

Functionality of Fractures Distal Radius Joints Treated with Volar Plate Versus Fixator External: Evidence from A Regional Hospital in Veracruz, Mexico

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ABSTRACT

Background : Distal radius fractures are among the most common upper-limb injuries, and their treatment plays a key role in restoring wrist function . Two common surgical methods —volar locking plate and external fixator — remain under debate regarding functional superiority in the early postoperative Period .

Objective : To compare functional outcomes of intra-articular distal radius fractures treated with volar locking plate versus external fixation in a regional hospital in Mexico

Methods : Comparative observational study including 136 surgically treated patients evaluated using the PRWE scale at 6 weeks and 3 months postoperatively

Results : At 6 weeks , the external fixator group had a mean PRWE score of 87.41 compared with 56.85 in the volar plate group . In 3 months , scores improved but differences remained significant (36.84 vs 25.82; $p < 0.001$).

Conclusion : The volar locking plate provides faster and superior early functional recovery compared with external fixation . External fixation remains useful for selected cases but tends to show slower functional improvement .

KEYWORDS: fly locking plate , external fixator , distal radius fracture, wrist function , PRWE.

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INTRODUCTION

Distal radius fractures represent one of the injuries further frequent upper limb and constitute a problem relevant in practice traumatological , given its impact in the function of the hand and wrist . These injuries occur both in adults young people , generally due to high -level trauma energy , like in adults older people , where Low - impact falls predominate . There are different Treatment modalities , including external fixation and reduction open with internal fixing by volar locking plate . External fixation , traditionally employee , allows stabilize the fracture minimally invasive , although can require periods prolonged periods of immobilization and present complications associates . On the other hand On the other side , the flying plate has consolidated as one of the techniques further used currently , offering greater stability

anatomical and facilitating rehabilitation Early , but with risks inherent to surgery and major costs .

Despite the wide The use of both methods does not exist consensus in literature with respect to which provides best results functional in the short and medium term deadline . In this In that sense , the evaluation of outcomes clinical from the patient 's perspective This has become highly relevant . The Patient-Rated Wrist Evaluation (PRWE) questionnaire has become well-established . as a tool reliable and validated for measuring wrist pain and functionality , allowing obtain results objective and comparable .

In the Orizaba Regional General Hospital No. 1 , where both techniques are used routine , it is necessary to have local evidence that allows compare his effectiveness in recovery functional status of patients . This study seeks contribute information clinic that contributes to optimize decision

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making therapeutic approaches already improve the quality of life of patients attended in this institution .

MATERIALS AND METHODS

A comparative analytical study was conducted in which quantitative and qualitative variables related to post-treatment functionality of distal radius fractures were evaluated. Quantitative variables included PRWE questionnaire scores obtained at 6 weeks and 3 months post-surgery. Qualitative variables analyzed were sex, dominant hand, operated side, and type of fixation used (volar plate or external fixator).

Quantitative variables were described using means and standard deviations, while qualitative variables were summarized using absolute frequencies and percentages. For the comparison between the two treatment groups, the Student 's t-test for independent samples was used to identify significant differences in the functional evolution of PRWE scores at both assessment points. Levene's test was previously applied to verify the homogeneity of variances and determine the appropriateness of using the Student 's t-test with equal or unequal variances.

Statistical analysis was performed using IBM SPSS Statistics software , version 24.

RESULTS

Table 1 shows the distribution by age group. The 40-60 age group comprised 63 patients, representing 46.3% of the total

patients studied and constituting the largest segment of the sample. The 18-40 age group represented 25.7% with 35 patients, while those over 60 years of age made up 27.9% with 38 patients. In total, 136 patients (100%) were included in the study.

Table 1. Age groups

Age groups	Frequency	Percentage
18-40 years	35	25.7%
40-60 years	63	46.3%
People over 60 years old	38	27.9%
Total	136	100%

The most frequent group was from 40 to 60 years old.

Figure 1 shows the age distribution histogram of the 136 patients evaluated, with a mean age of 50.88 years and a standard deviation of 15.577 years. The graph revealed a majority of patients in their fifties, with a range from young adults to older patients. The distribution was relatively symmetrical, without a marked asymmetry towards the extremes of age, indicating that most values clustered around the mean.

