Little Fragments, Big Problems: The Role of Little BITs in Distal Radius Fracture

Pequeños Fragmentos, Grandes Problemas: El Rol de los "Little BITs" en la Fractura del Radio Distal

Camila Azócar[1] José Luis Cifras[2] Pablo Orellana[1] Gonzalo Corvalán[1,3] Gabriel Durán[4] Rodrigo Liendo[5]

[1] Department of Orthopedics and Traumatology, Hand Team, Clínica Indisa, Santiago, Chile
[2] Department of Orthopedics and Traumatology, Hand Team, Hospital Regional de Talca, Universidad de Talca, Chile
[3] Department of Orthopedics and Traumatology, Hand Team, Hospital San José, Santiago, Chile
[4] Emergency Department, Hospital Mutual de Seguridad, Santiago, Chile

Address for correspondence Camila Azócar Sanhueza, MD, Camino el Parque 100, depto 2801, edificio Cedro, Vitacura, Santiago, Chile (e-mail: camiazocars@gmail.com).

[5] Department of Orthopedics and Traumatology, Shoulder Team, Universidad Católica de Chile, Chile

Rev Iberam Cir Mano 2023;51(1):e31–e40.

Abstract

Introduction Intra-articular fracture of the distal radius may have fragments deemed especially complex because of the difficulty in their synthesis or their relevance in joint stability. Little BITs are these small fragments that we must BE AWARE of, IDENTIFY properly, and TREAT CAREFULLY. The Little BITs consist of the small dorsal ulnar fragment (DUF), the radial or central depression (CD), and the small or comminuted volar rim fragment (VRF). This study aims to describe the Little BITs and evaluate their frequency in intra-articular fractures of the distal radius. In addition, we propose surgical possibilities for their treatment.

Method This is a retrospective study of clinical and imaging records of a series of 201 patients with distal radius fractures undergoing surgical treatment. We evaluated demographic variables, AO classification, and the presence of Little BITs in computed tomography (CT) scans.

Results The study included 173 patients, 60% male, and a mean age of 48.5 years. Most (96.5%) presented type C fractures according to the AO classification. At least one Little BIT was present in 61.3% of the patients. DUF was the most frequent (35.3%), followed by VRF (24.3%) and CD (13.3%). Only two patients had the three Little BITs at the same time.

Conclusion Little BITs are frequent in intra-articular distal radius fractures, being detected in 61.3% of our series.

Keywords
- distal radius fracture
- wrist arthroscopy
- hand surgery

received
October 3, 2022
accepted
March 7, 2023

DOI https://doi.org/10.1055/s-0043-1769603.
ISSN 1698-8396.

Thieme Revinter Publicações Ltda., Rua do Matoso 170, Rio de Janeiro, RJ, CEP 20270-135, Brazil

Resumen

Introducción En la fractura intraarticular del radio distal existen fragmentos que son especialmente complejos por su dificultad en la síntesis o su importancia en la estabilidad articular. Los Little BITs hacen referencia a estos fragmentos pequeños que hay que BUSCAR dirigidamente, IDENTIFICAR de manera adecuada y TRATAR correctamente. Definimos como Little BITs al fragmento dorsal ulnar pequeño (FDU), al hundimiento radial o de la porción central (HR) y al fragmento pequeño o conminuto del volar rim (FVR). El objetivo de este trabajo es describir los Little BITs y determinar su frecuencia en las fracturas intraarticulares del radio distal. Además, proponemos alternativas quirúrgicas para su manejo.

Método Estudio retrospectivo de evaluación de registros clínicos e imagenológicos de una serie de 201 pacientes operados por fractura del radio distal. Se evaluaron variables demográficas, clasificación AO y presencia de los Little BITs en la tomografía computada.

Resultados Se incluyeron 173 pacientes, 60% de sexo masculino con edad promedio de 48,5 años. 96,5% correspondían a fracturas tipo C de la AO. 61,3% de las fracturas tenían al menos un Little BITs, siendo el FDU el más frecuente (35,3%) seguido por el FVR (24,3%) y finalmente el HR (13,3%). Solo 2 fracturas contaban con los 3 Little BITs de manera simultánea.

Conclusión Los Little BITs son frecuentes en la fractura intraarticular del radio distal estando presentes en un 61,3% de nuestra serie.

Palabras Claves

- fractura del radio distal
- artroscopía de muñeca
- cirugía de mano

Introduction

Distal radius fracture (DRF) is among the most frequent fractures in the Emergency Department. It affects men and women with a bimodal peak and can result from low-energy falls in older patients or high-energy accidents in younger subjects.[1–4]

Even though there is no consensus on its management in all patients,[3–5] surgical treatment is superior in cases with specific radiological criteria of poor prognosis, including intra-articular involvement, especially in the active population.[3,4]

Multiple classifications have been described over the years trying to order the different fracture patterns;[3,6] however, these classifications seem insufficient to guide specific surgical treatment and have low inter- and intra-observer correlation.[7,8]

Recently, the routine use of computed tomography (CT) as a preoperative test led to a better knowledge of fracture patterns and the specific assessment of the different fragments involved,[9] improving preoperative planning.

Several authors,[9] including our research group,[10] have shifted from pattern-based fracture classification systems to fracture-specific fragment assessment systems. This shift allows a targeted evaluation of each joint fragment involved in the fracture and the specific planning of the appropriate type of osteosynthesis for anatomical reduction and maintenance of the required stability for early rehabilitation.

