



Distal Radius Fractures with Concomitant Elbow Lesions. A Prospective Analysis

Fracturas de Radio Distal con Lesiones Concomitantes de Codo. Un Análisis Prospectivo

Marcio Aurelio Aita¹ Guilherme Murbach Aliberti² Renan Martins Fontana³
Bruno Gianordoli Biondi³ Ezequiel Zaidenberg⁴ Ricardo Kaempf de Oliveira⁵
Gustavo Mantovani Ruggiero⁶

¹ Surgery Department, Orthopedic, Trauma, Hand and Microsurgery Division, Faculdade de Medicina do ABC, SP, Brazil

² Orthopedic and Trauma Department, Faculdade de Medicina do ABC, SP, Brazil

³ Orthopedic and Trauma Department, Hand and Microsurgery Division, Faculdade de Medicina do ABC, SP, Brazil

⁴ Orthopedic Department, School of Medicine, University of Buenos Aires, Buenos Aires, Argentina

Address for correspondence Marcio A Aita, PhD, Faculdade de Medicina do ABC, Surgery Department, Orthopedic, Trauma, Hand and Microsurgery Division, Av. Príncipe de Gales, 821, Príncipe de Gales, Santo Andre, SP, ZIP: 09060-650, Brazil (e-mail: marcioaita@me.com).

⁵ Orthopedic and Trauma Department, Santa Casa de Porto Alegre, RS, Brasil

⁶ Plastic Surgery Department, Università Degli Studi Di Milano, Milan, Italy

Rev Iberam Cir Mano 2023;51(1):e23–e30.

Abstract

Background Nowadays it is increasingly common politrauma with elbow injuries (IEI) and ipsilateral distal radius fractures (DRFs), about 17.5% of all adults' fractures (1), and the ideal method and the best time to treat are discussed in high-energy injuries (2) can have a strong social impact.

Objectives to compare the grip strength, patient-reported and radiographic outcomes in patients with ipsilateral unstable elbow injuries DRFs with or without longitudinal forearm instability treated in the same timed

Methods 231 patients with DRFs, were treated during the period between February 2018 to July 2021 and 18 patients were included. The Follow-up period was 12 months and 12 men and 6 women. Patients were divided into two groups: DRFs associated IEI with (Group 1 - 6 patients) or without Longitudinal radioulnar dissociation Group 2 - (12 patients). Clinical and functional outcomes and radiographic characteristics were evaluated at 12 months

Results At 12 months, was observed with respect to grip strength, all patients showed results in the third or fourth quartiles. The mean and the mean DASH scores were 3.8 and the VAS scores were 1.5. Eleven patients required a secondary procedure 61% (11/18) with remove elbow ex fix (5/18), spanning plate (2/18), change radial head ORIF (open reduction and internal fixation) to arthroplasty (1/18). Initial fracture reduction or joint stable was maintained in 94.4% (17/18) patients.

Keywords

- ▶ Dislocation
- ▶ Distal radius
- ▶ Elbow
- ▶ Fracture
- ▶ Wrist
- ▶ Multiple fracture
- ▶ Interosseous membrane reconstruction

received
July 21, 2022
accepted
March 7, 2023

DOI <https://doi.org/10.1055/s-0043-1769602>.
ISSN 1698-8396.

© 2023. SECMA Foundation. All rights reserved.

This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial-License, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (<https://creativecommons.org/licenses/by-nc-nd/4.0/>)

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

Resumen

Palabras clave

- ▶ Dislocación
- ▶ Radio distal
- ▶ Codo
- ▶ Fractura
- ▶ Muñeca
- ▶ Fractura múltiple
- ▶ reconstrucción de la membrana interósea

Conclusions There is a linear relationship between wrist and elbow injuries and outcomes, with or without longitudinal radio ulnar dissociation. Both proved predicted the restoration of the ability of patients to perform activities of daily living independently. We recommend that combined injuries should be managed at the same time and internal fixation is recommended to definitive treatment of DRFs/IEIs wherever possible and improves Patient-reported and radiographic outcomes.

