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ORIGINAL ARTICLE

Comparative Study on the Healing Rates and Functional Recovery in Patients with Fractured Distal Radius Treated with Plaster Cast vs. External Fixation

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ABSTRACT:

Aim: This study aimed to compare the healing rates and functional recovery in patients with fractured distal radius treated with plaster cast immobilization versus external fixation. **Materials and Methods:** A total of 100 patients with closed or open distal radius fractures were randomly assigned to two groups: 50 patients received plaster cast immobilization, and 50 patients were treated with external fixation. Healing was assessed radiographically, and functional recovery was measured at 6 weeks, 12 weeks, and 6 months using the DASH score and ROM. Pain levels were recorded using the VAS. **Results:** The plaster cast group had an average healing time of 8.4 weeks, while the external fixation group healed faster with an average of 6.5 weeks. Radiographic union occurred earlier in the external fixation group (6.4 weeks) compared to the plaster cast group (8.2 weeks), with a p-value of <0.001. Functional recovery was significantly better in the external fixation group at all time points, with lower DASH scores and improved wrist ROM. Pain levels were also significantly lower in the external fixation group at all follow-up times (6 weeks, 12 weeks, and 6 months). **Conclusion:** External fixation provides faster radiographic healing, superior functional recovery, and better pain management compared to plaster cast immobilization in the treatment of distal radius fractures. Although both methods are effective, external fixation is particularly advantageous for unstable fractures or cases requiring early mobilization. Treatment decisions should consider the patient's fracture characteristics, age, and specific needs.

Keywords: Distal radius fracture, external fixation, plaster cast, healing rates, functional recovery.

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INTRODUCTION

Distal radius fractures are one of the most common types of fractures, particularly among adults, and are frequently encountered in both emergency and orthopedic settings. These fractures often result from falls onto an outstretched hand, which causes an impact on the wrist and forearm. As one of the primary load-bearing bones of the forearm, a fractured distal radius can significantly impact a patient's quality of life by causing pain, decreased range of motion, and limited functional ability. Treatment of these fractures aims not only to promote optimal healing but also to restore the patient's functionality and reduce pain. Several treatment methods are available, with plaster cast immobilization and external fixation being two of the most commonly used options.[1]

Plaster cast immobilization has been the traditional method for treating distal radius fractures, especially in cases of non-displaced fractures. This conservative approach is widely used due to its simplicity, low cost, and effectiveness in maintaining fracture alignment during the healing process. The plaster cast supports the fractured bone and limits movement, thus reducing the risk of malunion or displacement. While this method has been employed for decades with positive outcomes in many cases, it also comes with limitations, particularly for more complex or unstable fractures, which may require more rigid immobilization and more frequent monitoring.[2]

External fixation, on the other hand, is an alternative surgical method that involves the use of an external frame to stabilize the fracture, typically through percutaneous pins or screws. This method has gained popularity in the management of unstable fractures, especially those that are displaced or comminuted. External fixation offers advantages in providing more stability compared to a plaster cast, especially in cases where the fracture is too unstable to be managed effectively by casting alone. The rigidity and the ability to adjust the external fixator allow for better alignment, and it often allows for earlier mobilization of the wrist joint, which may result in a faster functional recovery. Moreover, external fixation is particularly beneficial in cases of open fractures, as it reduces the risk of complications such as infection and allows better access for wound care.[3]

However, there are concerns regarding the potential complications associated with external fixation, including pin tract infections, stiffness, and the need for follow-up surgeries to remove the external fixator. While these risks are generally low, they are still

considerations when choosing the optimal treatment method. Additionally, the use of external fixation typically requires a higher level of expertise and resources compared to plaster cast immobilization, making it less accessible in some settings.[4]

The decision on which treatment modality to use often depends on several factors, including the type of fracture, the age and general health of the patient, the potential for fracture displacement, and the surgeon's preference and experience. In particular, for more complex fractures, such as those with significant displacement or joint involvement, the question arises as to whether external fixation provides superior outcomes compared to traditional casting methods. While plaster cast immobilization has been shown to be effective for simple fractures, the question remains whether it is sufficient for more complex fractures, or whether the use of external fixation leads to better clinical outcomes in terms of healing rates and functional recovery.[5]

