EPIDEMIOLOGY, CLASSIFICATION, AND TREATMENT OF BILATERAL FRACTURES OF THE DISTAL RADIUS

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ABSTRACT

Objective: To study epidemiology, fracture pattern, associated injuries, and treatment of individuals with bilateral distal radius fracture, in a tertiary hospital. Methods: Retrospective cross-sectional study developed based on patients with bilateral distal radius fracture from January 2012 to November 2017. Demographic data, trauma mechanism, radiological patterns, degree of deviation, associated injuries, classification of fractures according to the Association of Osteosynthesis (AO), the Salter-Harris (SH) and Frykman scales, and type of treatment used in each case. Results: 13 cases were included in the trial, 10 adults and three children. In infants, the mean age was 9.6 years (7–11 years), and low-energy trauma was described in all these cases. In total, 66.6% of the children presented the SHII classification. In adult patients, the mean age observed was 43.5 years (27–56 years), with high-energy trauma reported in four (40%) cases. The AO 23C.3 and 23B.2 classifications were the most prevalent in adults. Conclusion: In adult individuals, there was a higher incidence of open fractures, wrist joint involvement, ulna fracture, and concomitant injuries, with high-energy trauma observed only in this group, corresponding to half of the cases. Level of Evidence IV, Case Series.

Keywords: Radius Fractures. Epidemiology. Wrist Injuries. Clinical Study.

INTRODUCTION

Distal radius fractures, which occur up to 3 cm from the articular surface between the radius and the proximal row of the carpal bones, correspond to the most common injuries of the upper limbs, representing approximately 17.5% of all fractures of the human skeleton and up to a sixth of all fractures treated in emergencies.1-3 The distal radius fracture presents a well-established distribution pattern among children/adolescents, with a higher prevalence in individuals aged 5–14 years, and among adults, especially among men aged over 40 years and women aged over 60 years. In this group, the literature describes a two to three times higher incidence of injury in females, with osteoporotic disease being considered a significant risk factor, usually involving low-energy trauma with hyperextended and flat hand.2 In the younger population, high-energy trauma, such as in automobile accidents, has greater impact as an injury mechanism.4 In these circumstances,
other associated injuries can be observed since these are poly-
trauma patients, implying greater morbidity. However, although
common in one limb, bilateral distal radius fracture is rare, with few
case series in the literature, even in large trauma care centers. Fracture patterns and demography seem to vary when com-
paring unilateral and bilateral radius fractures, with the higher
prevalence of bilateral fractures in men, for example, who usually
experience high-energy trauma. Furthermore, compared to unilateral fractures, bilateral fractures are associated with
worse functional prognosis, especially in patients with residual
deforments, and the morbidity involved in this type of injury is
still unknown. Thus, this study aims to describe demographic variables, trauma
mechanism, radiographic patterns, and injuries associated with
bilateral distal radius fractures, in addition to the type of therapy
provided for each individual in our series.

MATERIALS AND METHODS
In a retrospective analysis of medical records from visits conducted
from January 2012 to November 2017, 18 patients were diagnosed
with bilateral distal radius fracture. The survey was implemented
via an active search in the database of a tertiary hospital, using the
International Disease Code (ICD-10) S52.5, which corresponds
to fractures of the lower extremity of the radius. The medical
records and image files of the respective patients were examined.
Inclusion criteria were patients of both sexes and all ages with
a record of bilateral distal radius fracture, regardless of having
associated injuries or not. Patients whose medical records and/or
radiographs contained deficiencies or did not meet the parameters
evaluated in this study were excluded.

All radiographs in anteroposterior (AP) and lateral views were evaluated
by a physician, member of the Brazilian Society of Orthopedic Trauma and
the Association of Osteosynthesis (AO)/Trauma. Among the 18 patients, five were excluded from the analysis,
two for lack of medical records of the initial emergency care and
three for lack of radiographs before specific treatment. The final
amount of the study sample was 13 patients.
The descriptive analysis presented, in tables, the observed data,
expressed as mean ± standard deviation (SD) for numerical
data, and frequency (n) and percentage (%) for categorical data.
The graphs were constructed to illustrate the relative distribution
of the gravity scales. The statistical analysis was processed using
the SAS® System version 6.11 statistical software (SAS Institute,
Inc., Cary, North Carolina).