Inadequate assessment of intra-articular fragments can lead to insufficient preoperative planning, poor fracture reduction, and intra- and postoperative complications[11] such as intra-articular screws, loss of secondary reduction, secondary osteoarthritis, and the need for second osteosynthesis or salvage surgeries as arthrodesis (►**Fig. 1**).

These are significant issues for the patient since they generate bad clinical outcomes, alterations in daily life, work and sports activities, and high economic costs.

To reduce the risk of poor outcomes and associated complications, we have devised a system for DRF evaluation in preoperative CT scans, emphasizing small fracture fragments that can go unnoticed and generate problems of lack of reduction, poor fixation, or joint instability. Many of these fragments frequently require specific reduction maneuvers or synthesis methods beyond the classic use of the volar-locked plate.

This paper aims to describe these small fragments, called "Little BITs," and determine their frequency in a series of surgically managed DRFs. In addition, we propose different osteosynthesis methods to achieve the expected anatomical reduction and stability.

Material and Methods

Assessment of Distal Radius Fracture

Our evaluation system is based on preoperative CT images in the most proximal axial section to the joint. It begins with identifying the three basic corners of the distal radius: the radial corner or central portion, the dorsoulnar corner, and the volar rim corner (►**Fig. 2**). This system allows the clear identification of the largest fragments and the definition of a

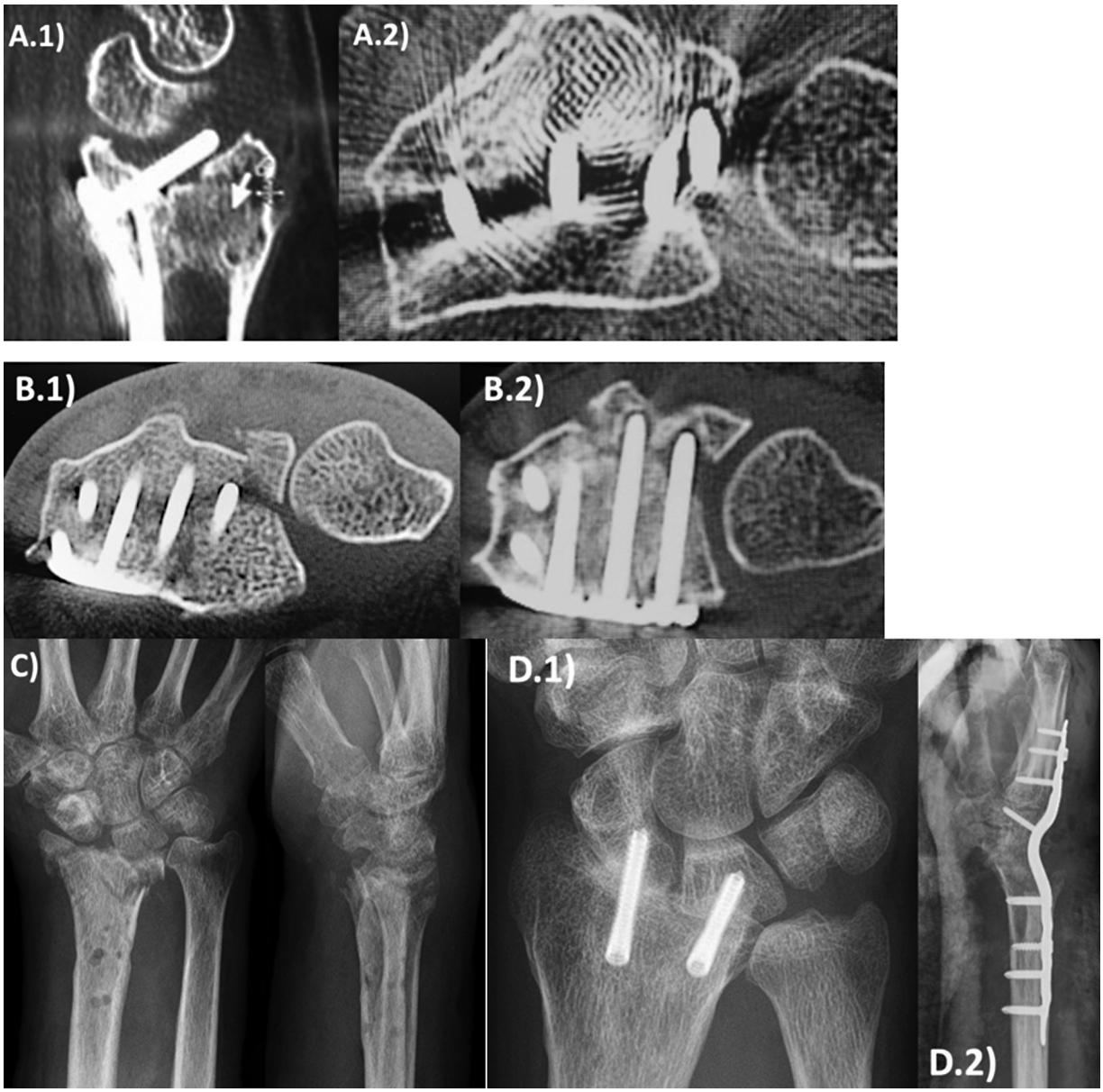

Fig. 1 Major issues in distal radius osteosynthesis surgery. (**A**) Intra-articular screw. (**B**) Dorsoulnar fragment displaced by the osteosynthesis material, generating a gap in the distal radioulnar joint. (**C**) Secondary osteoarthritis after osteosynthesis removal. (**D**) Salvage surgeries: radioscapholunate arthrodesis and total wrist arthrodesis.

surgical plan by evaluating the type of osteosynthesis to perform.

