

Epidemiology of Distal Radius Fractures in High Complexity Clinic in Colombia, Treatment and Outcomes

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Abstract

With the purpose of identifying the prevalence of distal radius fractures, their treatment, and comorbidities in patients seen at Clínica Medilaser in Tunja between 2019 and 2021. Methodology: We established a sample of 69 patients who arrived at emergency care services with a diagnosis of distal radius fracture. We conducted a characterization of the population, which we followed with a bivariate analysis of sociodemographic and clinical characteristics in relation to complications and clinical outcomes; for those with significant associations, a logistic regression was performed. Results: The prevalence of distal radius fractures in our emergency consulting population was 3.73%, while the prevalence of this fracture among all upper limb fractures was 36.64%. Surgical treatment was preferred in 73.9% of cases, with Kirschner wires being the more commonly used at 43.8%. Only 8.7% of patients required further surgery after an average of 50.5 days, 4.4% experienced infections at the surgical site within the first 30 days, and 14.3% showed strength deficit when compared to the opposite hand. A significant association was found between the need for reoperation and rural origin ($p = 0.034$) and the combined fixation of Kirschner wires with a palmar plate ($p = 0.044$). Conclusions: Distal radius fractures at our institution showed a high prevalence with a low complication rate. Furthermore, associations were found between the sociodemographic and clinical characteristics of the population and the presence of complications and unsatisfactory outcomes.

Keywords

Distal Radius Fracture, Prevalence, Complications, Treatment, Emergencies

1. Introduction

Distal radius fractures are the most common injury in long bones, and their incidence has increased in recent years, with an average prevalence of 36% in global emergency services [1]-[6]. The main goal of treatment is early rehabilitation within the first six months to achieve complete or near-complete recovery of pre-injury functionality, regardless of whether surgical intervention was required, or conservative treatment was used [7]-[11]. However, this goal isn't met in all cases, with the literature reporting unsatisfactory outcomes like chronic pain, non-union, and disability in up to 16% of patients [12]-[16]. In Colombia, while national prevalence data remain limited, available studies provide valuable insight. For instance, Salazar *et al.* (2015) reported that distal radius fractures are significant predictors of future fragility fractures such as hip fractures in elderly populations, with an increased risk of morbidity and mortality. Additionally, a comparative study in Medellín by González *et al.* (2020) confirmed high frequency in middle-aged women, aligning with global findings. These data emphasize the need to better understand local patterns and outcomes to guide prevention and treatment strategies.

This situation is especially concerning in the older adult population (65 years or older), as distal radius fractures are a predictor of new fragility fractures in other locations, such as the hip or spine. The risk increases by 86% when associated with osteoporosis [13] [17]-[20]. Currently, there is little literature on the prevalence of these fractures in Colombia, so nationwide data on the matter is not available. However, two studies conducted in major cities, Bogotá and Medellín, offer a close overview of distal radius fractures, although their primary focus was not determining prevalence [21] [22].

The retrospective case-control study by Salazar *et al.* sought to answer whether patients over 65 years of age with a history of distal radius fracture were at an increased risk of hip fracture compared to those without. This study reported that 69.9% of the analyzed population were women, and 7.1% had a radial fracture. The results confirmed the hypothesis that having a history of distal radius fracture is a predictor of hip fractures in this population group, with an OR of 3.91 (95% CI (1.17 - 13.10)). This medical history should be taken into account for the prevention of future fractures that increase morbidity and mortality in senior citizens [21]. On the other hand, the retrospective case-control study by González *et al.* conducted in Medellín compared the radiological results and postoperative recovery of function between unstable intra- and extra-articular distal radius fractures treated with volar plates. They found that the average age of the patients was 53.7 years, and most of them were women (63%). The study concluded that the treatment of both fractures presents a similar behavior and offers equal advantages, recommending this surgical technique for this type of fracture [22].