Antecedentes Hoy en día es cada vez más común el politraumatismo con lesiones de codo (LC) y fracturas ipsilaterales de radio distal (FRDs), alrededor del 17,5% de todas las fracturas del adulto y se discute que el método ideal y el mejor momento para tratar lesiones de alta energía pueden tener un fuerte impacto social.

Objetivos Comparar la fuerza de agarre, los resultados radiográficos e informados por el paciente en pacientes con lesiones de codo ipsilaterales inestables y FRD con o sin inestabilidad longitudinal del antebrazo tratados en el mismo tiempo

Métodos Se incluyeron 231 pacientes con FRD, tratados durante el período comprendido entre febrero de 2018 a julio de 2021 y 18 pacientes. El período de seguimiento fue de 12 meses y 12 hombres y 6 mujeres. Los pacientes se dividieron en dos grupos: FRD asociados con LC (Grupo 1 - 6 pacientes) o sin disociación radiocubital longitudinal Grupo 2 - (12 pacientes). Los resultados clínicos y funcionales y las características radiográficas se evaluaron a los 12 meses.

Resultados A los 12 meses, se observó con respecto a la fuerza de agarre, que todos los pacientes presentaban resultados en el tercer o cuarto cuartil. Las puntuaciones DASH media fueron 3,8 y las puntuaciones EVA fueron 1,5. Once pacientes requirieron un procedimiento secundario 61% (11/18) con remover codo ex fix (5/18), spanning plate (2/18), cambiar cabeza radial ORIF (reducción abierta y fijación interna) a artroplastia (1/18). La reducción inicial de la fractura o la estabilidad articular se mantuvieron en el 94,4% (17/18) de los pacientes.

Conclusiones Existe una relación lineal entre las lesiones de muñeca y codo y sus resultados, con o sin disociación radiocubital longitudinal. Ambos demostraron predecir la restauración de la capacidad de los pacientes para realizar actividades de la vida diaria de forma independiente. Recomendamos que las lesiones combinadas se manejen al mismo tiempo y se recomienda la fijación interna para el tratamiento definitivo de FRD/LC siempre que sea posible y mejore los resultados radiográficos e informados por el paciente.

Introduction

Nowadays it is increasingly common politrauma with elbow injuries (IEI) and ipsilateral distal radius fractures (DRFs), about 17.5% of all adult fractures,¹ and the ideal method and the best time to treat are discussed in high-energy injuries² can have a strong social impact.³ Previously, only case reports have been published.⁴⁻⁷

In addition, as the mechanism of injury is similar, it is hypothesized that DRFs may be associated with elbow injuries and longitudinal radio ulnar dissociation. Combined injuries in upper limbs can occur separately or associated with interosseous membrane (IOM) injury and result in pain, decreased range of motion, and palmar grip strength.^{8,9}

Objectives: to compare the grip strength, patient-reported and radiographic outcomes in patients with ipsilat-

eral unstable elbow injuries DRFs with or without longitudinal forearm instability treated at the same time.

Patients and Methods

A single University Hospital, parallel-group, prospective, case series was conducted at the Department of Orthopedic, Centro Universitário ABC, Santo Andre, Brazil, approved by the institutional research ethics committee (no. ETIK 805.909). The inclusion criteria were adult patients with a diagnosis of simultaneous elbow injuries (IEI) and ipsilateral DRFs who were treated at the same time. The exclusion criteria were injuries to the contralateral limb, ongoing chemotherapy or radiotherapy, and patients with mental illness or alcohol abuse.