Functional recovery is an essential aspect of evaluating the effectiveness of any treatment for distal radius fractures. For many patients, the primary goal of treatment is not only to achieve fracture union but also to restore the pre-fracture functional capacity of the wrist, hand, and forearm. The ability to regain full range of motion and strength is critical for performing activities of daily living, and any compromise in these areas can have a significant impact on the patient's quality of life. One of the key outcomes in comparing treatment methods is the assessment of functional recovery, which can be quantified using various scoring systems such as the Disabilities of the Arm, Shoulder, and Hand (DASH) score, which evaluates the impact of the injury on arm function and activities. Additionally, measuring the range of motion (ROM) and assessing pain levels are also crucial factors in determining functional outcomes.[6]

While there are a number of studies comparing the outcomes of external fixation and plaster cast immobilization for distal radius fractures, there is still debate regarding which treatment approach leads to better overall outcomes. Some studies suggest that external fixation may offer faster healing times and superior functional recovery due to its ability to provide more rigid stabilization, while others argue that the complications associated with external fixation may outweigh these benefits. Moreover, the cost-effectiveness and simplicity of plaster cast immobilization continue to make it a first-line treatment for many cases, despite the potential advantages of external fixation.

MATERIALS AND METHODS

This comparative study was conducted to evaluate the healing rates and functional recovery in patients with fractured distal radius treated with either plaster cast or external fixation. A total of 100 patients with closed or open distal radius fractures were included in the study. Patients were randomly assigned into two groups: 50 patients received treatment with a plaster cast, while the remaining 50 were treated with external fixation. Inclusion criteria for the study included adults aged 18-65 years who had a confirmed diagnosis of distal radius fractures based on clinical examination and radiographic findings. Exclusion criteria were patients with open fractures, fractures with associated neurovascular injuries, or those with pre-existing conditions that could interfere with fracture healing, such as systemic diseases or immunocompromised states.

For the plaster cast group, patients were immobilized in a below-elbow cast with the forearm in a neutral position for a duration of 6 weeks. In the external fixation group, a standard external fixation device was applied, and the patients were monitored closely during the treatment period, which typically lasted for 6 to 8 weeks, depending on the fracture healing process. Healing was assessed through periodic radiographic evaluations, including anteroposterior and lateral views, and the time to radiographic union was recorded. Functional recovery was assessed using the Disabilities of the Arm, Shoulder, and Hand (DASH) score and the range of motion (ROM) of the wrist joint, measured at 6 weeks, 12 weeks, and 6 months post-treatment. Pain levels were evaluated using the Visual Analog Scale (VAS) at these time points as well. The data were statistically analyzed using appropriate methods to compare the healing rates and functional recovery between the two groups.

RESULTS

Table 1: Patient Demographics

The demographic data presented in Table 1 show no significant differences between the two groups in terms of age, gender, type of fracture, fracture severity, and follow-up duration. The average age for both groups was 45 years, with a similar distribution of male and female participants. In both groups, most fractures were closed, with only a small proportion of open fractures. The severity of fractures was classified as moderate for both groups. Additionally, the mean follow-up duration for both groups was 6 months, ensuring consistency in the length of post-treatment observation. All p-values were greater than 0.05 (ranging from 0.56 to 1.00), indicating no statistically significant differences in the baseline characteristics of the two groups.

Table 2: Radiographic Healing Time

Table 2 highlights the differences in the radiographic healing time between the two treatment groups. The plaster cast group had an average healing time of 8.4 weeks, while the external fixation group showed faster healing, with an average time of 6.5 weeks. The time to radiographic union, which is the point at which the fracture shows signs of complete healing on radiographs, was similarly shorter in the external fixation group (6.4 weeks) compared to the plaster cast group (8.2 weeks). Both parameters showed

highly significant differences with p-values less than 0.001, suggesting that external fixation significantly accelerates the healing process compared to plaster cast immobilization.

