functional outcomes, only with subjective evaluation, according pain, range of motion, complications and limitation in regular activities. Physical therapy rehabilitation treatment was started with active motion at 6 weeks and return to activities at 3-6 months in patients with associated injuries.

We also collected data about type of volar plate used, surgery time, presence and classification of triangular fibrocartilage complex (TFCC) and intrinsic midcarpal ligament lesions, their respective management with or without treatment, postoperative care including immobilization and follow-up. Categorical variables were described by absolute frequency and percentage and quantitative variables were described by measures of central tendency (mean, median) and dispersion (SD).

## Results

We included 148 patients with intra-articular distal radius fractures. There were 81 males and 67 females with an average age of 47 years (16-82) (Table 1).

Table 1. Demographic characteristics of patients and preoperative planning with CT scan assessment.

| | | |
|---|---|---|
| **Gender** | Male 81 (55%) | Female 67 (45%) |
| **Age (years)** | 47 ± SD 14,72 (16-82) | |
| **Side** | Right 64 (43%) | Left 84 (57%) |

Qualitative variables are expressed as N= number of patients (percentage=%) and quantitative variables as means ± standard deviation (SD) (range).
Source: own elaboration.

Preoperative CT scan was carried out in 34 patients (23%). The average total time of surgery followed by arthroscopy was 89 minutes (median 85).

During wrist arthroscopy evaluation, we found associated soft-tissues injuries in 99 patients (66%). The predominant lesion was TFCC tears, which were observed in 70 cases (43%).

According to the Palmer classification of TFCC injuries, we identified the highest rate of Palmer ID at 60%, followed by Palmer IB at 30%. The 21 peripheral ulnar-sided tears were classified using the Atzei classification system. About the management of these lesions, 31% were treated (Table 2).

About midcarpal ligament affectations, there were described in 62 cases (42%), SL isolated in 11 (7%) patients and only LT in 4 (3%) patients. These lesions were classified with Geissler classification[15] (Table 3).

About the management of these patients, we decided to treat 31%, according to the type of injury and stability of lunate with direct arthroscopy visualization. The arthroscopy procedure consisted of a thermocoagulation technique in 2 patients (3%); Kirschner-wire (K-wire) temporal fixation in 8 patients (13%) and both of them in 5 patients (8%).[15,16]

About postoperative care, most patients were immobilized with dorsal splints, in 82 of them (55%), that correlation with complex fractures and associated lesions. In other cases, compressive elastic bandages were used in 66 patients (45%). The average follow-up time of patients was 9 months after the time of operation.

Table 2. Results of triangular fibrocartilage complex injuries in patients. Classified and treated according to Palmer classification and peripherical ulnar-sided lesions with Atzei classification.

| Structure affected | N (%) | Palmer | N | Atzei | N | Treatment | N (%) |
|---|---|---|---|---|---|---|---|
| TFCC | 37 (25%) | **IA** | 4 | **Class 1** | 11 | **NO** | 48 (69%) |
| Associated | 33 (22%) | **IB** | 21 | **Class 2** | 7 | **YES** | 22 (31%) |
| TFCC + SL | 14 | **IC** | 0 | **Class 3** | 2 | Suture/reattachment | 12 (17%) |
| TFCC + LT | 7 | **ID** | 42 | **Class 4** | 1 | Debridement | 7 (10%) |
| TFCC + SL + LT | 12 | **II** | 3 | | | Combinate | 3 (4%) |
| Total | 70 (47%) | | | | | | |

TFCC=triangular fibrocartilage complex; SL=scapholunate ligament; LT=lunotriquetral ligament; N=number of patients; %=percentage
Source: own elaboration.

Table 3. Results of evaluation and treatment intrinsic midcarpal ligament (scapholunate and lunotriquetral) injuries in patients according to Geissler classification.

| SL | N (%) | Geissler class | | LT | N (%) | Geissler class | |
|---|---|---|---|---|---|---|---|
| Total | 51 (34%) | I | 4 | Total | 37 (25%) | I | 10 |
| Isolated | 11 (7%) | II | 17 | Isolated | 4 (3%) | II | 12 |
| + TFCC | 14 (9%) | III | 19 | + TFCC | 7 (5%) | III | 13 |
| | | IV | 5 | | | IV | 3 |
| SL + LT ligaments | | | | | 14 (9%) | | |
| SL + LT + TFCC | | | | 12 8%) | | | |
| TOTAL | | | | | 62 (42%) | | |

+ TFCC= associated to triangular fibrocartilage complex tear; SL=scapholunate ligament; LT=lunotriquetral ligament; N=number of patients; %=percentage;
Source: own elaboration

## Discussion

In our study, 66% of patients with this fracture show a concomitant soft-tissue lesion, similar rate to other studies reported.[15] Several studies demonstrate high incidence of associated lesions of TFCC or intrinsic midcarpal ligament in patients with intra-articular distal radius fractures.[10,15,17,18] Those injuries are not usually detected at initial radiographs studies and other techniques are necessary to establish a correct diagnosis and facilitate early treatment. The best procedure is wrist arthroscopy evaluation.[10,16]

The most common injury detected was TFCC tear, what was found in 47% of our patients. That prevalence is similar to several studies reported, which demonstrate a variable rate between 35-78% of TFCC injuries in intra-articular distal radius fractures. Only one study differs from that and shows the highest rate of SL ligament injuries.[18] The actual incidence of the respective injuries is difficult to establish due to different exclusion criteria between series.