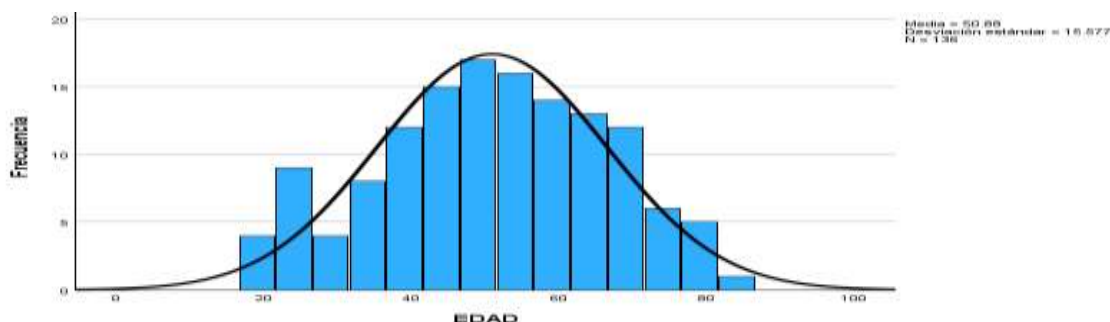


Figure 1. Age frequency histogram

Frequency distribution by age with a mean of 50.88 years.

Table 2 shows the distribution by sex, where it was found that the majority of patients were female, with a frequency of 84 (61.8%), while 52 were male (38.2%). In total, 136 patients were evaluated (100%).

Table 2. Distribution by sex.

	Frequency	Percentage
Female	84	61.8%
Male	52	38.2%
Total	136	100%

Predominance of female sex with 61.8% of the patients studied.

Table 3 shows the distribution of patients according to the surgical treatment method used: External fixator: 68 patients, representing 50% of the sample. Volar plate: 68 patients, also equivalent to 50% of the sample. A total of 136 patients were evaluated, representing 100% of the study population.

Table 3. Type of fastening used.

	Frequency	Percentage
External fixator	68	50%
Plate fly	68	50%
TOTAL	136	100%

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Equitable distribution in terms of both treatments
Table 4 shows a bar graph illustrating the relationship with the dominance of the patients who underwent surgery. 112 patients were observed with right dominance (82.3%) and 24 patients with left dominance (17.6%) out of a total of 136 patients.

Table 4. Dominant Hand

	Frequency	Percentage
Right	112	82.3%
Left	24	17.6%
Total	136	100%

Most of the patients were right-handed.

Table 5 shows the distribution of patients according to the side operated on. The left side was the most frequently operated on, with 76 cases (55.8%), while the right side accounted for 60 cases (44.1%) out of a total of 136 patients. This indicates a slight predominance of procedures performed on the left side compared to the right.

Table 5. Laterality of surgical site.

	Frequency	Percentage
Right	60	44.1%
Left	76	55.8%
Total	136	100%

Most patients underwent surgery on the left side.

The evaluation was applied to all 136 patients. **PRWE (Patient-Rated Wrist Evaluation)** at 6 weeks and 3 months post - surgery with both treatment methods . questionnaire

validated measures wrist pain and function From the patient 's perspective , with a total score between 0 (no limitation) and 100 (maximum). disability).

Table 6 compares the functional assessment using the PRWE score at 6 weeks and 3 months post-surgery. At 6 weeks, patients treated with an external fixator had a mean score of 87.41 points, while those treated with a volar plate had a mean score of 56.85 points, reflecting better early progress in the volar plate group. At 3 months, the volar plate group again showed a better result, with a mean score of 25.82 points, compared to the external fixator group, which had a mean score of 36.84 points.

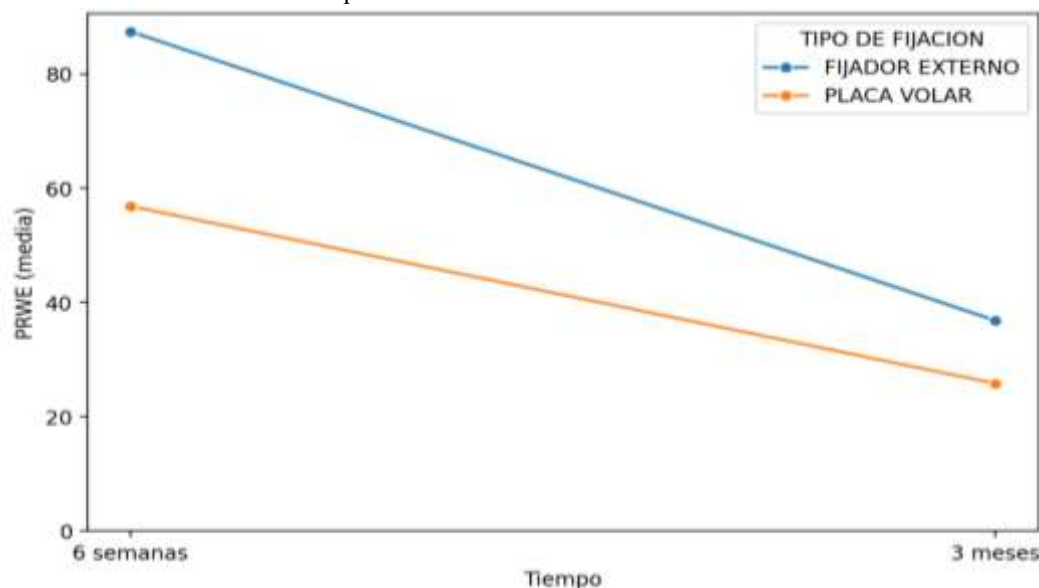
Table 6. Comparative table of PRWE scores at 6 weeks and 3 months.