Little BITs

Little BITs consist of the following fragments (►**Fig. 3**):

- Radial corner or central depression (CD)
- Small dorsoulnar fragment (DUF)
- Small or comminuted volar rim fragment (VRF)

These small articular fragments are the Little BITs, an acronym for "Be aware," "Identify," and "Treat carefully" (►**Fig. 4**). This name is a reminder to look for these fragments, so they do not go unnoticed.

Study Design

This is a retrospective observational study of electronic clinical records and imaging. We evaluated a consecutive series of 201 DRFs operated between 2017 and 2019 according to the patient's gender and age, preoperative radiographs and CT scans, AO fracture classification, and Little BITs detection. We excluded patients with no preoperative CT and those presenting extra-articular fractures.

We analyzed the results as proportions and average values per Chi^2 and T-student statistical tests, establishing $p < 0.05$ as a statistically significant difference, using the STATA 15 software.

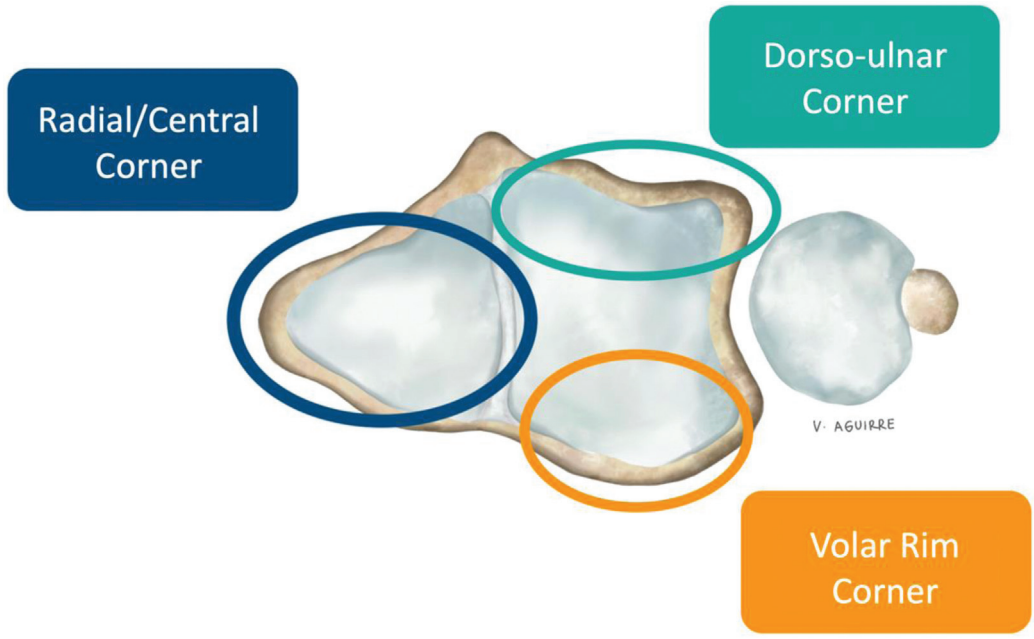

Fig. 2 Distal radial corners.

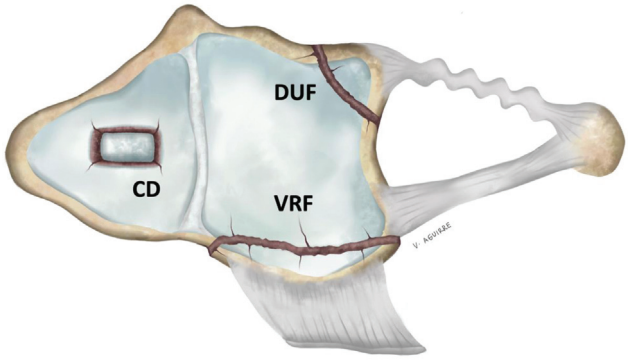

Fig. 3 Little BITs. DUF = Dorsoulnar Fragment; CD = Central Depression VRF; = Volar Rim Fragment.

B	Be aware	Buscar
I	Identify	Identificar
T	Treat carefully	Tratar Correctamente

Fig. 4 Little BITs acronym.

Results

We assessed 173 DRFs after applying exclusion criteria. Most patients were male (60.1%), and their mean age was 48.5 years (standard deviation [SD], 13.4 years). Most (96.5%) cases were type C fractures per the AO classification, and only 3.5% were type B fractures.

In total, 61.3% of the DRFs had at least one Little BIT. A small DUF was the most frequent (35.3% of the cases). In addition, we detected a small or comminuted VRF in 24.3% and a DC in 13.3% of the cases (►**Fig. 5**). Only two fractures (1.2%) had the three Little BITs at the same time.

We compared the average values using a t-test and found no statistical differences in Little BITs' presence according to age ($p = 0.10$). Similarly, there were no statistical differences regarding the presence of Little BITs per gender using the Chi^2 test of proportions ($p = 0.46$).

Discussion

The correct and complete DRF evaluation is essential for preoperative planning. It allows the anticipation of potential difficulties during surgery, the preparation for an eventual supplementary osteosynthesis, and the reduction of short- and long-term poor clinical outcomes.

Large fragments are often properly synthesized through a volar approach with locked plates, achieving adequate joint reduction and good clinical outcomes. Less than 5% of the cases required dorsal plates.[12]

Smaller fragments usually require targeted reduction because they are not adequately identified and treated. In addition, these fragments often compromise joint stability both in the radiocarpal and distal radioulnar (DRU) joints. If not properly stabilized, they can lead to a secondary loss of reduction.

