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Injuries associated to distal radius fractures. Arthroscopic diagnosis

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Original article

Injuries associated to distal radius fractures. Arthroscopic diagnosis

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SUMMARY. ***Introduction.*** **With a distal radius fracture, the proper bone anatomy structure restoring is essential to minimize complications. However, there are aggregate injuries which, sometimes are not recognized or diagnosed. Therefore, they are not treated and make the wrist a dysfunctional joint. The purpose of our study is to make an arthroscopic diagnosis of intra-articular injuries associated to distal radius fractures and treated with surgery and rehabilitation therapy presenting as a pain sequel and functional limitation. We also wanted to check whether the baseline fracture X-rays show information suggesting associated injuries.** ***Material and methods.*** **We conducted an observation, prospective, cross section, descriptive open ended study between January and December 2003. We performed 20 wrists arthroscopies on 20 patients who had suffered distal radius fracture and had been treated by closed or open reduction and fracture fixation with pins, external fixation, T plate or a combination of these with or without bone graft. Time lapsed between the fracture and the arthroscopy was an average of 5 months. With the arthroscopic procedure a triangular fibrocartilage complex (TFC) injury was intentionally searched. These injuries were classified according to Palmer. Other injuries searched were Outerbridge type chondral injuries and complete or partial injuries of interosseal ligaments.** ***Results.*** **Results show that all patients (100%) suffered some associated injury. In all cases we saw intra-articular bridle formation and certain degree of fibrosis. Chondral injury was seen in 85% of patients and it was the most common**

RESUMEN. ***Introducción.*** **Ante una fractura distal del radio la adecuada restitución de la anatomía ósea es esencial para minimizar las complicaciones; sin embargo, existen lesiones agregadas que en ocasiones no son reconocidas o diagnosticadas y por lo tanto no tratadas que hacen de la muñeca una articulación disfuncional. El objetivo de nuestro estudio es hacer un diagnóstico artroscópico de las lesiones intra-articulares que se asocian a las fracturas distales del radio ya tratadas quirúrgicamente y con rehabilitación que presentan como secuela dolor y limitación funcional y verificar si en las radiografías iniciales de la fractura se observan datos que sugieran lesiones asociadas.** ***Material y métodos.*** **Realizamos un estudio observacional, prospectivo, transversal, descriptivo y abierto de enero a diciembre del 2003. Practicamos 20 artroscopías de muñeca a 20 pacientes que habían sufrido fractura distal del radio tratados mediante reducción cerrada o abierta y fijación de la fractura con clavillos, fijador externo, placa en T o una combinación de éstos con o sin injerto óseo. El tiempo de evolución desde la fractura hasta el momento en que se efectuó la artroscopía fue de 5 meses en promedio. Con el procedimiento artroscópico se buscó intencionadamente lesión del FCT, las cuales se clasificaron de acuerdo a Palmer, lesiones condrales según los tipos de Outerbridge, y lesiones completas o parciales de ligamentos interóseos.** ***Resultados.*** **Los resultados demuestran que todos los pacientes (100%) sufrieron alguna lesión asociada; en todos los casos observamos formación de bridas intra-articulares y algún grado de fibrosis. La lesión condral estuvo presente en 85% de los pacientes, siendo más frecuente en la superficie articular del radio (60%).**

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on the articular surface of the radius (60%). In 12 (60%) patients, we found an injured TFC mostly on the cubital insertion. The interosseal ligament injury was seen in 25% of patients. *Conclusions.* In all cases, radius distal fracture was accompanied by associated injuries with chondral injuries being the most frequent followed by TFC injuries and interosseal ligament injuries ranking third. We found a direct relationship between the fracture class and the type of associated injury and less interosseal ligament injuries, contrary to what we saw in extra-articular fractures. TFC injuries were also more common in joint fractures. Baseline X-rays were predictive of associated injuries.

Key words: wrist, radius, fracture, arthroscopy.

En 12 pacientes (60%) encontramos lesión del fibrocartílago triangular, mayoritariamente en su inserción cubital. La lesión de los ligamentos interóseos la observamos en 25% de los pacientes. *Conclusiones.* La fractura distal del radio se acompañó de lesiones asociadas en todos los casos, siendo la lesión condral la más frecuente, seguida por las lesiones del FCT y en tercer lugar las lesiones de los ligamentos interóseos. Encontramos una relación directa entre la clase de fractura y el tipo de lesión asociada: en fracturas articulares ocurrió más lesión condral y menos lesión de ligamentos interóseos, contrario a lo observado en la fractura extra-articular. La lesión del FCT también fue más frecuente en la fractura articular. Las radiografías iniciales resultaron predictivas de lesiones asociadas.