231 patients submitted surgical treatment of DRFs, 12 men, and 6 women with a mean age of 40.6 years (range, 23-

53 years) treated during the period between February 2018 to July 2021 were included. The follow-up period was 12 months. The right limb was involved in 11 patients and the left in 7 patients. Mechanism of injury was a fall from standing height (FOOSH) in 7 patients, a fall from a window or stairs in 3 patients, traffic accident in 8 patients. (► Fig. 1)

Patients were divided into two groups: DRFs associated IEI with (Group 1 - 6 patients) or without longitudinal radio ulnar dissociation (Group 2 - 12 patients): (after fractures fixation, to perform pull test and ballotement test^{10,11} (see ► Table 1).

Surgical Technique

All patients submitted regional or general anesthesia. Surgical methods of DRFs and IEIs fractures to prevent secondary dislocation (to check ligament lesions associated). This seems to be more important than a perfect reduction. For the treatment of simple fracture or single fragments, cannulated self-tapping screws, minimally invasive arthroscopy assisted methods, and plates, as the best solution or Open Reduction and Internal Fixation (ORIF) with specific locking plates or prosthesis (radial head), Kirschner (K-wires) or headless cannulated screws (lag screws).

Approach to associated ligament injuries (elbow or wrist)¹²

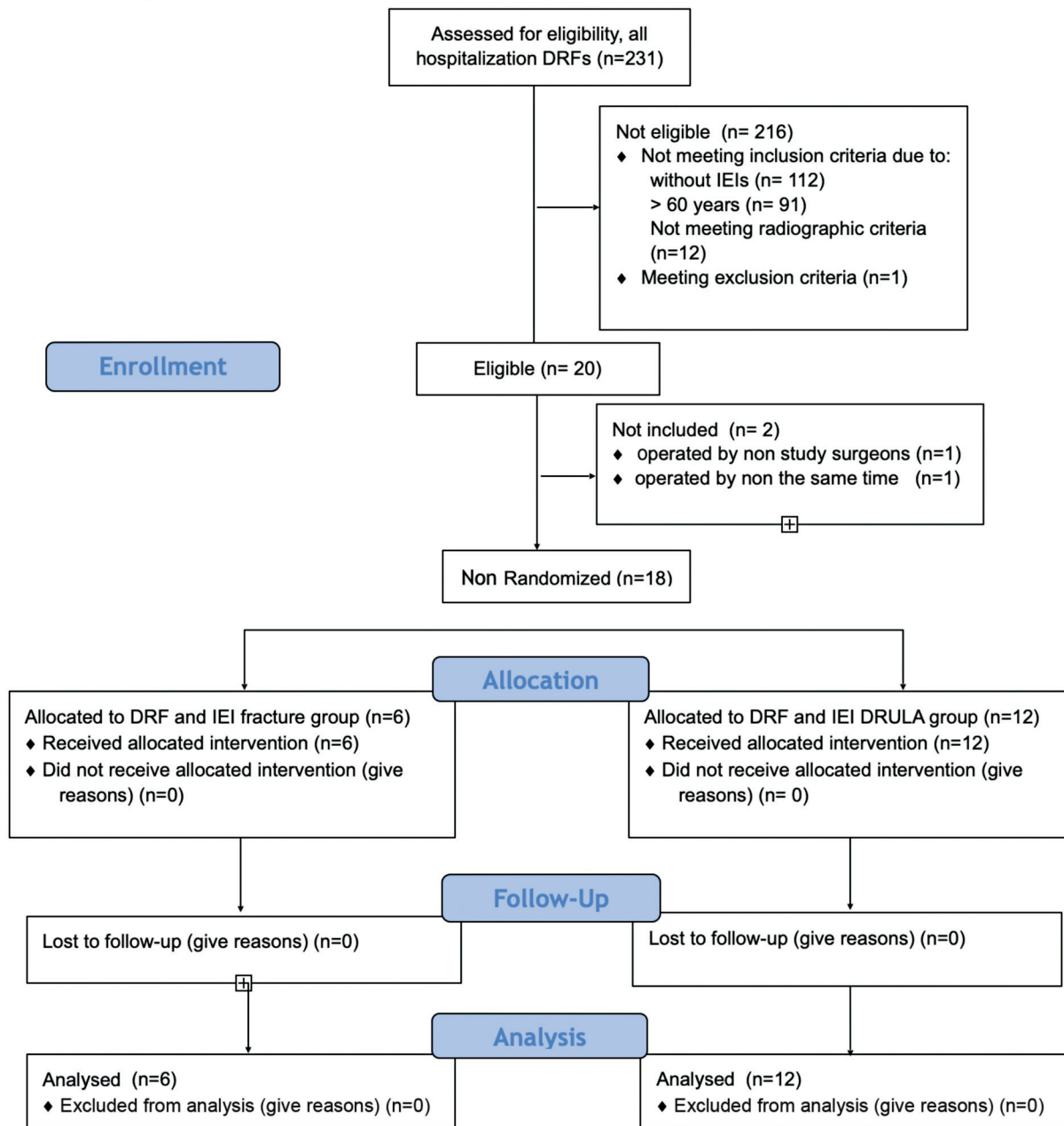


Fig. 1 Consolidated Standards of Reporting Trial (CONSORT) flowchart, DRF, distal radius fracture with IEI, ipsilateral elbow injury.

Table 1 Hazard ratio analysis predicting 7-year incidence of any ADL limitation form

Hand grip strength quartiles	Men, HR 95% CI, N 1/4 979	Women, HR 95% CI, N 1/4 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.

–a. repairable

- Shrink age thermal by radiofrequency) of the ligament fibers.
- TFCC reinsertion with anchors / internal brace®) (See ▶**Video 1**).
- direct suture (see ▶**Video 2**)

–b. irreparable

- reconstruction: arthroplasty, ORIF, graft, bone tunnels, augmentation (see ▶**Fig. 2**)
- trans-articular stabilization, if necessary, with spanning plate or dynamic external fixation (see ▶**Fig. 3**)

Video 1