Hintringer et al.[9] performed a complete evaluation of the different DRF fragments and focused on the key fragments to

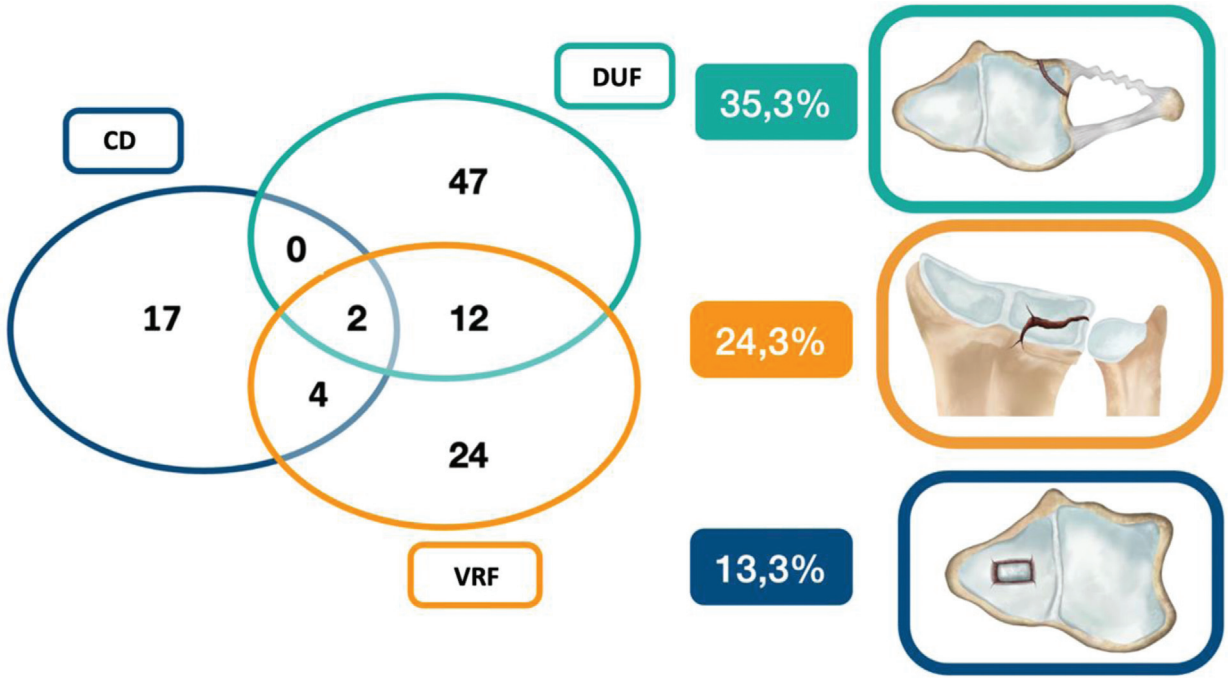

Fig. 5 Summary of the consequences of Little BITs. DUF = Dorsoulnar Fragment; CD = Central Depression; VRF = Volar Rim Fragment.

achieve an adequate reduction and osteosynthesis for each case. Their approach, like ours, is to emphasize the most significant fragments and those that may difficult the osteosynthesis, beyond focusing only on existing classifications and fracture patterns, which we know are insufficient.[7,8]

Our study emphasizes the complete analysis of preoperative CT in DRF. Searching for, identifying, and correctly treating the fragments that usually cause difficulties at fracture synthesis allows detailed surgical planning to avoid unforeseen events during surgery. The Little BITs defined in this study are small fragments. Their synthesis is usually difficult, compromising the carpal radius and DRU joint stability. In addition, the lack of adequate treatment generates worse clinical outcomes.[13]

DC (►**Fig. 6**) is significant because its reduction requires direct maneuvers since it is often unfeasible to mobilize it