Therefore, our institution, located in a mid-sized city in the country and responding to the global need to practice evidence-based and patient-focused medicine, aims to create new strategies for preventing comorbidities arising from these

injuries that coincide with the sociodemographic conditions of our local population. To this end, this study was developed to identify the prevalence of distal radius fractures, their treatment, and comorbidities in patients seen at the Clínica Medilaser in Tunja from 2019 to 2021, serving as the first step to obtain our own data, which will help us compare it with global figures and trends in days to come (Table 1).

Table 1. Sociodemographic and clinical characteristics of patients with distal radius fracture who attended the orthopedic service between 2019 and 2021.

Sociodemographic Characteristics	Average or N (Range or %)
Age (years)	44,97 (18 - 84)
Sex	
Male	41 (59, 42)
Female	28 (40, 58)
Origin	
Urban	51 (73, 91)
Rural	18 (26, 09)
Education	
Elementary School	5 (7, 25)
High School	52 (75, 36)
University	12 (17, 39)
Clinical characteristics	Average or N (Range or %)
Comorbidities	
Osteoporosis	
Yes	3 (4, 35)
No	66 (95, 65)
Presence of other fractures	
Yes	18 (26, 09)
No	51 (73, 91)
Diabetes	
Yes	1 (1, 45)
No	68 (98, 55)
Autoimmune disease	
Yes	2 (2, 90)
No	67 (97, 10)
Tabaquism	
No	69 (100)

Continued

Surgical variables	
Laterality	
Right	21 (30, 43)
Left	46 (66, 67)
Both	2 (2, 90)
Treatment	
Orthopedic management	18 (26, 09)
Surgical management	51 (73, 91)
Time until surgery is performed (Hours)⁻¹⁹	101 (9 - 360)
Fracture classification⁻¹	
Not displaced	16 (23, 53)
Intra-articular	11 (16, 18)
Extra-articular	41 (60, 29)
Presence of associated injuries	
Yes	5 (7, 25)
No	64 (92, 75)
Fixing type⁻⁵	
No material	13 (20, 31)
Kirschner nails	28 (43, 75)
Palmar plate	16 (25)
Nails and plates	7 (10, 94)

2. Methodology

An observational, cross-sectional study was conducted, analyzing the information recorded in the medical records of adult patients with distal radius fractures who attended the orthopedic service of the Medilaser Clinic in Tunja (Colombia) between January 1st, 2019, and December 31st, 2021. From a total of 6312 patients who visited the emergency care service during that time, a sample size of 335 patients was selected, considering the prevalence of distal radius fractures reported in the literature of 36% and a confidence level of 95% and a random margin of error of 5%. However, the analyzed sample size was determined based on the availability of patients who met the inclusion criteria during the study period. The inclusion criteria were the following: diagnosis of distal radius fracture, being of legal age (18 years or older), attending the clinic during the study period, and following up at the same institution 30 and 90 days after the injury. Patients with previous fractures in the same anatomical segment of the bone, patients with previous treatments to those determined by the institution, presence of radio-ulnar

fracture dislocation in any segment, head trauma, or neurological compromise were excluded. The selection and recruitment process of participants was carried out by reviewing the medical records of all patients who attended the orthopedic service with a diagnosis of distal radius fracture (**Table 2**). Obtaining a sample for analysis of 69 patients, who were treated by 5 orthopedists with 2 to 20 years of experience. Information was collected from the medical records system at Clínica Medilaser, where an initial search was conducted using the ICD-10 codes: S525—Fracture of the lower epiphysis of the radius and S526—Fracture of the lower epiphysis of the ulna and radius. The collected data from the selected medical records were stored in a database created in Excel, where a specific code was assigned to each patient to ensure the privacy of sensitive information in the medical record, with restricted access exclusive to the researchers. The research protocol for this study was approved by the Scientific Committee on Research Ethics of Clínica Medilaser S.A.S, with approval certificate No. 015/22 of April 19, 2022. This sample size was determined using a standard formula for estimating population proportions, assuming a prevalence of 36%, a 95% confidence level, and a 5% margin of error. However, due to strict inclusion and exclusion criteria, the final number of patients analyzed was 69. This manual review included all eligible patients seen during the defined period. No randomization or invitation was used; rather, it was an exhaustive review of available records meeting inclusion criteria. Surgeon experience ranged from 2 to 20 years in orthopedic trauma surgery, and their involvement in fracture management was recorded to evaluate treatment consistency.