RESULTS
The results are outlined in the tables below (Table 1, Table 2,
and Table 3).

| # | Age | Sex | Energy of trauma | Deviation of degree | Ulna fracture | Associated injuries | Exposed fracture |
|---|-----|-----|------------------|--------------------|---------------|---------------------|-----------------|
| 1 | 35  | M   | Low              | 38° 34°            | No            | Yes                 | No              |
| 2 | 52  | M   | High             | 5° 11°             | No            | Yes                 | No              |
| 3 | 52  | F   | Low              | 21° 20°            | No            | No                  | No              |
| 4 | 11  | M   | Low              | 23° 16°            | Yes           | Yes                 | No              |
| 5 | 7   | M   | Low              | 0° 36°             | Yes           | Yes                 | No              |
| 6 | 30  | M   | High             | 19° 9°             | No            | No                  | No              |
| 7 | 11  | M   | Low              | 29° 34°            | No            | No                  | No              |
| 8 | 56  | M   | High             | 39° 3°             | Yes           | No                  | No              |
| 9 | 56  | F   | High             | 0° 21°             | No            | No                  | Yes             |
| 10| 41  | M   | High             | 18° 30°            | No            | No                  | No              |
| 11| 55  | F   | Low              | 11° 9°             | Yes           | Yes                 | No              |
| 12| 27  | M   | Low              | 21° 23°            | No            | Yes + traumatic brain injury | No |
| 13| 31  | M   | Low              | 10° 5°             | No            | Yes traumatic brain injury + mandible fracture | No |
F: female; M: male; R: right; L: left.

| # | Articular involvement | Posterior comminution | AO/Salter-Harris Classification | Universal Classification | Frykman Classification |
|---|-----------------------|-----------------------|--------------------------------|--------------------------|------------------------|
| 1 | Yes                   | Yes                   | Yes                            | 23C3.2                    | 23C3.1                  | IV-C                |
| 2 | Yes                   | Yes                   | No                             | 23B3.1                    | 23C3.1                  | IV-B                |
| 3 | No                    | No                    | Yes                            | 23A2.1                    | 23A2.1                  | II                  |
| 4 | No                    | No                    | No                             | SH-II                     | SH-II                   | -                   |
| 5 | No                    | No                    | Yes                            | Metaphyseal               | Metaphyseal             | -                   |
| 6 | Yes                   | Yes                   | Yes                            | 23B2.1                    | 23B2.1                  | IV-B                |
| 7 | No                    | No                    | Yes                            | SH-II                     | SH-II                   | -                   |
| 8 | Yes                   | Yes                   | No                             | 23C1.3                    | 23C1.2                  | IV-B                |
| 9 | Yes                   | No                    | No                             | 23B1.1                    | 23A2.1                  | III                 |
| 10| Yes                   | Yes                   | Yes                            | 23C3.2                    | 23B3.1                  | IV-C                |
| 11| No                    | Yes                   | No                             | 23A1.2                    | 23A1.2                  | II                  |
| 12| Yes                   | No                    | Yes                            | 23B2.1                    | 23B2.1                  | IV-B                |
| 13| Yes                   | No                    | Yes                            | 23C1.2                    | 23C3.1                  | IV-A                |

Table 1. Case series, energy of trauma, degree of deviation, associated injuries, and exposure. Instituto Doutor José Frota.

Table 2. Fracture classification and patterns. Instituto Doutor José Frota.
DISCUSSION