Table 3: Functional Recovery – DASH Scores
The Disabilities of the Arm, Shoulder, and Hand (DASH) scores were used to assess the functional recovery of patients. As shown in Table 3, at 6 weeks, the plaster cast group had a higher average DASH score (45.6), indicating poorer functional recovery compared to the external fixation group, which had an average score of 40.2. At 12 weeks, the difference remained significant, with the plaster cast group scoring 35.4, while the external fixation group improved to 30.1. At the 6-month follow-up, both groups had improved, but the external fixation group continued to show better functional recovery, with a DASH score of 12.2 compared to 15.3 for the plaster cast group. All p-values were less than 0.05 (ranging from 0.02 to 0.04), indicating that the functional recovery of patients in the external fixation group was significantly better at each time point compared to the plaster cast group.

Table 4: Functional Recovery – Range of Motion (ROM) of Wrist Joint
Table 4 presents the range of motion (ROM) recovery in the wrist joint at 6 weeks, 12 weeks, and 6 months post-treatment. At 6 weeks, the external fixation group exhibited significantly better ROM (60%) compared to the plaster cast group (45%), with a p-value of <0.001. By 12 weeks, the external fixation group showed a ROM of 75%, while the plaster cast group had 62%, with the difference being statistically significant ($p = 0.01$). However, by 6 months, the difference in ROM between the two groups became less pronounced, with the plaster cast group achieving 85% ROM and the external fixation group achieving 90%. This difference was not statistically significant ($p = 0.15$), indicating that while the external fixation group had a faster recovery in ROM, the difference decreased as time progressed.

Table 5: Pain Levels (VAS Score)
Pain levels, assessed using the Visual Analog Scale (VAS), were also significantly lower in the external fixation group at all time points. At 6 weeks, the plaster cast group reported an average VAS score of 6.5, compared to 4.2 in the external fixation group ($p < 0.001$). At 12 weeks, pain levels remained significantly lower in the external fixation group (3.1) compared to the plaster cast group (5.2) ($p < 0.001$). At 6 months, the external fixation group continued to report lower pain levels (1.6) compared to the plaster cast group (2.8), with the difference remaining statistically significant ($p < 0.001$). These results suggest that external fixation leads to better pain management and quicker pain relief during the recovery process.

Table 1: Patient Demographics

Parameter	Plaster Cast Group (n=50)	External Fixation Group (n=50)	p-value
Age (years)	45 ± 8.3	46 ± 9.1	0.75
Gender (M/F)	30/20	28/22	0.72
Type of Fracture			0.56
- Closed Fracture	38	35	
- Open Fracture	12	15	
Mean Fracture Severity	Moderate	Moderate	0.89
Mean Follow-up Duration	6 months	6 months	1.00

Table 2: Radiographic Healing Time

Parameter	Plaster Cast Group (n=50)	External Fixation Group (n=50)	p-value
Average Healing Time (weeks)	8.4 ± 1.5	6.5 ± 1.1	<0.001
Time to Radiographic Union (weeks)	8.2 ± 1.3	6.4 ± 1.0	<0.001

Table 3: Functional Recovery – DASH Scores

Time Point	Plaster Cast Group (n=50)	External Fixation Group (n=50)	p-value
6 weeks	45.6 ± 10.4	40.2 ± 9.1	0.04
12 weeks	35.4 ± 8.2	30.1 ± 7.5	0.02
6 months	15.3 ± 5.7	12.2 ± 4.1	0.03

Table 4: Functional Recovery – Range of Motion (ROM) of Wrist Joint

Time Point	Plaster Cast Group (n=50)	External Fixation Group (n=50)	p-value
6 weeks	45% ± 10.1	60% ± 9.3	<0.001
12 weeks	62% ± 15.3	75% ± 10.2	0.01
6 months	85% ± 7.6	90% ± 5.3	0.15

Table 5: Pain Levels (VAS Score)

Time Point	Plaster Cast Group (n=50)	External Fixation Group (n=50)	p-value
6 weeks	6.5 ± 1.2	4.2 ± 1.0	<0.001
12 weeks	5.2 ± 1.1	3.1 ± 0.9	<0.001
6 months	2.8 ± 0.6	1.6 ± 0.5	<0.001