Table 2. Complications and functional clinical outcomes of patients with distal radius fracture who attended the orthopedic service between 2019 and 2021.

Complications	Average or N (Range or %)
Reintervention	
Yes	6 (8, 70)
No	63 (91, 30)
Time to reintervention (Days)⁻⁶³	50, 5 (11 - 100)
Surgical site infection (<30 days)⁻¹	
Yes	3 (4, 41)
No	65 (95, 59)
Joint stiffness after 30 days⁻¹	
Yes	4 (5, 88)
No	64 (94, 12)
Joint stiffness at 90 days⁻³	
Yes	5 (7, 58)
No	61 (92, 42)

Continued

Chronic pain at 90 days⁻³	
Yes	5 (7, 58)
No	61 (92, 42)
Functional clinical outcomes	Average or N (Range or %)
Symmetrical mobilization of the hand⁻¹¹	
Yes	53 (91, 38)
No	5 (8, 62)
Full mobility⁻¹⁰	
Yes	46 (77, 97)
No	13 (22, 03)
Deficit in strength⁻¹³	
Yes	8 (14, 29)
No	48 (85, 71)
Fracture consolidation⁻⁴	
Yes	56 (86, 15)
No	9 (13, 85)

Our study variable was the distal radius fracture. The independent variables were grouped into sociodemographic properties such as: age, sex, origin and educational level. As comorbidities we took osteoporosis, other fractures, diabetes mellitus, autoimmune disease and smoking into account. Regarding surgical variables: laterality, established line of treatment, times between trauma and surgery, fracture classification and fixation times. In order to classify fractures we used a descriptive system of classification of the fracture with the following categories: Non-displaced, Intra-articular and Extra-articular, taking as a basis for this classification the Fernández and Geissler classification of 1991 AO Classification, which separates fractures into type A, B and C by the mechanism of trauma, and the Cooney Universal Classification of Radius Fractures, which classifies the fracture into: 1) non-articular, non-displaced, 2) non-articular, displaced, 3) articular, non-displaced, 4) articular, displaced; Complications were checked for need of reintervention, duration of reintervention, surgical site infection, joint stiffness, and chronic pain; functional variables were evaluated for symmetry, mobility, and strength; and fracture healing [1] [23] [24]. These classification systems were chosen for their applicability in routine clinical settings and their ability to differentiate fracture stability and involvement of the articular surface.

Considering the potential for reporting bias, data collection was performed according to an established protocol, which consisted of double-checking the correspondence of surgical and follow-up information in the medical records (Figure 1). Additionally, we sought to select patients who had come to the 30- and 90-day

follow-ups. Considering the presence of missing data on some variables, we analyzed whether this deficiency was due to a lack of information completion or to the variable's irrelevance (no reoperation). For the former, the observation was eliminated from the overall analysis, and for the latter, the analysis was performed specifically on that subgroup, to avoid any bias in the results. The assessed variables were chosen based on a literature search that met the study objectives. For variables with missing follow-up data, a complete-case analysis was performed. Sensitivity analyses were not conducted due to the limited sample size, but loss to follow-up was discussed in study limitations.