Distal radius fractures are among the most prevalent fractures of the upper limbs, representing approximately one sixth of all fractures treated in emergency departments. This type of injury is commonly found in older adults, which is related to the progression of osteopenia in the aging process, corroborating the occurrence of osteoporotic fractures due to fragility in places such as distal radius, proximal humerus, lumbar spine, and hips. In younger individuals, car accidents, falls from height (greater than 2 meters), and sports activities are more prevalent as a trauma mechanism, although, in this group, the occurrence of bilateral distal radius fracture is still poorly described. Stone et al., also described electric shock from domestic sources (110–220 v, 50–60 Hertz) as a trauma mechanism associated with bilateral distal radius fracture, in addition to other injuries, such as fracture of the humerus and scapula, and the bilaterality of lesions should always be considered in these patients. Currently, there are no epidemiological studies of bilateral distal radius fractures in the Brazilian literature. Thus, our study becomes relevant, considering the distribution pattern of uni or bilateral fractures of the distal radius, due to the greater degree of complexity of such cases and the presence of associated injuries. Moreover, our study allowed for a comparative assessment of injuries in both adult and child. From our sample, high-energy trauma – often described as a trauma mechanism in the adult population – can be associated as a determining factor for the risk of exposed fracture, joint wrist involvement, associated ulna fracture, or the occurrence of concomitant injury elsewhere, a fact that can lead to greater morbidity and potential complications. Van der Vliet et al., published a study comparing, by applying questionnaires, the functional evolution of patients with poly-traumatized distal radius fractures and victims of high-energy trauma with victims of low-energy trauma. The final sample of the study was 345 patients, who were grouped into three groups, multiple trauma patients with an Injury Severity Score (ISS) ≥ 16, victims of non-multiple high-energy trauma with an ISS < 16, and victims of low-energy trauma. For functional assessment of patients, the following questionnaires were applied by the researchers: assessment of quality of life, health-related quality of life (HRQoL), and Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) for functional assessment of the affected wrist. At the end of the study, a mean HRQoL of 0.84, 0.85, and 1.0 was observed for poly-trauma patients, high-energy traumas, and low-energy traumas, respectively, while the mean QuickDASH was 7, 11, and 5 for these respective groups; effectively associating high-energy trauma with a worse prognosis in cases of distal radius fracture. Notably, this study evaluated patients with unilateral fractures; thus, the morbidity and mortality involved in bilateral fractures, which can be potentially greater, are still poorly described in the literature. In a recent observational study with a sample of 22,962 patients with unilateral distal radius fracture, there was a mortality of 93 (0.4%) cases in 30 days and 679 (2.9%) cases in one year of fracture. Another retrospective cross-sectional study, with a sample of 93 patients diagnosed with bilateral distal radius fracture found a total of 51 (55%) children and 42 (45%) adults, similar to our results. In children, 44 (86%) cases suffered low-energy trauma, with concomitant injuries recorded in only two (4%) cases, with SHII and Torus fractures being the most prevalent, corresponding to 30 (29%) and 32 (31%) cases, respectively. However, in the adult population, 37 (88%) patients suffered high-energy trauma, with associated injuries recorded in 16 (38%) cases, with joint fractures being the most prevalent, corresponding to 44 (52%) cases. In that study, a variety of eight types of associated injuries were observed, among which Cranioencephalic Trauma (TBI), long bone fractures, acute carpal tunnel syndrome, and pelvic ring fractures were the most prevalent. However, the aforementioned study, like ours, does not include the follow-up of patients, preventing an assessment of functional evolution or radiographic parameters after treatment.

Graham et al., when assessing radiological parameters, range of motion of the wrist and data obtained by a functional assessment questionnaire of the upper limb, QuickDASH, in 10 patients with bilateral distal radius fracture who underwent surgical treatment with open reduction and internal fixation, showed no statistically significant difference in functional results in the recovery of the range of motion (ROM) of the wrist, and in the restoration of radiological parameters when compared with studies involving patients with unilateral fractures.

Khonglan, Ahmed, and Borghaime., in the case report of a pianist patient, victim of an automobile accident, with bilateral distal radius fracture and associated metacarpal-phalangeal dislocation, reinforced the importance of early functional rehabilitation of these injuries after adequate reduction and fixation, ensuring adequate fracture consolidation and satisfactory functional gain in three months of evolution. Such an emphasis on early rehabilitation in the postoperative period of distal radius fractures was also given in a prospective and randomized study, in which 30 patients with distal radius fracture undergoing open reduction and internal fixation were followed in series. The patients were divided into two groups of 15 individuals, one group was subjected to early physical therapy mobilization, and another group maintained with immobilization for

Table 3. Fracture classification, exposure, and treatment. Instituto Doutor José Frota.