TFCC (triangular fibrocartilage complex) foveal reinsertion assisted by Wrist arthroscopy Online content including video sequences viewable at: <https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0043-1769602>.

Video 2

Acute treatment Essex - Lopresti Injury - Elbow, forearm, and wrist approach Online content including video sequences viewable at: <https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0043-1769602>.

For cases with longitudinal radio ulnar dissociation, was a radial approach, wherein the BR tendon was harvested, and prepared with an internal brace by sectioning the tendon on its muscle transition and preserving the insertion on the radius styloid. After, created an oblique tunnel from the radius to the distal ulnar stump by using a 3.5-mm cannulated drill and fluoroscopic guidance and passed the BR tendon graft through the tunnel and kept it tensed on the lateral exit on the distal ulnar, thereby providing stability between the sigmoid notch on the radius and the ulnar. The definitive implants on the ulnar were only inserted after accomplishing stability (DX Anchor, Arthrex Inc., Naples, FL, or tendon graft were fixed to the bone by the “suture” method).⁸

In other patients, was performed TFCC reinsertion assisted by arthroscopy and created a transverse tunnel from the radius to the ulna shaft by using a 2.7-mm cannulated drill using fluoroscopic guidance and passed the Mini TightRope® system from the radius to the ulna shaft. This method provided adjunctive fixation and DRUJ stabilization.¹²

Now, DRUJ and PRUJ were clinically and intra-operatively tested by using the Pull radius and ballotement tests (negatives now), with full pronation and supination showing a normal congruency and stability between the ulnar head and the sigmoid notch. All patients were assessed radiographically and clinically at 12 months.

Functional Assessment

Grip strength was measured with a Jamar Hand Dynamometer (Sammons Preston, Bolingbrook, IL)¹³⁻¹⁵ and was divided into four groups¹⁻⁴ according to the quartiles (▶**Table 1**) and according to their inability to perform activities of daily living (ADLs). Complications and Patient-reported outcomes were assessed with visual analog scale (VAS) for pain and the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire^{16,17} at 12 months.