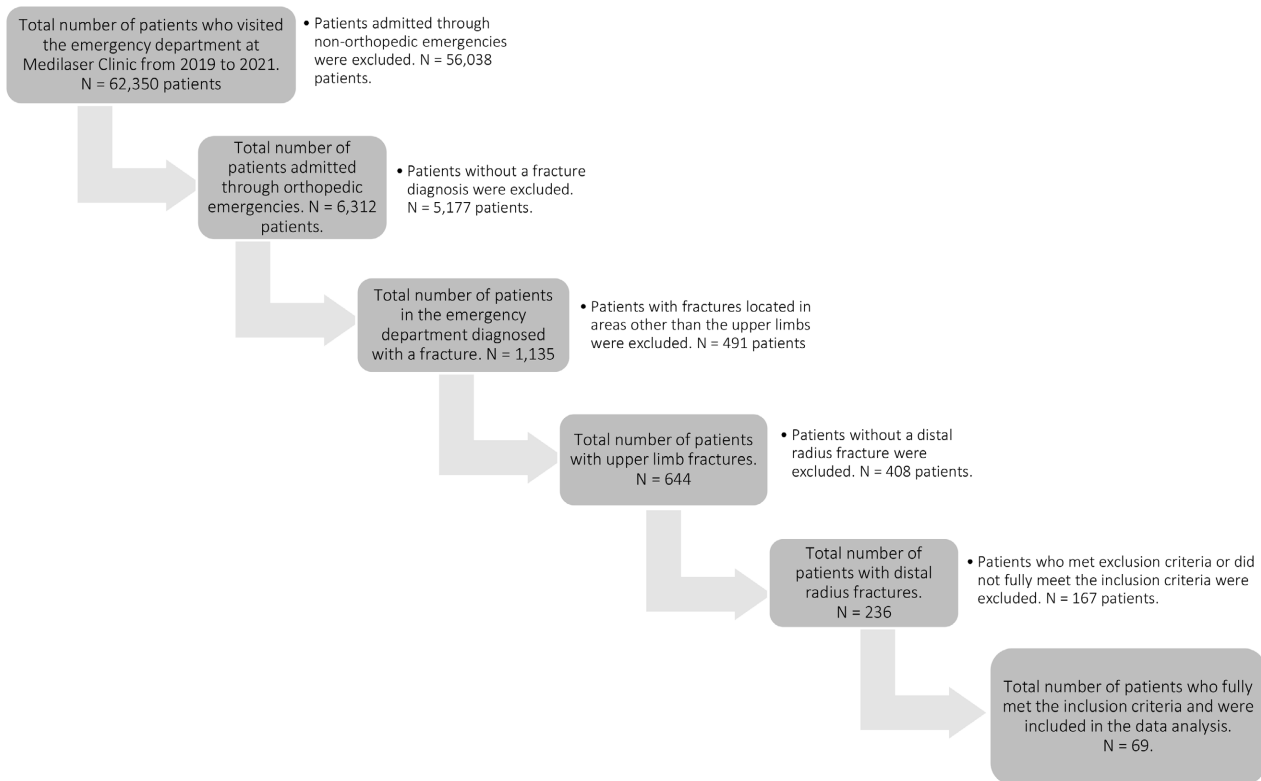


Figure 1. Flow chart of the data collection process.

Finally, considering the objective of identifying the prevalence of distal radius fractures, we conducted a descriptive analysis of each of the studied variables. We established whether the variables were qualitative or not, we calculated the means and ranges, for continuous variables we found the averages, standard deviation and variance, making a univariate description of all the variables. Subsequently, to find any association between the type of fracture, treatment and comorbidities, a bivariate analysis was performed between the sociodemographic and clinical characteristics, and the complications and clinical outcomes. For this analysis, the Chi square tests and Fisher's exact test were used, in those relationships that were identified a p-value < 0.05, a residual analysis was performed. Additionally, Cramer's coefficient was calculated to identify the strength of association of these relationships, considering these significances: small strength: ≤ 0.1 , medium: 0.1 to 0.49

and large: ≥ 0.5 . Regarding continuous variables, the Shapiro Wilk test is initially performed to determine the normality of the variables. We determined that the variable “age” and “reoperation time” have this behavior and therefore decided to perform the Levene test to identify the equality of variances and the nonparametric Kruskal-Wallis test to establish significant differences. At the end of those relationships with a p-value < 0.05 , a logistic and linear regression was performed depending on the type of variable to empirically determine associations within the variables. The statistical program used was R, RStudio Team (2020). The Chi-square and Fisher’s exact tests were applied to explore associations between categorical variables such as type of treatment and complications. These methods assume independence between observations and sufficient sample size per category. Cramer’s V was used to quantify the strength of association. For continuous variables, normality was checked using the Shapiro-Wilk test, and when non-parametric distribution was present, the Kruskal-Wallis test was employed. Logistic and linear regression models were constructed to adjust for potential confounders and evaluate multivariate associations between independent variables and clinical outcomes.