| #  | AO/Salter Harris | Exposed fracture | Fracture treatment |
|----|-----------------|------------------|--------------------|
| 1  | 23C3.2 23C3.1   | No No            | Elective surgery   |
| 2  | 23B3.1 23C3.1   | No Yes           | Elective surgery   |
| 3  | 23A2.1 23A2.1   | No No            | Closed reduction + cast |
| 4  | SH-II SH-II     | No No            | Elective surgery   |
| 5  | Metaphyseal bilateral | No No     | Closed reduction + cast |
| 6  | 23B2.1 23b2.1   | No No            | Elective surgery   |
| 7  | SH-II SH-II     | No No            | Elective surgery   |
| 8  | 23C1.3 23C1.2   | Yes No           | External fixation + Elective surgery |
| 9  | 23B1.1 23A2.1   | Yes Yes          | External fixation + Elective surgery |
| 10 | 23C3.2 23B3.1   | No No            | Elective surgery   |
| 11 | 23A1.2 23A1.2   | No No            | Closed reduction + cast |
| 12 | 23B2.1 23B2.1   | No No            | Elective surgery   |
| 13 | 23C1.2 23C3.1   | No No            | Elective surgery   |

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REFERENCES

1. Alffram PA, Bauer GCH. Epidemiology of fractures of the forearm: a biomechanical investigation of bone strength. J Bone Joint Surg Am. 1962;44(1):105-14.

2. Paksima N, Panchal A, Posner MA, Green SM, Mehrman CT, Hiebert R. A meta-analysis of the literature on distal radius fractures: review of 615 articles. Bull Hosp Jt Dis. 2004;62(1-2):40-60.

3. Ilyas AM, Jupiter JB. Distal radius fractures—classification of treatment and indications for surgery. Hand Clin. 2010;26(1):37-42.

4. Cohen MS, McMurtrey RY, Jupiter JB. Fractures of the distal radius. In: Browner BD, Jupiter JB, Levine AM, Trafton PG, editors. Skeletal trauma: basic science, management, and reconstruction. 3rd ed. Philadelphia: WB Saunders; 2003. p. 1315-61.

5. Ehsan A, Stevanovic M. Skeletally mature patients with bilateral distal radius fractures have more associated injuries. Clin Orthop Relat Res. 2010;468(1):238-42.

6. Quadlbauer S, Pezzei C, Jurkowitsch J, Kolmayr B, Keuchel T, Simon D, et al. Polytrauma and high-energy injury mechanisms are associated with worse patient-reported outcomes after distal radius fractures. Clin Orthop Relat Res. 2019;477(10):2267-75.

7. Graham JG, Penna S, Fletcher D, Kwok M, Aita DJ, Takei TR, Beredjiklian PK. Outcomes of open reduction and internal fixation of bilateral fractures of the distal radius. J Hand Microsurg. 2019;11(2):117-20.

8. Ego KA, Koval KJ, Zuckerman JD. Handbook of fractures. Philadelphia: Lippincott Williams & Wilkins; 2010.

9. Stone N 3rd, Karamitopoulos M, Edelstein D, Hashem J, Tucci J. Bilateral distal radius fractures in a 12-year-old boy after household electrical shock: case report and literature summary. Case Rep Med. 2014;2014:235756.

10. van der Vliet QMJ, Sweet AAR, Bhashyam AR, Ferree S, van Heijl M, Houwert RM, et al. Polytanya and high-energy trauma and who were active in the emergency where there is no trauma center with numerous orthopedists – specialized in orthopedic trauma and who were active in the emergency where there is no protocol for conducting each type of injury – the inter-observer bias regarding the initial care for each case interferes with its evolution and outcome, resulting in a confounding bias for our study.

Therefore, it is extremely important for future perspectives on the subject, research, manuscript reviewing, data interpretation, and critical review; JBAN, CJDS, MLCC: responsible for research, manuscript reviewing, data interpretation, and critical review; JVC: involved in technical procedures and manuscript writing.

CONCLUSION

In adults, there was a greater incidence of open fractures, wrist joint involvement, ulna fracture, and concomitant injuries, with high-energy trauma exclusively observed in this group, corresponding to half of the cases.

New randomized clinical studies should be elaborated, with statistically significant samples, enabling a follow-up of patients with bilateral distal radius fractures and, consequently, estimating the functional impact and morbidity of this condition is still uncertain.