

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

## EPIDEMIOLOGIA, CLASSIFICAÇÃO E TRATAMENTO DE FRATURAS BILATERAIS DO RÁDIO DISTAL

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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.

### RESUMO

**Objetivo:** Estudar epidemiologia, padrão de fraturas, lesões associadas, e tratamento dos indivíduos com fratura de rádio distal bilateral, em um hospital terciário. **Métodos:** Estudo transversal retrospectivo desenvolvido a partir de pacientes com fratura de rádio distal bilateral no período entre janeiro de 2012 e novembro de 2017. Foram analisados dados demográficos, mecanismo de trauma, padrões radiológicos, grau de desvio, lesões associadas, classificação das fraturas de acordo com AO, Salter Harris (SH) e Frykman, e tipo de tratamento empregado em cada caso. **Resultados:** 13 casos foram incluídos no ensaio, sendo 10 adultos e três crianças. Nos infantes, a média de idade foi de 9,6 anos (7-11 anos), e o trauma de baixa energia esteve descrito na totalidade destes casos. A classificação SHII esteve presente em 66,6% das crianças. Nos pacientes adultos, a média de idade observada foi de 43,5 anos (27-56 anos), com o mecanismo de trauma de alta energia relatado em quatro (40%) casos. A classificação AO 23C.3 e 23B.2 foram as mais prevalentes nos adultos. **Conclusão:** Em indivíduos esqueleticamente maduros, observou-se maior incidência de fraturas expostas, acometimento articular do punho, fratura de ulna e lesões concomitantes, sendo o trauma de alta energia observado apenas neste grupo, correspondendo a metade dos casos. **Nível de Evidência IV, Série de Casos.**

**Descritores:** Fraturas do Rádio. Epidemiologia. Traumatismos do Punho. Estudo Clínico.

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### 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.<sup>1-3</sup> 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.<sup>2</sup> In the younger population, high-energy trauma, such as in automobile accidents, has greater impact as an injury mechanism.<sup>4</sup> In these circumstances,

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The study was conducted at Instituto Doutor José Frota.

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other associated injuries can be observed since these are poly-trauma patients, implying greater morbidity.<sup>5</sup> 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.<sup>6</sup> Fracture patterns and demography seem to vary when comparing unilateral and bilateral radius fractures, with the higher prevalence of bilateral fractures in men, for example, who usually experience high-energy trauma.<sup>5,6</sup> Furthermore, compared to unilateral fractures, bilateral fractures are associated with worse functional prognosis, especially in patients with residual deformities, and the morbidity involved in this type of injury is still unknown.<sup>5,7</sup>

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  $\pm$  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).

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

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

F: female; M: male, R: right; L: left.

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

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

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

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

## 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.<sup>8</sup> 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.<sup>8</sup> 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.<sup>6</sup> Stone et al.,<sup>9</sup> 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.,<sup>10</sup> published a study comparing, by applying questionnaires, the functional evolution of patients with polytraumatized 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)  $\geq$  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 polytrauma 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.<sup>6</sup> 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.<sup>11</sup>

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.<sup>5</sup> 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.<sup>5</sup> 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.,<sup>7</sup> 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 Borgohaim,<sup>12</sup> 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.<sup>6</sup> 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

five weeks. Those in the first group showed a better range of motion and grip strength, at the end of the six-month follow-up.<sup>6</sup> Raudasoja et al.<sup>13</sup> described the importance of maintaining the radial height and the congruence of the articular surface of the wrist, in addition to early joint mobilization, as fundamental radiological restoration parameters for satisfactory functional recovery. According to their study, priority should be given to open reduction and internal fixation surgery in order to obtain anatomical reduction.

Good results were also described by Ravikumar et al.,<sup>14</sup> in a case report of a pregnant woman, 28 years old, 34 weeks of gestational age with bilateral distal radius fracture due to a fall, with satisfactory consolidation of the fractures in four weeks. In this case, hyperestrogenism and increased cardiac output, attributed to the third trimester of pregnancy, were considered essential for the satisfactory early consolidation of fractures.

One of our biggest limitation is the lack of randomized clinical studies with serial functional assessment of patients with treated bilateral distal radius fracture, making the clinical evolution and morbidity of this condition uncertain. Despite the numerical limitation of our sample, statistical significance can be attributed to our study given the overall low prevalence of the studied condition. Another limitation was the lack of access to the specific surgical treatment involved in each injury and what motivated the types of fixations, such as radiological findings, the extent of the soft tissue injury or skin coverage, the patient's clinical conditions and other associated injuries, and the time of fracture.

Since this is a study developed at a major traumatology reference 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.

Thus, it is extremely important for future perspectives on the subject, the development of randomized controlled clinical studies, with a larger number of patients diagnosed with bilateral distal radius fracture, thus enabling a statistically significant “follow-up.” Since this is a new topic, with scarce scientific studies – most of which are case reports – the evolutionary functional evaluation and the radiological restoration of fractures, considering the different treatments, are rarely described in the literature, even when comparing with patients with unilateral fractures of the distal radius, in such a way that the functional impact and morbidity of this condition is still uncertain.

## 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 fracture and, consequently, estimating the functional impact and morbidity of this condition.

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