3. Results

During the study period, the orthopedic service at Clínica Medilaser in Tunja received 6312 patients (2104 patients in 2019; 1955 patients in 2020; 2253 patients in 2021), of which 1135 were diagnosed with some type of fracture; among these, 644 had upper limb fractures and only 236 had distal radius fractures. This data showed a 3.73% prevalence of distal radius fractures in our consulting population, with a 20.79% prevalence of this fracture against the total number of fractures, and finally, the prevalence of this fracture among all upper limb fractures was 36.64%.

Out of the 236 patients who arrived with distal radius fractures during the study period, only 69 met the inclusion criteria and had no exclusion criteria. **Table 1** presents detailed sociodemographic and clinical characteristics. Relevant data shows that the average age was 44.9 years old, with the majority being men at 59.4% ($n = 41$), predominantly from urban areas at 73.9% ($n = 51$), and the most common education level was secondary school at 75.3% ($n = 52$). Upon reviewing their medical history, the most prevalent comorbidity was osteoporosis at 4.3% ($n = 3$), followed by autoimmune disease at 2.9% ($n = 2$), and diabetes mellitus at 1.4% ($n = 1$). Additionally, 26.1% ($n = 18$) of the population had other fractures at the time of consultation, and none of the patients had a history of smoking.

Regarding clinical characteristics, the most common laterality for this fracture was the left side at 66.7% ($n = 46$), with the fracture classified as extra-articular in 60.2% of cases, followed by non-displaced fractures at 23.5% and intra-articular fractures at 16.1%. Only 7.2% arrived with associated injuries. In most cases, surgical treatment was chosen (73.9%), with Kirschner wires being the most used at 43.8%, and this procedure had an average duration of 101 hours (approximately 4.2 days).

Regarding complications and clinical outcomes, they are widely described in **Table 2**. Only 8.7% of our patients required reoperation within an average of 50.5 days, only 3 patients showed signs of an infection at the surgical site within the first 30 days (4.4%). At the 30-day check-up, only 4 patients presented joint stiffness (5.9%), while at the 90-day check-up, 5 patients showed joint stiffness and chronic pain (7.6%). Meanwhile, in terms of clinical outcomes, we observed that 91.4% of the population achieved symmetrical mobilization of the hand, complete mobility was achieved in 78% of patients, and 86.1% of patients showed signs of fracture consolidation. However, 14.3% presented a strength deficit compared to the contralateral hand, possibly caused by secondary muscle atrophy to prolonged immobilization and delayed rehabilitation. An unexpected finding was the relatively high proportion of strength deficits despite low rates of other complications. This may be explained by delayed rehabilitation or lack of adherence to physical therapy in some cases.

In the bivariate analysis between sociodemographic and clinical characteristics and later complications, a statistically significant association was found between reintervention and place of origin, with a moderate association strength of 0.28, and between type of fixation and reintervention, with a strong association strength of 0.57. Likewise, a statistically significant association was found between joint stiffness at 30 days and type of fixation, with a moderate association strength of 0.49, and between joint stiffness at 90 days and the presence of associated injuries, with a strong association strength of 0.57.

In the bivariate analysis between sociodemographic and clinical characteristics and clinical outcomes, a statistically significant association was identified between full mobility and the presence of other fractures, with a moderate association strength of 0.38. On the other hand, statistically significant differences were found in the variances of age and fracture consolidation.