Postoperative Management

The rehabilitation elbow and wrist protocol included cast immobilization (wrist) for two weeks and elbow for only one week, with exercises “dart throw movie”, elbow flexion-extension, and free movements for the fingers, from the first day after surgery. Active exercises and dynamic orthoses were used from the third week onwards. This assessment must be individualized. Patients were encouraged to perform activities that avoided overload or changes in function.¹²

Statistical Analysis

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

Results

Patients’ demographic characteristics are presented in ▶**Table 2**. At the 12-month follow-up. The mean grip strength of the affected wrist was distributed in four groups (both corresponding to the third or fourth quartiles).



Fig. 2 Pre and intra operative aspects: Elbow fracture dislocation associated with articular distal radius fracture and longitudinal instability - surgical treatment with radial head arthroplasty, distal radius osteosynthesis with volar locking plate and reconstruction of the distal part of interosseous membrane with Braquirradialis tendon graft.



Fig. 3 Pre, intra e post-operative Radiographic aspects: Elbow dislocation associated with articular distal radius fracture and longitudinal instability - surgical treatment with medial, anterior e lateral elbow ligaments repair with suture anchors, elbow dynamic external fixator, distal radius osteosynthesis with a volar locking, and spanning plate and reconstruction of the distal part of interosseous membrane with Braquirradialis tendon graft.

(► **Table 3**). Patient-reported and radiographic outcomes are shown in ► **Table 4**. On Complimentary radiographies examination, initial fracture reduction was observed in 94.4% of the patients, (17/18). The other procedures were 61% (11/18) with remove elbow ex fix (5/18), spanning plate (2/18), change radial head ORIF (open reduction and internal fixation) to arthroplasty (1/18). Complications were observed in 5.6% (1/18) patients. This included loss of radial head reduction after ORIF and treated with radial head arthroplasty.

Discussion

Combined injuries have been published over the last few years, although literature describes only individual management of radial head dislocation or distal radius fracture, and there aren't guidelines for the treatment of such injuries (isolated or combined trauma). This study showed the diagnosis and treatment of acute combined injuries with or without longitudinal forearm instability.

The treatment goal is a stable reduction of the PRUJ and DRUJ. The radial head should be reduced by open technique to treat the ruptured ligament or capsule, to preserve intact annular ligament that has been pulled over the radial head. If missed or neglected, an open re-duction or arthroplasty must

Table 2 Demographic characteristics and injury details

	Fracture (n = 6)	DRULA (n = 12)
Age (yearst)	42.5 (28-53)	39.67 (23-53)
Genderb		
Female	3 (50)	3 (25)
Male	3 (50)	9 (75)
Hand dominance		
Right	4 (66.67)	9 (75)
Left	2 (33.33)	3 (25)
Dominant extremity fractured	5 (83.33)	10 (83.33)
AO classification		
A	4 (66.67)	3 (25)
B	1 (16.67)	3 (25)
e	1 (16.67)	4 (33.33)
Carpal fractures	–	2 (16.67)
Preoperative radiograph displacement		
Volar tilt > 20 degrees	5 (83.33)	7 (58.33))
Ulnar variance > 10 mm	4 (66.67)	12 (100)
Associated Ipsilateral Elbow Injuries (IEI)		
Radial head fracture	2 (33.33)	8 (66.67)
Distal humerus fracture	3 (50)	–
Proximal ulna fracture	1 (16.67)	–
Elbow ligament lesions	–	8 (66.67)
Combinated	2(33.33)	8 (66.67)

Abbreviation: DRULA (distal radioulnar longitudinal axis).

^aData are presented as mean (range).

^bData are presented as frequency (percentage)

be done with an annular ligament reconstruction. The same ORIF should do with distal radius fractures. If DRUJ maintain unstable, must be IOM reconstruction and or TFCC reinsertion. In this present study demonstrated an improvement in the mobility of the elbow, forearm, and wrist, without stiffness, thus similar to Adams et al.,¹⁸ in which TFCC reconstruction was also performed, with 86.1%ROM recovery.