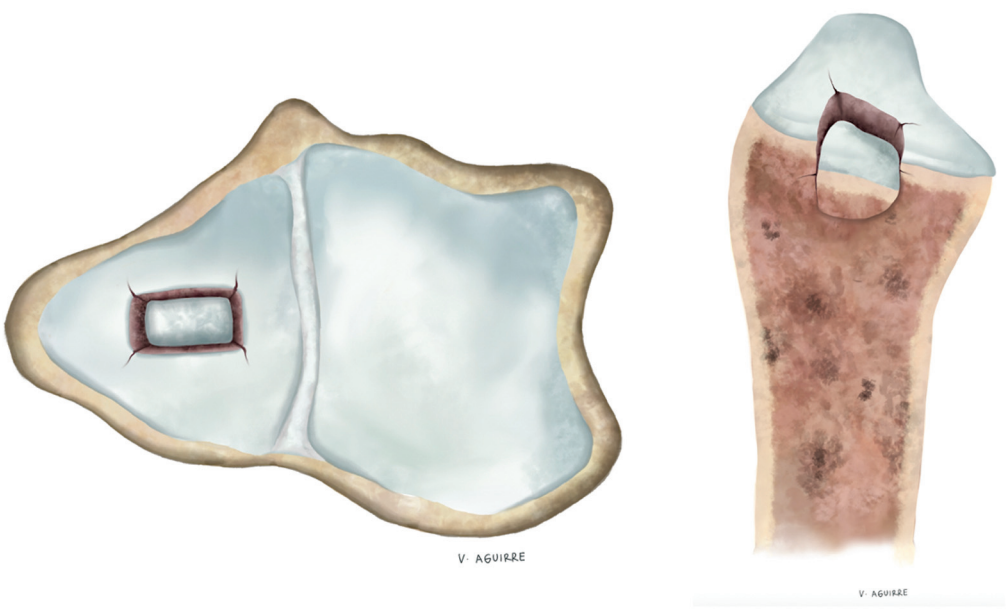

Fig. 6 Radial corner or central depression

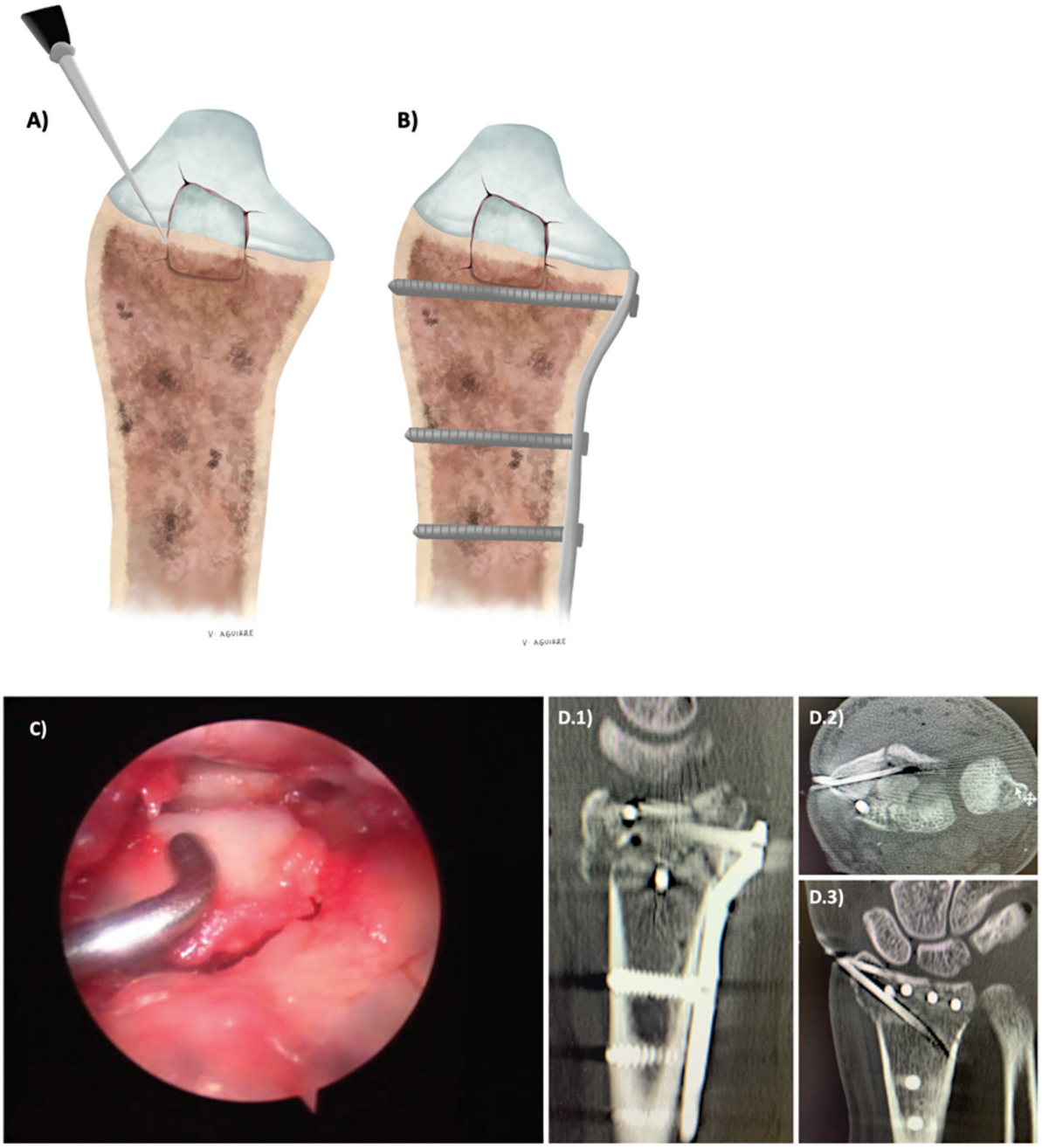

Fig. 7 Radial central depression reduction and osteosynthesis. (**A-B**) Fragment reduction and osteosynthesis scheme. (**C**) Image of the arthroscopic reduction with a palpation device. (**D**) Images of osteosynthesis with wires outside the plate.

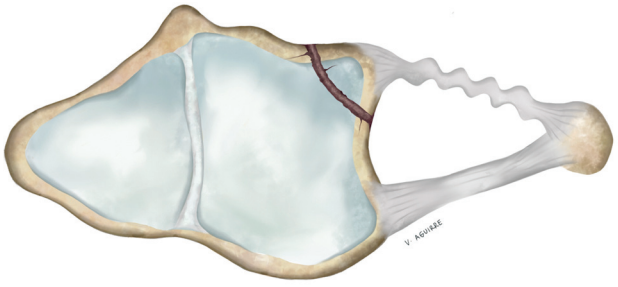

Fig. 8 Small dorsoulnar fragment.

through ligamentotaxis maneuvers. Classically, its reduction has been described through the same fracture site or a small dorsal incision allowing articular visualization.

In our experience, arthroscopic support usually allows an anatomical reduction of the DC fragment, diminishing the need for other incisions and further soft tissue damage. A palpation device or small-jointed instrument allows fragment repositioning and its fixation with wires from outside the plate or the distal screws of the volar plate locked as a palisade (►**Fig. 7**).