Palabras clave: muñeca, radio, fractura, artroscopía.

Introduction

Distal radius fracture is the most frequent of the chest limb injuries. The proper restoration of bone anatomy is essential to minimize complications. It may be conducted conservatively or with surgery by internal fixation with percutaneous pins or plates, external fixation, or a combination of both with or without bone graft, depending on the type of fracture.[8,20] However, there are aggregate injuries that sometimes are not recognized or diagnosed and therefore, remain untreated making the wrist a dysfunctional joint characterized by pain and limited arches of motion of the radiocarpal joint, the ulnocarpal joint and/or the distal ulnoradial joint that may even lead to arthrosis and limit the patient's ability to carry out daily, sports, or labor activities conditioning, many times, the temporary or permanent disability in the patient.

The injuries most frequently associated to distal radius fractures correspond to cubital styloid avulsion, chondral carpal, radius and ulna injuries, capsule ligament injuries, and triangular fibrocartilage complex (TFC) injuries.[3,9,14,18] Richards et al arthroscopically examined the wrist on distal radius fractures requiring surgery and found that 35% of intra-articular injures and 53% of extra-articular injuries were associated to TFC injuries.[22] Short[19] reports that in the presence of a dorsal angulation of the radius at 45°, the ulnocarpal joint and TFC bear 65% of axial strains. Ulna impaction on the lunate ligament may produce lunate-pyramidal ligament tear.[4,19]

Imaging diagnosis available today is helpful but not definite in detecting injuries associated to distal radius fractures. Arthrography diagnoses radial TFC injuries and lunate-pyramidal ligament tears. However, other injuries are frequently overlooked. Golimbu, Skahen et al, claim that magnetic resonance imaging (MRI) detects central and radial TFC injuries with 95% sensitivity. Bednar et al. claim that sensitivity is only 44% and specificity is 75%. They recommend arthroscopy for a final diagnosis. Pederzini performed an arthrogram, MRI and arthroscopy in 11 patients with TFC injuries and found 100% specificity with arthroscopy versus 80% and 82% per cent in arthrography and MRI respectively.

Arthroscopy is the standard pattern in detecting TFC, ligament and intra-articular injuries while providing therapeutic possibilities. Degenerative and irreparable tears may be debrided and reparable tears may be immediately treated.[12,22]

The purpose of our study is to make an arthroscopic diagnosis of intra-articular injuries associated to distal radius fractures, already treated with surgery and rehabilitation showing sequels of pain and functional limitation. We wanted to check whether baseline fracture X-rays show information suggestive of associated injuries and confirm whether these associated injuries are more common in complete, partial, distal radius intra-articular or extra-articular injuries.

Material and methods

We conducted an observation, prospective, cross section, descriptive, open study between January and December 2003. During this period of time, we treated 80 patients with clinical and radiological diagnosis of distal radius fracture treated with closed or open reduction and fracture fixation with pins, external fixation, T plates or a combination of these with or without bone graft. We included those who, after a rehabilitation pro-

Table 1.