Other studies have shown grip strength outcomes without significant differences of methods in DRUJ stabilization associated with DRFs or IEIs. Of note, grip strength is an independent predictor of ADL disability among adult patients.¹⁴

This present study showed grip strength of 94.8%, DASH 3.8, VAS 1.5, and 5.6% incidence of complications, only one patient, who was treated with radial head ORIF evaluated with loss of fracture reduction, required additional surgical intervention. Kim et al.² showed in similar study grip strength was 76.9%, DASH score was 13.1 and VAS was 1.73 and complications occurred in 13/26 patients.

Stable fixation of DRF/elbow fractures or repair/reconstruction of elbow/forearm ligaments allows early mobilization and avoids poor results. Internal fixation with specific locking plates for DRFs/elbow because maintained initial

Table 3 Mean grip strength at 12 months

	Fracture Group (n = 6)	DRULA group (n = 12)	Quartile position	Tercile Position	p-Value
Male	(n 3/4)	(n 9/12)	(n 12/12)		
Affected wrist (kg)	32.00	35.44			
Normal wrist (kg)	36.49	37.14			
% Normal side	97.33	95.4	100		
Female	(n 3/4)	(n 3/12)	(n 5/6)	(n 1/6)	
Affected wrist (kg)	21.24	19.81			
Normal wrist (kg)	22.45	21.85			
% Normal side	94.6	90.67	83.33	16.67	

Table 4 Objective and patient-reported outcomes at 12-month follow-up

	Fracture group (n= 6)	DRULA group (n= 12)	p-Value
12 months			
DASH score (points) ^b	2.5	4.5	
VAS pain (mm/10 mm) ^b	1.2	1.7	
Maintenance initial reduction	100% (6/6)	91.67% (11/12)	
Complication rate	–	8.33% (1/12)	

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

reduction, safe and shortening surgical time, and complications such as compartment syndrome, infection, or acute carpal tunnel syndrome were described.

Currently, the paradigm of ETC (early total care) envisages early definitive surgery in politrauma. We agree that internal fixation is recommended for definitive treatment of DRFs/IEIs wherever possible and improves the life quality of patients, reduces hospitalization time, allows the immediate rehabilitation protocol, and reduces the time of restoration of ADLs and work-related activities.^{19–21}

Nonetheless, some limitations need to be acknowledged. The sample size was small for patient-reported outcomes analysis. However, is a linear relationship between wrist and elbow out-comes, and expect a satisfactory result if the two sites should be treated properly at the same time.

Conclusion

There is a linear relationship between wrist and elbow injuries and outcomes, with or without- Longitudinal radio ulnar dissociation. Both proved predicted the restoration of the ability of patients to perform activities of daily living independently. We recommend that combined injuries should be managed at the same time and internal fixation is recommended for definitive treatment of DRFs/IEIs wherever possible and improves Patient-reported and radiographic outcomes.

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.

Funding Statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Declaration of Conflicting Interest

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

References

- 1 Court-Brown CM. The epidemiology of fractures and dislocations. In: Court-Brown CM, Heckman JD, McQueen MM, Ricci WM, Tornetta P III. Rockwood and Wilkins Fractures in Adults, 8th Edition Vol. 1. Philadelphia, Lippincott: William and Wilkins; 2015:59–108
- 2 Kim TG, Heo YM, Yi JW, Oh BH, Lee GS. The Treatment of Distal Radius Fractures with Ipsilateral Elbow Injury. *J Hand Surg Asian Pac Vol* 2018;23(04):539–546
- 3 Aita MA, Rodrigues FL, Alves KHCR, de Oliveira RK, Ruggiero GM, Rodrigues LMR. Bridging versus Nonbridging Dynamic External Fixation of Unstable Distal Radius Fractures in the Elderly with Polytrauma: A Randomized Study. *J Wrist Surg* 2019;8(05): 408–415. Doi: 10.1055/s-0039-1692480
- 4 Meena S, Trikha V, Kumar R, Saini P, Sambharia AK. Elbow dislocation with ipsilateral distal radius fracture. *J Nat Sci Biol Med* 2013;4(02):479–481