<i>PRWE 6 WEEKS</i>		<i>PRWE 3 MONTHS</i>
TYPE OF FIXING	AVERAGE	AVERAGE
<i>External fixator</i>	87.41	36.84
<i>Plate fly</i>	56.85	25.82

In both time periods, the volar plate showed better functional assessment scores.

Figure 3 shows the temporal evolution of the average PRWE scores in patients treated with an external fixator and volar plate at 6 weeks and 3 months of follow-up. The group treated with volar plate presented lower average scores at both 6 weeks and 3 months, compared to the group managed with an external fixator.

Figure 3. Temporal evolution of PRWE score means



Both treatment methods showed improvement in the PRWE score over time; however, the volar plaque showed lower scores in both periods evaluated.

To compile the statistics Levene's test for equality of variances was applied for inferential analysis . When applied to the PRWE score at 3 months, an F value of 2.77 was

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obtained with a significance of $p = 0.0986$, as shown in Table 7.

This indicates that there are no differences statistically significant in the variance between groups, therefore the homogeneity of variances is assumed and it turns out originating the use of the Student's t- test for samples independent.

Table 8. Student 's t-test

Variable	Assumption of variances	t	gl	P of a factor	Two-factor P	Difference of means	Standard error of the difference	95% confidence interval of the difference
PRWE 3 MONTHS	Equal variances are assumed	31,961	134	<0.001	<0.001	11.015	0.345	Lower: 10,333 Superior: 11,696

The Student 's t-test showed a significant difference between both groups ($p < 0.001$), with better functional scores in the group treated with volar plate at 3 months.”

DISCUSSION

The results of the present study confirm that the volar locking plate provides faster functional recovery and better PRWE scores compared to the external fixator, a finding consistent with Gou et al., in a meta-analysis of randomized clinical trials conducted in China in 2021 with 245 patients, who reported that the volar locking plate offered better wrist mobility, less pain, and greater grip strength at one and three months postoperatively compared to the external fixator. ⁽¹²⁾

In Italy, Maccagnano et al. conducted a meta-analysis in 2021 with 312 patients and showed that the locked volar plate allowed for more precise anatomical restoration, less loss of reduction, and better early functional outcomes as measured by PRWE and DASH. ⁽¹⁴⁾

Sharma et al. conducted a prospective randomized study in India in 2020 with 60 patients and found that functional recovery (mean PRWE 22 vs. 35 in external fixator at three months) was significantly better in the volar plate group, although at one year the difference was reduced, indicating that the external fixator also achieves good long-term results. ⁽¹⁸⁾

Yu et al., in a retrospective study in China in 2019 with 72 patients, reported similar results: the locked volar plate allowed for faster functional recovery, greater range of motion and grip strength, while the external fixator was useful in patients with specific anatomical or clinical limitations. ⁽¹³⁾

Table 7. Levene's test.

	F	Next.
PRWE 3 MONTHS	2.77	0.0986

Equal variances are assumed

In Table 8, the Student's t- test for samples independent showed a difference statistically significant ($t(134) = 31.96$, $p < 0.001$), indicating that the group with **flying plate** presented PRWE scores significantly minors (better) functionality) that the group with **fixative external** at 3 months.

Dündar conducted an isokinetic study in Turkey in 2021 with 50 patients, and found that patients treated with volar plates recovered flexion and extension strength significantly faster, although both groups achieved similar functional levels at six months. ⁽⁶⁾

Polat et al., in a comparative study in Turkey in 2023 with 68 patients, confirmed that the volar plate allowed for better mobility and less initial joint stiffness. ⁽⁷⁾

Yılmaz conducted a prospective study in Turkey in 2023 with 60 patients, demonstrating that the volar locking plate allowed for better range of motion and less initial pain (PRWE 18 vs. 32 in external fixator at three months). ⁽²⁰⁾

Agarwal et al., in a prospective study in India in 2022 with 54 patients, showed that the volar plate favored early mobilization and better PRWE scores, while the external fixator showed advantages in cases with biological or logistical limitations. ⁽²²⁾