Pati-ent	Gender	Age	Site	Mechanism (comp. Axial)	Dx, Fx (23…)	Avulsion Ulna StyloidA	Inclination Radius AP (°)	Inclina-tion Radius Lateral (°)	Ulna Variance (mm)	Dorsal angle (°)	Palmar angle (°)	Surgery	History (weeks)	TFC Injury	Chondral Injuries				Ligament injury		
															R	Sc	Cr	C	Sc	LP	RSc
1	M	57	Left	Hyperextension	A2.2	Yes	14	10	-3	8	-	Fixator	40.4	-	III	IV	-	-	-	-	SI
2	M	40	Right	Hyperextension	A2.2	Yes	14	20	+2	22	-	Fixator	28.0	Radial	-	-	-	-	-	-	-
3	F	31	Right	Hyperextension	A2.2	Yes	45	17	+3	13	-	Fix/graft	21.4	Ulnar	II	-	-	-	-	-	-
4	F	49	Left	Hyperextension	A2.2	Yes	30	2	0	30	-	T plate	22.6	-	IV	-	-	-	-	SI	-
5	F	26	Right	Hypertension	A3.1	No	30	12	+1	4	-	Fixator	13.6	-	-	-	-	-	-	SI	-
6	M	36	Right	Hyperextension	A3.3	No	22	17	0	12	-	T plate	12.4	-	-	II	-	-	SI	-	-
7	F	65	Right	Hyperextension	B2.1	Yes	20	22	+2	18	-	Fixator	40.5	Radial	IV	-	IV	-	-	-	-
8	F	22	Right	Hyperflexion	B2.1	Yes	15	4	+2	-	13	T plate	14.5	Central	-	-	II	-	-	-	-
9	F	62	Right	Hyperextension	B2.1	No	9	25	+4	25	-	Fix/graft	20.6	-	-	-	III	-	-	-	-
10	F	47	Left	Hyperextension	B2.2	No	8	11	+3	13	-	T plate/pins	32.2	Central	-	II	-	-	-	-	-
11	M	45	Right	Hyperextension	B3.1	No	14	20	0	18	-	Fix/graft	13.1	-	-	II	-	-	SI	-	-
12	M	33	Left	Hyperflexion	B3.3	Yes	14	6	+2	-	11	T plate	15.0	Ulnar	-	-	-	-	-	-	-
13	F	34	Left	Hyperextension	C1.2	No	8	22	0	22	-	Fixator	12.3	-	IV	-	IV	-	-	-	-
14	F	42	Right	Hyperflexion	C1.2	Yes	20	6	+2	-	6	Fixator	22.3	Ulnar	III	-	-	IV	-	-	-
15	M	39	Left	Hyperextension	C3.1	Yes	12	23	+2	18	-	Fix/graft	18.4	Ulnar	IV	-	-	-	-	-	-
16	M	57	Right	Hyperextension	C3.2	Yes	24	30	+3	30	-	Fix/pins	43.4	Ulnar	IV	III	-	-	-	-	-
17	F	38	Left	Hyperextension	C3.2	Yes	10	16	-1	5	-	Fix/pins	18.2	-	IV	IV	-	-	-	-	-
18	M	50	Left	Hyperextension	C3.2	Yes	22	25	+2	8	-	Fixator	13.0	Ulnar	IV	-	-	-	-	-	-
19	F	63	Right	Hyperextension	C3.2	Yes	8	8	+5	-	7	Fix/pins	18.6	Ulnar	IV	-	IV	IV	-	-	-
20	M	40	Left	Hyperflexion	C3.3	Yes	4	6	+3	-	5	Fix/pins/ Graft	8.0	Central	IV	IV	IV	-	-	-	-

Source: Clinical files, "Lomas Verdes" Trauma and Orthopedics Hospital, X-ray files, Arthroscopic surgery

gram had diminished mobility, pain and/or functional limitation as a sequel. We excluded those who did satisfactorily or who refused to submit to arthroscopy.

We performed 20 wrist arthroscopies on 20 patients (*Table 1*). Of these, 11 were females and 9 males. Average age was 44 years (ranging from 22 to 65). Eleven patients worked at home, 3 were clerks, 2 blue collar workers, two supervisors, one businessman, and one driver. The prevailing (80%) mechanism of injury was axial compression and hyperextension. The baseline diagnosis of the injury according to the OA classification was extra-articular fracture (23A) in 6 patients and complete fracture (23C) in 8 patients, dorsal angulation under pressure of the styloid process of the ulna, 70%. Sixty per cent of patients showed alteration of the radius inclination on the AP projection and 95%, alteration on the radius inclination on the lateral projection. Positive ulna variance (cubital rather then radial) showed in 70% of fractures. Initial treatment of the fracture was closed reduction and stabilization with external fixation in 75% of patients and open reduction with T plate fixation in the remaining 25%.

Time lapsed between the fracture and the arthroscopy was an average of 6 months. With the procedure, we intentionally looked for a TFC injury classified according to Palmer,[17] Outerbridge type injuries,[1] and complete or partial interosseal ligament injuries.

Results were analyzed with a computer program, version 11, by descriptive statistics having a central trend (averages and frequencies) at the time of fractures in order to take X-rays predictive of injuries associated to distal radius fractures.