The second most frequent associated injuries are intrinsic midcarpal ligament tears. We found scapholunate ligament lesion in 34% of patients and 25% of lunotriquetral ligament one. These results was according to other percentages released in literature.[8]

About the type of TFCC tears, we have 42 patients with Palmer ID lesions and it is determined that is the most common class of lesion, according to other studies described.[8,17]

The use of arthroscopic assisted reduction in the treatment of distal radius fractures remains controversial because some evidence suggests no differences in outcomes if arthroscopy were used for treatment of these fractures.3. However, wrist arthroscopy has demonstrated superiority in assessing the intra-articular step-off, identifying and evaluating chondral and ligament injuries with better radiographs and functional outcomes.[10,19]

The benefit of using arthroscopy in the management of distal radius fractures has been supported by some advantages. We can use to find acute chondral lesions with subchondral hematoma or avulsions, remove fracture debris and hematoma,[12] check the correct position of distal screws of volar locking plate for avoiding that cut through the subchondral bone and penetrate into the radiocarpal joint and obtain a successfully reduction of articular fragments.

According to restoration of right articular anatomy for preventing progression to posttraumatic arthrosis, surgical treatment with arthroscopy assistance is often recommended in intra-articular distal radius fractures with more than 1 or 2 mm displaced step-off.[12] That requires preoperative planning with adequate radiologic study, but plain radiographs could be insufficient. CT scan has been recommended for quantifying fracture patterns such as articular gapping or detection of distal radioulnar joint (DRUJ) involvement in TFCC lesions.[20] Only in 23% of our patients with intra-articular and complex distal radius fractures, CT scan was carried out before operative treatment (Figure 4).

In some cases, standard radiographs are useful in diagnosis of ligament injuries associated to distal radius fractures, but other advanced imaging such as CT scan arthrography or high-resolution magnetic resonance imaging (MRI) are most effective to evaluate SL and LT ligament lesions preoperatively.[21]


Figure 4. Preoperative planning images of described patient with an intra-articular distal radius fracture. AP (A) and lateral (B) of left wrist radiographs after reduction and immobilization with cast; CT scan with coronal (C) and sagittal (D) views is made before surgery treatment for better determination of articular affectation more than 1 mm step-off.
Source: Document obtained during the course of the study.

Once evaluated and graded soft-tissue injuries, it is important to make the appropriate decision of surgical management of these lesions. The long-term functional outcomes after TFCC tears are variable. It depends on the class of injury and the decision of treating these lesions. Several reports have shown that untreated peripheral tears cause painful clicking of the wrist, ulnar-sided tenderness and locking sensation with high incidence and uncommon instability of DRUJ with subsequent worse outcomes.[22] Nevertheless, untreated tears in other locations seemed to be less of a clinical problem than expected. For example, radial tears are usually not repaired owing to the lack of vascularization.[23]

In relation to wrist ligaments, treatment in grade IV of Geissler classification SL ligament tears were established using K-wire pinning[15,16] to temporal fixation for 6 weeks (Figure 5).

Figure 5 Postoperative anteroposterior (AP) X-ray exploration in patient with complex distal left radius fracture, treated with locking volar plate (Geminus® Skeletal Dynamics) and associated to midcarpal ligament injuries were treated with two K-wires fixation (scapholunate and lunotriquetral). Source: Document obtained during the course of the study.

Grades I and II of Geissler were treated with immobilization or thermocoagulation in any cases. Grade III lesions treatment are controversial, conforming to carpal instability. If left untreated, these lesions are likely to progress to scapholunate dissociation[6,19] and symptomatic carpal instability which in long-term leads to posttraumatic scapholunate advanced collapse (SLAC).[10,16] There is no evidence that lunotriquetral tears lead to long-term complications. Only association with ulnar impaction syndrome has been described.[16]

Some publications report disadvantages[12,16] of wrist arthroscopy can be the increase of direct costs and surgical time, even so they can be solved by experience of surgeons and management in expert centers. Surgery time observed in our results was 89 minutes (median 85; range 25 to 241) and it can be correlated to other orthopedic surgeries. The increase of this time has been influenced by complex fractures, bilateral upper extremity affected and other associated fractures in polytrauma patients.

Complications arising from wrist arthroscopy technique are uncommon. No complications were found. The overall rate has been estimated at 2% in the literature.[16,24] The complications described was nerve, tendon, vascular injuries, postsurgical joint infection, wrist stiffness, ganglion formation, iatrogenic cartilage damage, compartment syndrome of reflex sympathetic dystrophy.[25]

In summary, we emphasize the importance of considering the use of arthroscopy assistance for surgery management in intra-articular distal radius fractures with a correct indication and initial evaluation. Postoperative care with immobilization is conditioned by the presence of associated lesions, which are relevant in functional recovery, return to work and the ability to perform daily activities of patients.

Limitations: it is a descriptive study with their respective limitations that include the lack of ability to generalize, no possibility to establish causality and performance bias because of different surgeons in the interventions. The average follow-up time was relative short. Validate scores are necessary to evaluated functional postoperative results.

On the other hand, the strength of this study is the large number of patients collected. Same surgeons and surgical procedure were performed in all cases. More studies with higher level of evidence and larger sample size are necessary to determine the relationship between injuries with intra-articular distal radius fractures and determine the value of arthroscopy management.

## Conclusions

Concomitant injuries were found in 66% of patients with intra-articular distal radius fractures. The most common is the TFCC affectation in 47% of our cases, followed by intrinsic midcarpal ligament lesions in 42%. Both of them were observed in 22%. That supported the value of using arthroscopy assistance in operative management of distal radius fractures.

## Conflicts of interest

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