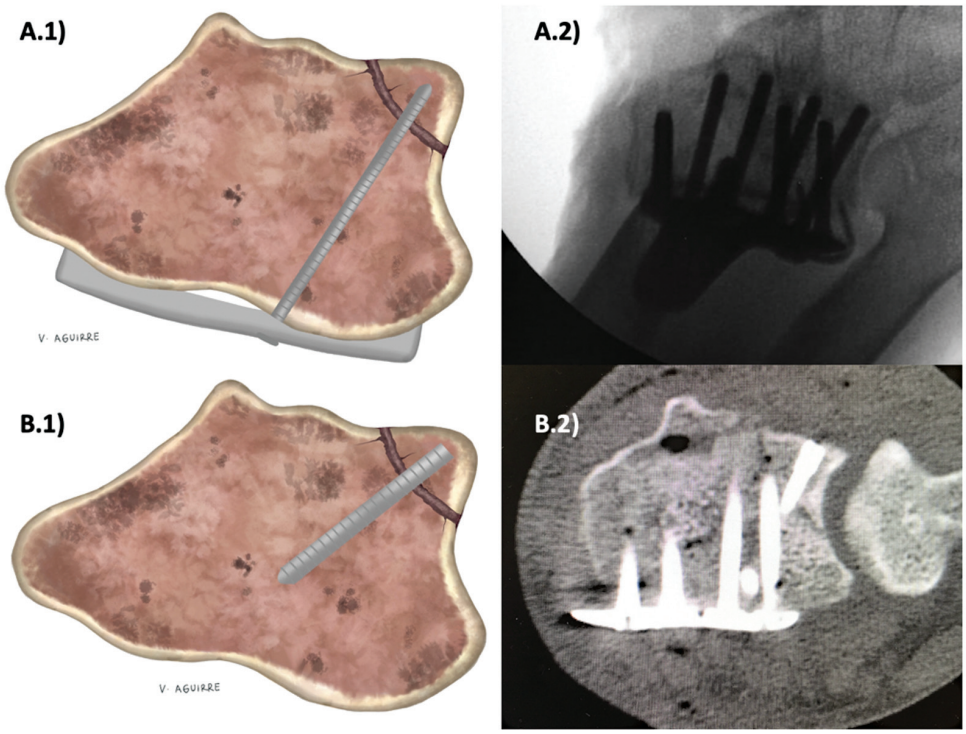

Fig. 9 Methods for small dorsoulnar fragment osteosynthesis. (**A**) Screw through a locked volar plate. (**B**) Headless screw coming from the dorsal aspect.

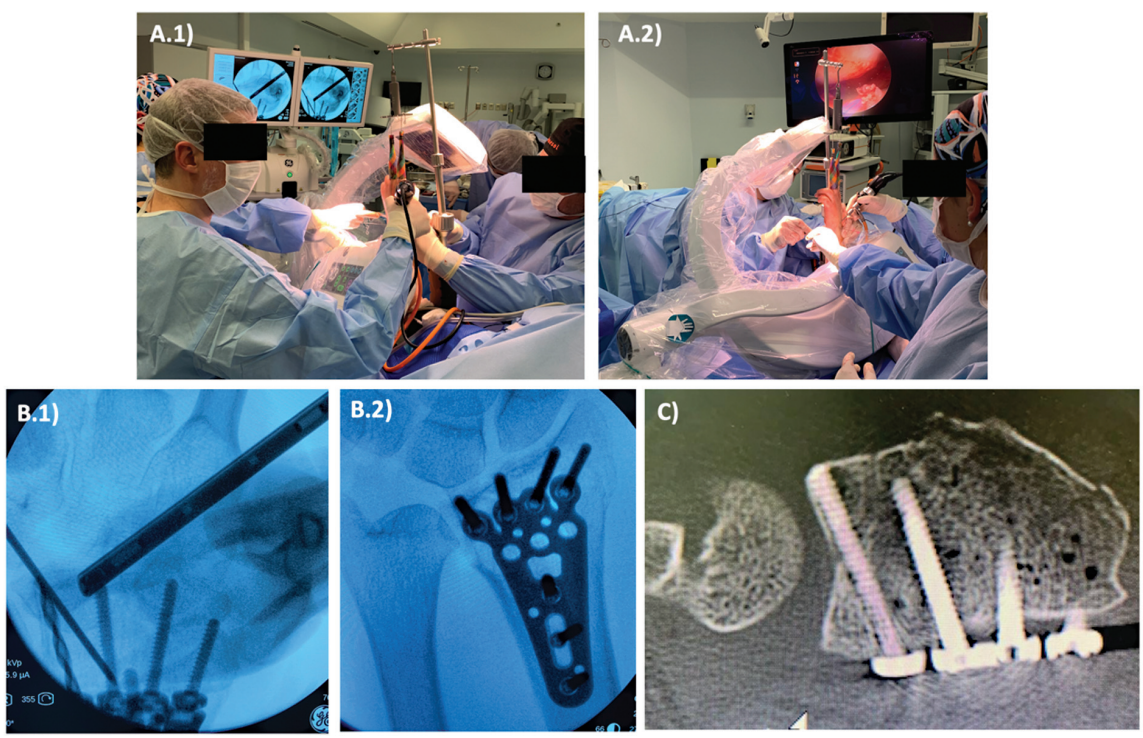

Fig. 10 Small dorsoulnar fragment (DUF) reduction and fixation with a screw from the blocked volar plate using simultaneous fluoroscopy and arthroscopy. (**A**) Clinical image of mini C-arm positioning and the arthroscopic traction tower with simultaneous imaging. (**B**) Fluoroscopy images of the brocade and screw positioning in DUF. (**C**) Control computed tomography showing the screw precisely fixing the DUF.