Surgical technique. The patient is kept in a decubitus position, holding a support with the upper limb, having the second and third fingers in abduction held with thimbles and putting distraction on the radiocarpal joint *(Figure 1)*. The main access portal pathway is 3-4 (third compartment) located 1 cm distal to the tuberculum radius between the common long thumb extensor tendon: a second portal is inserted, 4-5 between the index extensor and the little finger extensor, and portal 6R, placed between the little finger extensor and anterior, was also used. 10 ml of saline solution were given and the 2.7 mm instrument was introduced at a 30° angle. The radius and ulnocarpal relationship is checked and the fibrosis is debrided through the portal with a 3.0 shaver using radiofrequency to visualize the joint structures (radial process, radius lateral facet and medial with its crest, navicular, lunate, ulna, TFC, cubital prestyloid, and radionavicular ligaments, radiolunate, naviculolunate, radionaviculolunate, ulnolunate, ulnopyramidal, and pyramidal-lunate ligaments) and we determined whether there is any injury to these structures associated to the distal radius fracture. For better visualization of the TFC or the ulna side structures, we recommend using portal 6R.

Figure 1. Wrist arthroscopy with radiocarpal joint distraction.

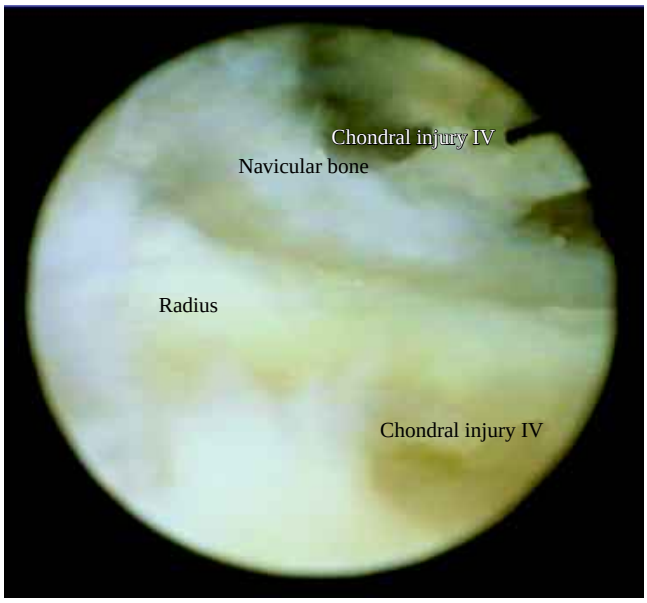


Figure 2. Chondral injury IV of the radius and navicular bone.

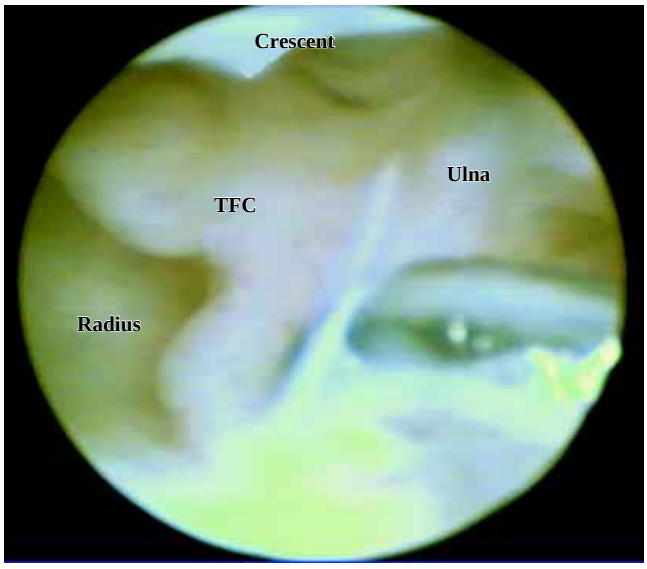


Figure 3. Radial injury of the TFC.

Results

The results *(Table 1)* show all patients (100%) suffered some associated injuries. In all cases we saw intra-articular bridle formation and some fibrosis. The chondral injury was present in most cases. Eighty five per cent of patients showed at least one injury, the most common being on the radius articular surface (60%), followed by the navicular bone *(Figure 2)*. Fifty five per cent of patients had more than one chondral injury. Sixty six per cent of injuries (22 to 27) were Grade IV injuries. 12 patients (60%) had TFC injuries mostly of their ulnar insertion (*Figure 3*). Interosseal ligament injuries were less frequent. They were found in only 25% of patients and never involved more than one joint.