Regarding complications, Nwosu et al. documented in an observational study in the United States in 2023 that the incidence of flexor tendinopathies was 7%, with implant removal in only 2 cases. ⁽²⁴⁾

Jafari et al., in a multicenter study in Iran in 2023 with 80 patients treated with an external fixator, reported that complications were mainly related to infections at the puncture sites (10%), partially affecting the initial functional recovery. ⁽²¹⁾

Carroll et al. conducted a clinical study in the United States in 2023 with 75 patients and observed that anatomical restoration with a volar plate allowed an average PRWE of 20 at three months, with minimal residual stiffness and good range of motion. ⁽²⁸⁾

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Finally, Jayaram et al., through an international network meta-analysis in 2023, concluded that the locked volar plate offered the best risk-benefit ratio, with early functional recovery, less loss of reduction, and a low incidence of serious complications.⁽³⁰⁾

In our population, the average age was 50.9 years, which coincides with that described by Martín-Blanco et al. (Spain, 2020), who reported that distal radius fractures are more frequent in middle-aged adults, especially in women, due to the progressive decrease in bone mineral density and the greater risk of falls in this group.⁽¹⁾

Similarly, the meta-analysis by Gou et al. (China) mentions that most of the included studies have a mean age ranging from 40 to 60 years, a range that closely corresponds to that observed in our population.⁽¹²⁾

The predominance of females in our sample (61.8%) is also consistent with the reviewed studies. Martín-Blanco et al. describe a higher incidence of this fracture in women, especially in the postmenopausal stage.⁽¹⁾

Gou et al. point out that in the clinical trials analyzed, there is a repeated pattern of female predominance associated with hormonal factors and greater bone fragility. These findings support the idea that the sex distribution observed in our series is not an isolated phenomenon, but rather part of a widely documented epidemiological pattern.⁽¹²⁾

Regarding the dominant hand, right-handedness predominated in our study (82.35%), which is consistent with the general distribution of laterality in the world population and was also reported in several of the trials included in the meta-analysis by Gou et al., where the majority of patients were right-handed.⁽¹²⁾

The predominance of interventions on the left side in our population also coincides with that reported by Martín-Blanco et al., who observed a slightly higher frequency of fractures in the non-dominant limb, possibly due to protective reflex mechanisms during the fall.⁽¹⁾

The results of the study show that the plate is locked . offers a better recovery functional early , reflected in lower PRWE scores in comparison with the fixative external ; however, literature It establishes , and our data suggest that these differences tend to decrease in he follow-up late . Likewise , the characteristics demographic and epidemiological characteristics of the population analyzed were consistent with what was reported internationally , and the complications observed in both methods Surgical findings aligned with studies previous , without appearing events adverse older unexpected . However, the study presents limitations important factors , including sample size reduced that can affect the power statistics , a non- randomized design that introduces a risk of selection bias , and follow-up relatively short that prevents appreciate completely the evolution long- term functional . Furthermore , variability intersurgical could influence in the results , the absence of radiological variables detailed limited he analysis

anatomical-functional , and nature The single-center nature of the study reduces the generalizability of the findings to other populations or health systems .

CONCLUSIONS

This study demonstrates that the volar locking plate offers faster functional recovery and better PRWE scores compared to the external fixator, especially during the first three postoperative months. Patients treated with the volar plate exhibited greater range of motion, improved grip strength, and less initial pain, facilitating early return to activities of daily living and improving the patient's functional perception. On the other hand, external fixation remains a valid alternative, especially in patients with biological or economic limitations, or with soft tissue involvement, achieving comparable long-term functional results and satisfactory bone healing rates. The choice of fixation method should be individualized, considering mechanical stability, bone quality, and the patient's functional goals, always prioritizing anatomical reduction and early mobilization.

Limitations of this study include the relatively small sample size, which may limit the generalizability of the results to broader populations. Furthermore, follow-up focused primarily on the first six postoperative months, so long-term functional outcomes may vary. Another point to consider is that individual factors such as adherence to rehabilitation, patient age, and comorbidities were not strictly controlled, which could influence PRWE scores and functional recovery. Finally, the lack of strict randomization and a multicenter design limits the robustness of the findings, suggesting that future studies with larger sample sizes and longer follow-up are needed to confirm these trends.

In conclusion, the evidence generated in this study supports the use of volar locking plates as the preferred method for most distal radius fractures, while external fixation remains a viable option in selected cases. Individualized treatment, rigorous monitoring of rehabilitation, and consideration of patient factors are essential to optimize functional outcomes and minimize complications.

Therefore, the null hypothesis is rejected since the data did show differences between both treatments and the alternative hypothesis is accepted because there were differences in the PRWE scores at 3 months.

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