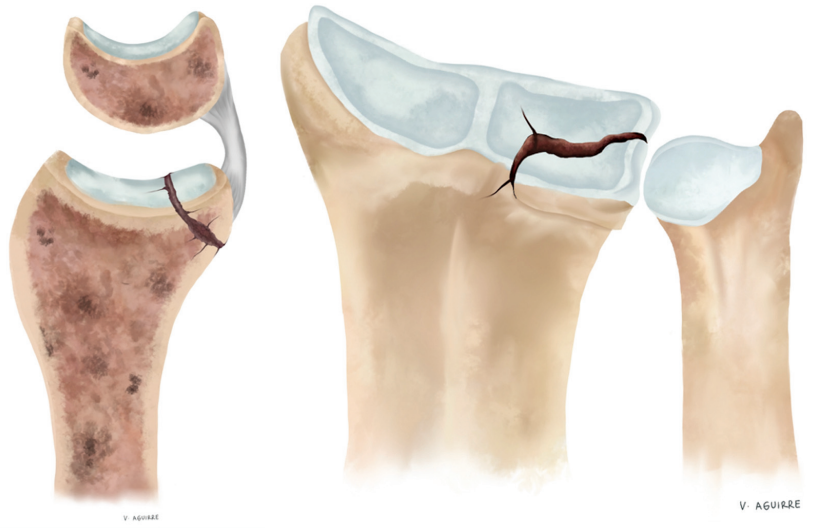

Fig. 11 Volar rim fragment.

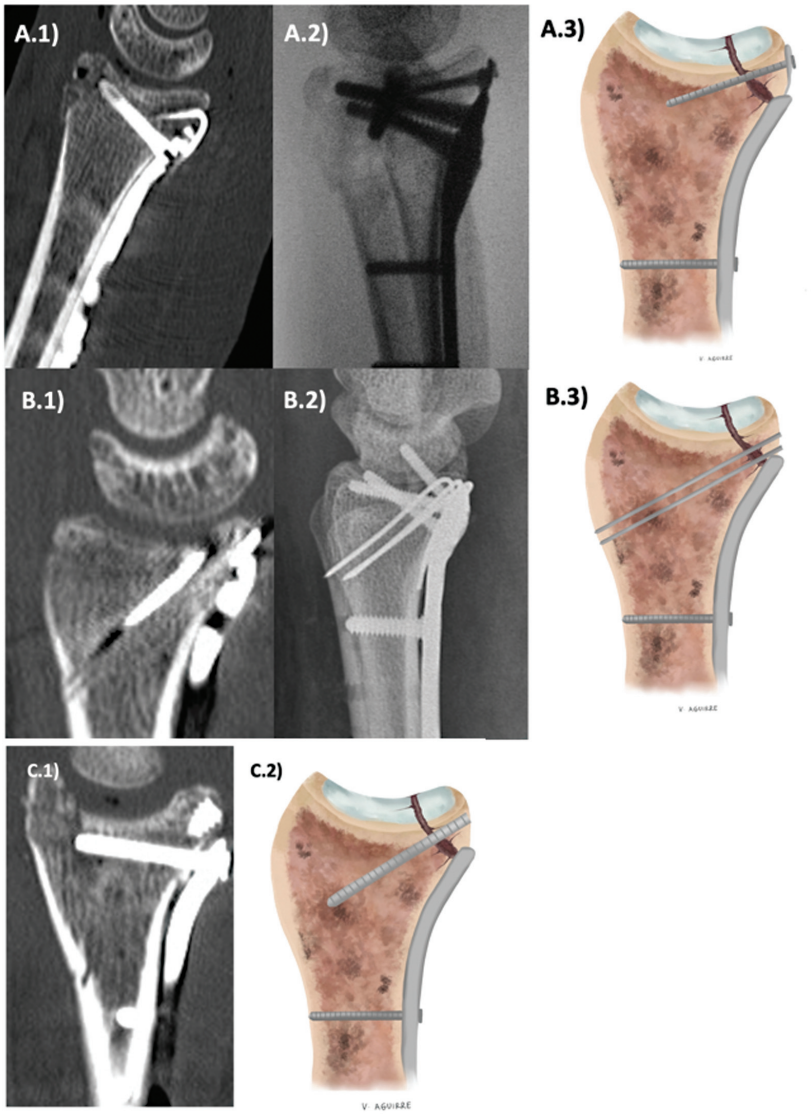

Fig. 12 Types of osteosynthesis for small or comminuted volar rim fragment. (**A**) Plates with distal extension. (**A.1**) Hooks. (**A.2–3**) Screws. (**B**) Wires from outside the plate. (**C**) Headless screw coming distal to the plate.

The small DUF occurs when its radial extension does not involve the Lister's tubercle (►**Fig. 8**). It is critical not only for being mobile and difficult to manipulate but because it is a biarticular fragment, so insufficient reduction can cause problems at the radiocarpal joint and DRU level. It is fundamental to the stability of this joint since it is the site of insertion of the dorsal DRU ligament, critical for the joint stabilization. On the other hand, its synthesis is a surgical challenge because it is usually a small fragment and is out of reach of conventional locked volar plates.

We propose DUF arthroscopic management to assess its actual size under direct visualization and achieve anatomical reduction. In selected cases, we can fix this fragment with a screw directed from the locked volar plate. If this is not possible, an alternative is to fix this fragment with a headless screw coming from the dorsal aspect[10] (►**Fig. 9**).