In correlating the type of fracture to the arthroscopic findings *(Charts 1, 2, 3, and 4)* we saw that in eight complete joint fractures (23C) 100% had some chondral injury; only one was grade IV; 75% suffered from a TFC injury but no patient had an interosseal ligament injury. In six partial joint fractures (23B) 83.3% of patients suffered from chondral injury; 66.6% had TFC injuries, and only one had an interosseal ligament injury. Finally in six extra-articular (23A) fractures, 66.6% of patients had chondral injuries, 33.3% TFC injuries and 66.6% interosseal ligament injuries.

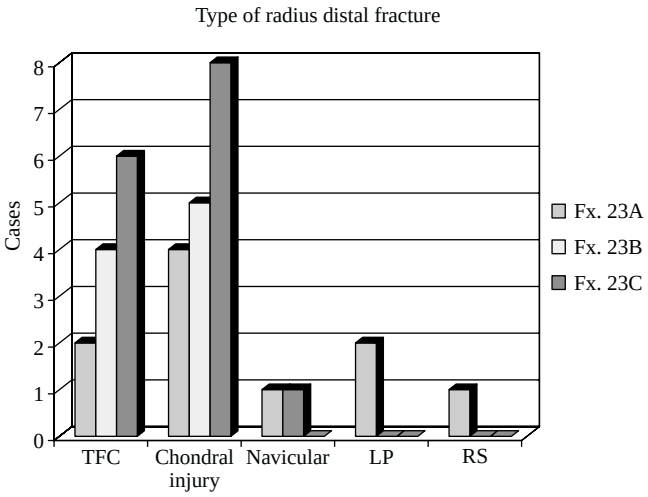
In correlating the X-ray alterations with arthroscopic findings we saw that in 78.5% of cases with ulna styloid process avulsion and in 85.7% of cases with positive ulnar variance there were TFC injuries.

Because of fibrosis, all patients had their joint cleaned in addition to chondroplasty with radiofrequency. This resulted in less pain and improved arches of motion.

Discussion

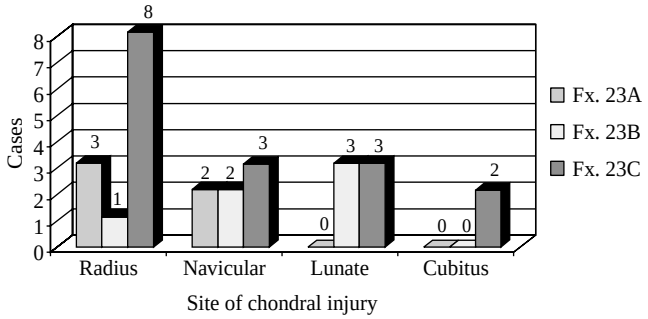
Arthroscopy allows for a direct visualization of the intra-articular wrist structures. It is, therefore, an excellent means to diagnose and sometimes treat injuries associated to distal radius fractures being overlooked on the initial X-ray, arthrography, CT scan and even MRI.

Reports on injuries associated to radius distal fractures arthroscopically diagnosed were taken in the acute phase treating the fracture at the same time[19] while other authors report TFC injuries conditioning instability secondary to the radius distal fracture.[9] In our study, arthroscopy was performed with diagnostic purposes once the fractures were treated by surgical reduction, even with traction, while patients continued to experience pain and limited arches of motion as a sequel with an average time course



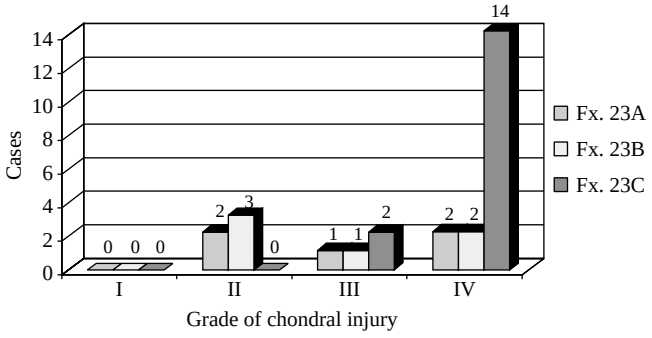
Source: Table 1

Chart 1. Frequency of injuries associated by type of distal radius fracture.