- 5 Ahmad R, Ahmed SM, Annamalai S, Case R. Open dislocation of the elbow with ipsilateral fracture of the radial head and distal radius: a rare combination without vascular injury. *Emerg Med J* 2007;24(12):860
- 6 Gupta V, Kundu ZS, Kaur M, Kamboj P, Gawande J. Ipsilateral dislocation of the radial head associated with fracture of distal end of the radius: a case report and review of the literature. *Chin J Traumatol* 2013;16(03):182–185
- 7 Batra S, Andrew JG. Ipsilateral compound distal radius fracture with missed elbow dislocation. A rare injury pattern. *Eur J Emerg Med* 2007;14(06):363–364
- 8 Aita MA, Mallozi RC, Ozaki W, Ikeuti DH, Consoni DAP, Ruggiero GM. Ligamentous reconstruction of the interosseous membrane of the forearm in the treatment of instability of the distal radioulnar joint. *Rev Bras Ortop* 2018;53(02):184–191
- 9 Ruedi TP, Murphy WM. Distal radius classification. In: *AO Principles of Fracture Management*. Davos Platz, Switzerland: Thieme; 2000
- 10 Essex-Lopresti P. Fractures of the radial head with distal radioulnar dislocation; report of two cases. *J Bone Joint Surg Br* 1951; 33B(02):244–247
- 11 Green JB, Zelouf DS. Forearm instability. *J Hand Surg Am* 2009;34(05):953–961. Doi: 10.1016/j.jhsa.2009.03.018
- 12 Aita MA, Biondi BG, Montano GA, Towata F, Rodriguez GLG, Ruggiero GM. Arthroscopic Management of Intra-articular Ligament Lesions on Distal Radius Fractures. *RICMA* 2021;5(03): 172–178
- 13 Matson AP, Ruch DS. Management of the Essex-Lopresti Injury. *J Wrist Surg* 2016;5(03):172–178
- 14 Fess EE. *Grip Strength*. 2nd ed. Chicago, IL: American Society of Hand Therapists; 1992
- 15 Al Snih S, Markides KS, Ottenbacher KJ, Raji MA. Hand grip strength and incident ADL disability in elderly Mexican Americans over a seven-year period. *Aging Clin Exp Res* 2004;16(06):481–486
- 16 Petersen P, Petrick M, Connor H, Conklin D. Grip strength and hand dominance: challenging the 10% rule. *Am J Occup Ther* 1989;43(07):444–447
- 17 Gummesson C, Ward MM, Atroshi I. The shortened disabilities of the arm, shoulder and hand questionnaire (QuickDASH): validity and reliability based on responses within the full-length DASH. *BMC Musculoskelet Disord* 2006;7:44
- 18 Orfale AG, Araújo PMP, Ferraz MB, Natour J. Translation into Brazilian Portuguese, cultural adaptation and evaluation of the reliability of the Disabilities of the Arm, Shoulder and Hand Questionnaire. *Braz J Med Biol Res* 2005;38(02):293–302
- 19 Adams JE, Culp RW, Osterman AL. Interosseous membrane reconstruction for the Essex-Lopresti injury. *J Hand Surg Am* 2010;35(01):129–136
- 20 Bates P, Parker P, McFadyen I, Pallister I. Demystifying damage control in musculoskeletal trauma. *Ann R Coll Surg Engl* 2016;98(05):291–294
- 21 Simons T, Brinck T, Handolin L. [Timing of surgical treatment of fractures of multiply injured patients - from science to tactics]. . [in Finnish]*Duodecim* 2016;132(09):828–835