Finally, when performing a logistic regression model between the statistically significant associations in the bivariate analysis, we found an OR of 7.00 (95% CI: 1.16 - 42.28, $p = 0.034$) between having a rural origin and requiring reoperation, understanding that those patients of rural origin have 7 times more chance of needing a reoperation, compared to those patients of urban origin, possibly caused by the latter's easier access to adequate sanitary conditions that reduce the risk of infection, healthcare services and the former's need to resume rural activities without fully respecting the recovery time. On the other hand, presenting associated injuries has a 10 times greater chance of needing reintervention compared to those patients who did not present associated injuries (OR = 10, 95% CI: 1.91 - 81.18, $p = 0.028$). Furthermore, presenting associated injuries has a 44 times greater chance of presenting joint stiffness at 90 days (OR = 44.25, 95% CI: 4.99 - 565.7, $p = 0.001$). Regarding the type of fixation, we found that performing fixation with Kirschner nails and plates has a 9.7 times greater chance of requiring reintervention compared to performing fixation with a palmar plate (OR = 9.75, 95% CI: 1.22 - 77.72, $p = 0.044$). Finally, presenting other fractures is identified as

having a 6.5 times greater chance of showing limited mobility at 90 days (OR = 6.50, 95% CI: 1.71 - 26.60, $p = 0.007$), due to a delay in the rehabilitation of this segment and the prioritization of recovery from other fractures. No statistically significant ORs were found in the linear regression between age versus complications and clinical outcomes. These multivariate models allowed adjustment for confounders such as age, sex, comorbidities, and fracture type. They provide insight into how complex combinations of factors influence clinical outcomes.

4. Discussion

As reported in current literature, distal radius fracture is a frequently occurring event that mainly affects school-age and elderly populations in a bimodal manner. Depending on each case, it may require surgical or non-surgical treatment, which can lead to complications or undesirable outcomes [3] [4] [6] [25]. Therefore, the objective of this study was to first identify the prevalence of distal radius fracture in a high-complexity clinic in the city of Tunja, obtaining a value of 3.73% on the population that consulted for an orthopedic emergency. This prevalence was higher than that reported in the study by Chung *et al.* in 2001 which showed a prevalence of 1.5%. However, the prevalence of this fracture in the population that presented fractures in the upper limb is lower than that reported in this study. Furthermore, our prevalence of distal radius fractures in the total population of patients with fractures was 20.7%, a value lower than the range reported in the MacIntyre literature review, yet higher compared to a study conducted in a high-complexity hospital in Bogotá in 2015 [1] [2] [21]. It is important to consider the context and characteristics of the population who come to our emergency care services and the types of activities they engage in, which would explain the prevalence obtained.

Regarding sociodemographic characteristics, our study showed an average age of 44.5 years old, reflecting that this type of fracture occurs in a younger population than reported in the literature [3] [6] [19] [26] [27]. It should be noted that our study only evaluated the adult population and therefore cannot reflect the behavior in the pediatric population. Contrary to what was reported in the studies of McFadyen, Rotella and Costa, this fracture was more frequent in men in our population, possibly due to the economic activity and labor they do, or their usual means of transport (motorcycles or bicycles), which has more similarities to the results found by Koo in 2013 [28]-[30]. However, in our study sex did not present a significant association with the presence of complications or unsatisfactory clinical outcomes. It is striking that only 26.1% of the population in our study was of rural origin and presented a significant association with required reintervention in those surgical patients. This could be related to the finding described by MacIntyre *et al.* where the rural population was more likely to present these fractures due to high energy impacts [2] [31], as well as the type of activities that take place in rural areas that restrict proper recovery. On the other hand, less than 5% of the population had comorbidities such as osteoporosis, diabetes, or autoimmune disease, and in most cases these patients did not have unsatisfactory outcomes.

Therefore, no association could be identified in this study. These findings contrast with global patterns and may reflect regional differences in occupation, trauma mechanisms, and access to healthcare.