Fragment fixation with a screw from the locked volar plate requires careful maneuvers to avoid breaking it or leaving intra-articular screws. We have performed this technique using fluoroscopy and arthroscopy simultaneously to achieve the correct position of this screw in a single attempt (►**Fig. 10**).

The small VRF (►**Fig. 11**) measures less than 1 cm from the articular edge towards the proximal aspect in a sagittal CT scan. This fragment has been widely described in the literature as critical for radiocarpal stability due to the attachment of the radiolunate ligaments.[14–16] A comminuted or small VRF in the sagittal plane is often out of reach of the usual locked volar plates and requires targeted fixation elements.[14]

Current locked volar plates have distal extensions to fix this fragment. These extensions can present hooks or smaller diameter screws and be molded according to the specific plate brand (►**Fig. 12A**). If this type of osteosynthesis is not available, one can use headless screws or wires distal to the plate (hidden under it) depending on the size of the fragment (►**Fig. 12B-C**).

Lee et al.[13] reported that patients with an insufficient reduction of such fragments had worse clinical outcomes. These authors also said that DFU is the main fragment predicting worse outcomes in functional scales.

Little BITs require complex treatment and are highly frequent in joint DRFs, being present in at least 61.3% of the cases in our series. As such, it is imperative to seek them out to address them correctly.

We propose several surgical alternatives for these cases and believe that arthroscopy is a fundamental tool to evaluate the actual size of the fragments under direct visualization, achieve anatomical reduction, and assess ligament stability.

Conclusion

An intra-articular DRF is complex and requires directed evaluation of its fragments for correct surgical planning and stable synthesis to allow early rehabilitation and good clinical outcomes. Some fragments are especially complex and require active search, identification, and proper treatment. Little BITs were frequent in our series and lack of treatment can generate worse functional outcomes according to the recent literature.

Conflict of Interests
The authors declare no conflict of interest regarding this paper.

References

1 Hevonkorpi TP, Launonen AP, Huttunen TT, Kannus P, Niemi S, Mattila VM. Incidence of distal radius fracture surgery in Finns aged 50 years or more between 1998 and 2016 - too many patients are yet operated on? BMC Musculoskelet Disord 2018; 19(01):70
2 Rundgren J, Bojan A, Mellstrand Navarro C, Enocson A. Epidemiology, classification, treatment and mortality of distal radius fractures in adults: an observational study of 23,394 fractures from the national Swedish fracture register. BMC Musculoskelet Disord 2020;21(01):88
3 Mauck BM, Swigler CW. Evidence-Based Review of Distal Radius Fractures. Orthop Clin North Am 2018;49(02):211–222. Doi: 10.1016/j.ocl.2017.12.001
4 Shapiro LM, Kamal RNManagement of Distal Radius Fractures Work Group. Nonvoting Clinical Contributor; Nonvoting Oversight Chairs; Staff of the American Academy of Orthopaedic Surgeons and the American Society for Surgery of the Hand. Distal Radius Fracture Clinical Practice Guidelines-Updates and Clinical Implications. J Hand Surg Am 2021;46(09): 807–811
5 Ju JH, Jin GZ, Li GX, Hu HY, Hou RX. Comparison of treatment outcomes between nonsurgical and surgical treatment of distal radius fracture in elderly: a systematic review and meta-analysis. Langenbecks Arch Surg 2015;400(07):767–779
6 Fernandez DL. Distal radius fracture: the rationale of a classification. Chir Main 2001;20(06):411–425
7 Wæver D, Madsen ML, Rölfing JHD, et al. Distal radius fractures are difficult to classify. Injury 2018;49(Suppl 1):S29–S32
8 Belloti JC, Tamaoki MJ, Franciozi CE, et al. Are distal radius fracture classifications reproducible? Intra and interobserver agreement. Sao Paulo Med J 2008;126(03):180–185
9 Hintringer W, Rosenauer R, Pezzei C, et al. Biomechanical considerations on a CT-based treatment-oriented classification in radius fractures. Arch Orthop Trauma Surg 2020;140(05): 595–609
10 Fragmento Dorso-Ulnar en Fracturas del Radio Distal. Clasificación y Manejo. Sanhueza, Azócar, Lecaros, Díaz, Cifras. Rev Chil Ortop Traumatol 2018;00:1–10
11 Orbay J, Bain G. Volar Rim Fractures of the Distal Radius: Can We Reduce the Complications and Need for Revision Surgery? J Wrist Surg 2022;11(03):191–194
12 Boretto JG, Altube G, Petrucelli E, Zaidenberg EE, Gallucci GL, De Carli P. Dorsal Plating for Specific Fracture Pattern of the Distal Radius. J Hand Surg Asian Pac Vol 2021;26(04):502–512
13 Lee CH, Kwon Y, Jung IY, Lee BG, Kim SJ. Effect of the Articular Surface Incongruency on Surgical Outcome of the Distal Radius Fracture. BioMed Res Int 2022;2022:8357675
14 Beck JD, Harness NG, Spencer HT. Volar plate fixation failure for volar shearing distal radius fractures with small lunate facet fragments. J Hand Surg Am 2014;39(04):670–678

15 Harness NG, Jupiter JB, Orbay JL, Raskin KB, Fernandez DL. Loss of fixation of the volar lunate facet fragment in fractures of the distal part of the radius. J Bone Joint Surg Am 2004;86(09): 1900–1908

16 O'Shaughnessy MA, Shin AY, Kakar S. Stabilization of Volar Ulnar Rim Fractures of the Distal Radius: Current Techniques and Review of the Literature. J Wrist Surg 2016;5(02): 113–119