Source: Table 1

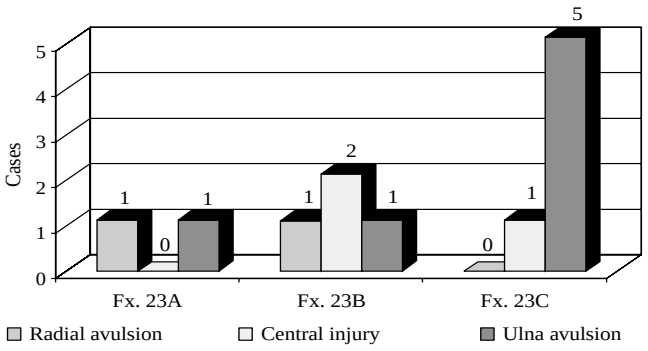
Chart 2. Distribution of chondral injuries by injury site and type of fracture.



Source: Table 1

Chart 3. Distribution of chondral injuries by type of fracture based on the Outerbridge classification.

of 22 weeks. The injury mechanism showing axial compression and hyperextension in 16 cases, had dorsal angulation of these fractures, the injury most commonly reported by the literature.



Source: Table 1

Chart 4. Frequency of TFC injuries about the Palmer classification, by type of fracture.

In arthroscopy findings we had patients with chondral injuries grade II through IV of different wrist bones. The radius was involved more often, having found injuries in 12 patients. All had complete and partial intra-articular chondral fractures Grade III and IV, especially the lunate and navicular ligaments. Only one patient with partial intra-articular fracture and two with extra-articular fractures, showed no chondral injury. There is little information in the literature about the chondral injury grade and location of the fracture. Most of these emphasize the TFC fracture and then the ligament injuries. However, these injuries should be expected to lead to wrist arthrosic changes and therefore, functional limitation and pain.

Other reports confirm 60% of our patients suffer from other injuries at a more frequent incidence of the injury on the radius side. The most frequent were ulnar injuries and correspond to ulnar avulsion. We reported only two cases of injures for the 6 extra-articular injuries against 10 intra-articular injuries (partial or complete) contradicting the literature reporting TFC injuries in extra-articular fractures in about 60% versus 41% of intra-articular fractures.[19]

In this case report we saw a frequency of interosseal ligament injuries in all 20 patients with a prevalence of extra-articular fractures. Twenty eight per cent prevailed on intra-articular fractures. Of those, 2 were navicular ligament injuries, two were lunate-pyramidal ligament injuries, and one was a radionavicular ligament injury. These are the three most injured ligaments reported in the literature with navicular ligament injuries in 15% to 20% of cases, lunate-pyramidal in 7% to 23% of cases, and radionavicular ranking third.

In radiology parameters we see that 70% of our patients had ulna styloid avulsion which was more frequent in intra-articular fractures contrasting with the report by Richards where extra-articular injuries were more frequent. Ninety one per cent of TFC fractures shown were related to ulna styloid avulsion. Richards, however, found no relationship.[18]

The AP projection showed twelve patients having altered inclination angle of the distal radius joint surface. There was no relationship to associated injuries. The lateral projection showed that only one patient had normal inclination but, again, no relationship to intra-articular lesions was determined.

In terms of ulna variance reflecting the degree of radius shortening by the fractures, most patients presented radius shortening and in 12 cases with TFC injury, they were related to a positive ulna variance. This is consistent with other reports.

We found no relationship between dorsal or palmar angulation of the fracture and the interosseal ligament injuries. As for the TFC, 5 cases presented with palmar angulation of the fracture against 7 cases in dorsal angulation. We, therefore, found no relationship unlike the reports in the literature where TFC injuries are more common in dorsal fracture angulations.

Conclusions

1. The distal radius fracture accompanies associated injuries in all cases with the chondral injury being the most frequent followed by TFC injuries and then by interosseal ligament (navicular, lunate-pyramidal, and radionavicular ligament) injuries.
2. We found a direct relationship between the class of fracture and the type of associated injury: in joint fractures more than one chondral injury and less interosseal ligament injuries occurred, contrary to the observations in extra-articular fractures. TFC injuries were also more frequent in joint fractures.
3. Baseline X-rays were predictive of injuries associated to the following cases:
   - Complete joint fracture conditioning chondral injuries in 100% of cases, in one or more sites.
   - Styloid process fractures associated to TFC injuries, at the ulna level, with 78.5% sensitivity and 83.4% specificity.
   - Positive ulna variance (prevalence in length of ulna over radius). This translates into shortening of radius, conditioning TFC injuries with 85.7% sensitivity and 100% specificity.
   - There was no relationship between the baseline X-rays and interosseal ligament injuries.

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