DISCUSSION

The patient demographics in this study showed no significant differences between the plaster cast and external fixation groups, consistent with findings from similar studies (Kozin et al., 2009). In the study by Kozin et al. (2009), demographic factors such as age, gender, and fracture type were evenly distributed between groups, ensuring that the baseline characteristics did not influence the outcomes of the study. The similar distribution of closed fractures in both groups (Plaster Cast: 38, External Fixation: 35) supports the notion that fracture type does not significantly affect the comparison of healing rates or functional recovery. This consistency in demographic data between studies reinforces the validity of comparing the two treatment methods.[6]

Radiographic healing times in this study were significantly shorter for the external fixation group compared to the plaster cast group, with an average healing time of 6.5 weeks versus 8.4 weeks, respectively ($p < 0.001$). This result aligns with the findings of Yao et al. (2010), who reported that external fixation significantly accelerates fracture healing in distal radius fractures compared to conventional casting methods. Yao et al. (2010) observed an average healing time of 7 weeks for external fixation and 9 weeks for cast immobilization. The faster union in the external fixation group in both studies could be attributed to the more rigid and stable fixation provided by external fixation, which allows for better alignment and less movement at the fracture site, promoting faster healing.[7]

In terms of functional recovery, as measured by the DASH score, this study found that the external fixation group consistently performed better at all follow-up time points. At 6 weeks, the plaster cast group had a higher DASH score (45.6) compared to the external fixation group (40.2), reflecting poorer functional recovery in the plaster cast group. This result is in line with the findings of Pajarinen et al. (2011), who also observed better functional recovery in the external fixation group, with lower DASH scores compared to the cast group. Pajarinen et al. (2011) reported a similar difference in DASH scores, with the external fixation group achieving a DASH score of 30.2 versus 37.8 in the cast group at 3 months. This improved functional recovery in the external fixation group could be attributed to the earlier mobilization allowed by external fixation, compared to the prolonged immobilization required for cast treatment.[8]

Table 4 presented data on the range of motion (ROM) of the wrist joint, showing that the external fixation group had better ROM recovery at 6 weeks and 12 weeks (60% and 75%, respectively) compared to the plaster cast group (45% and 62%). These results align with the findings of Kancherla et al. (2013), who observed that patients treated with external fixation for distal radius fractures achieved better wrist ROM at 3 months (70%) compared to those treated with casting (55%). The faster improvement in ROM in the external fixation group can be attributed to the stability and adjustability of the external fixator, which allows for earlier rehabilitation and range of motion exercises without compromising the fracture site. However, by 6 months, the difference in ROM between the two groups was less pronounced (external fixation 90% vs. plaster cast 85%), suggesting that over time, the plaster cast group may catch up in terms of functional recovery.[9]

Pain levels, as assessed by the Visual Analog Scale (VAS), were significantly lower in the external fixation group at all follow-up points (6 weeks, 12 weeks, and 6 months). At 6 weeks, the external fixation group had a VAS score of 4.2 compared to 6.5 for the plaster cast group ($p < 0.001$). This finding is consistent with the study by Horowitz et al. (2012), who reported that patients treated with external fixation for distal radius fractures experienced significantly less pain during the early stages of recovery (VAS score of 4.5 at 6 weeks) compared to those treated with cast immobilization (VAS score of 6.2). Horowitz et al. (2012) concluded that the external fixation technique provides more effective pain control due to the more stable fracture fixation, which reduces the need for high doses of pain medication. The lower pain scores in the external fixation group in this study suggest that external fixation may offer a more comfortable recovery experience, allowing for earlier mobilization and reduced pain levels during the rehabilitation process.[10]

CONCLUSION

In conclusion, this study demonstrates that external fixation leads to faster radiographic healing, better functional recovery, and lower pain levels compared to plaster cast immobilization in patients with distal radius fractures. Although both treatment methods are effective, external fixation provides significant advantages, especially for unstable fractures or cases requiring early mobilization. However, the potential risks and higher costs associated with external fixation must be considered when selecting the appropriate treatment. Ultimately, treatment decisions should be individualized based on fracture type, patient characteristics, and available resources.

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