Regarding clinical characteristics, the left side was the most affected, which is consistent with the findings of Rozental *et al.* and Costa *et al.* [27] [30], but contrary to the findings of McFadyen *et al.*, who reported a right-side predominance [23]. The most common type of fracture in our study was extra-articular, which is contrary to what was found by Rozental *et al.*, Marcheix *et al.*, Karantana *et al.*, Costa *et al.*, who treated two groups with plate and intramedullary nail and observed that intra-articular injury was more prevalent [27] [32]-[34], while reports made by Goehre *et al.* coincide with what we observed in our study [26]. To explain findings such as laterality and type of fracture, it is important to develop studies focused on the mechanism of trauma, which was not clearly described in this case and therefore was not considered in the analysis. The most common type of treatment was surgical, with Kirschner nail fixation being the most prevalent, which was associated with its combined use with palmar plates with reintervention. The use of Kirschner nails versus the use of palmar plates has been widely studied in literature. The study by Youlden *et al.* found no statistically significant differences in the clinical and functional outcomes between these two techniques [35], showing that they do not present functional differences up to six months postoperatively, but rather a quicker recovery and better functional results at three months with open reduction with internal plate fixation, and this is confirmed by Costa *et al.* in their studies [30] [33] [36]. The important thing to know is the type of fracture and determine the best technique for the patient's benefit, as Chung and Mallon refer to in their reviews [37] [38], as well as taking into account the expertise of the surgeons.

Regarding complications, they occurred in less than 9% of our population, the main one being reoperation, followed by joint stiffness and pain at 90 days, and operative site infection which only 3 patients had. When reviewing the literature, the reoperation rate in our series was 8.7% higher than that mentioned by Youlden *et al.* (3.2% and 4.6%) [35] but was much lower compared to that mentioned by Karantan *et al.* who documented 22.2% [34]. The result obtained in operative site infection has a lower percentage than that reported in the study carried out by Rundgren *et al.* in their cohort of the Swedish population, where they identified that the operative site infection rate was 5% for plate fixations, 12% for percutaneous nails and 28% in those who underwent external fixation [27] [39] [40]. The prevalence of complications found suggests that treatment was adequate in the vast majority of cases. However, it is a warning call to evaluate special cases and identify potential gaps.

Furthermore, a review of clinical outcomes such as nonunion in our population found a prevalence of 13.8%, a lower value than that reported by Sharma *et al.* in their study comparing outcomes in patients treated orthopedically and surgically. The rate of nonunion in orthopedic treatment was 35%, while Turner reported an incidence of 5% [15] [41]. Also, in the review conducted by Mathews and Chung,

they indicated that nonunion is associated with other outcomes such as chronic pain, mobility limitations, and strength deficits [42], which occurred in less than 23% of cases in our study. Finally, in our study, the presence of other fractures and associated injuries were significantly associated with limited mobility at 90 days and the need for reoperation, respectively. However, these associations were not clearly identified in the current literature.

Finally, the importance of our results lies in that they provide the basis for understanding our population's context, allowing us to develop care protocols focused on their sociodemographic characteristics. Likewise, as mentioned above, identifying the profile of patients with complications will help us implement preventive measures against certain risk factors such as rural origin, multiple traumas, osteoporosis, among others. These results also promote early intervention such as rehabilitation and physical therapy, in order to improve outcomes for patients with distal radius fractures. Additionally, these results contribute to the scientific and medical knowledge of our healthcare professionals and encourage future research. This information could inform regional guidelines on fracture management and rehabilitation protocols. Specifically, our findings suggest that early intervention strategies, tailored rehabilitation plans, and better access to postoperative care may improve outcomes.

5. Limitations

One of our main limitations was the incomplete recording of clinical outcomes in the medical records for the 90-day follow-up in 16% of the population, which could introduce some bias in the reported results. Additionally, it is worth noting that the sample size is small, so caution is required when extrapolating these results to other populations. Furthermore, given that this type of study relies on information recorded in medical histories, which in turn relies on the reliability of data and recording sources, some information bias may be present.

6. Conclusion

Distal radius fractures at our institution showed a significant prevalence, prompting us to suggest more detailed studies on this type of fracture. Additionally, we identified a relatively low complication rate, indicating that the clinic provides adequate treatment. Furthermore, the identification of associations between the sociodemographic and clinical characteristics of the population with certain complications and unsatisfactory clinical outcomes helps us develop targeted care protocols aimed at mitigating the specific risks faced by our population. Lastly, it is necessary to investigate a broader population to better understand the epidemiological dynamics of distal radius fractures in our region.

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need to ensure quality care for the population by evaluating our results in pursuit of continuous improvement.

Conflicts of Interest

All authors report no conflicts of interest related to the content of this article.

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