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Original Research Article

Evaluation of open reduction and internal fixation with closed reduction and external fixation in distal radial fracture

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ABSTRACT

Background: Radial fracture frequently occurs in osteoporotic disorders, or in low-energy injuries. It is most frequent fracture of the upper extremity. Open reduction or closed reduction is done but there is debate between the two about its efficacies. Aims and objectives were to find out the efficacy and safety of open reduction and internal fixation (ORIF) with that of closed reduction and external fixation (CREF) among patients with distal radial fracture of all ages.
Methods: This prospective study was conducted with patients of distal radial fracture. They underwent interventions, namely, ORIF (Open reduction group) or CREF (Closed reduction group). DASH score was measured before the intervention and during several follow ups at 4th week to 15th week. DASH score was statistically analyzed between the two groups. Additionally, the complications of the patients in each group were evaluated and sick leaves of the patients was recorded to assess their quality of life.
Results: The study has found that the number of days taking patients took sick leave from field work is significantly more in "closed reduction" group as compared to "open reduction" group ($p<0.05$). The number of days patients took sick leave is significantly higher in “closed reduction” group as compared to “open reduction” group ($p<0.05$).
Conclusions: The study has concluded that the disability of the patients who received ORIF decreased significantly as compared to those who received external fixation and the patients who received open reduction significantly improved from the fracture.

Keywords: Open reduction, Closed reduction, Internal fixation, Radial fracture, Distal radius

INTRODUCTION

Following study will discuss distal radial fractures. In current era, yearly 26 people suffered it among 10,000. In addition, it is the most known fracture of upper extremity. Similarly, it can also be available in the emergency room and one-sixth of all fractures. Research has demonstrated that it can be available among aged person who is suffering from osteopenia or osteoporotic disorders. The cause of distal radial fractures is low-energy injuries/ simple fall.[1] However, modern medical science has suggested that it has several ways of recovery including, open contraction and internal fixation with a volar or dorsal plate.[1,2]

The research has indicated useful clinical outcomes with different plates. For example, dorsal, volar, pillar and fragment-specific tools and others. The study has demonstrated that in the prior era, the distal radial fracture was common to ORIF in the administration of volatile ruptures.[2] On the other hand, there were several obstacles noted in operating closed plating through numerous methods. For Example, fractures of tendons, carpal tunnel syndrome as well as problematic limited injury syndrome.[3] Furthermore, in the last few decades CREF were utilised for unsteady distal radius fractures.

Similarly, limited difficulties have been noted in different

kinds of literature. For example, pin-track infection, less reduction, immobility of the fingers and others. In the present time, the essence of bone reduction and restoration of the articular texture has been highlighted.[4] Numerous research has shown an explicit correlation between post-traumatic arthrosis and intra-articular phase flaws of two mm or more. In addition, different surgical surveillance may operate on this obstacle. Furthermore, the different surgical administration is better than other medications.[5] In addition, the pin and plaster fixation and percutaneous pinning medication are not appropriate processes for volatile distal radial fractures. Similarly, this way can bring poor results for the treatment. On other hand, surgical treatment is suggested for volatile and non-reducible distal radial fractures and it can be complicated.[3-5]

Similarly, few observational studies have demonstrated the benefit of the usage of plates. In addition, most of the time external fixation is normally used in the distal radial fractures.[4,5] Therefore, the above-mentioned two methods are appropriate for volatile distal radial fractures. Furthermore, it has been controversy over the few years which is the way of treatment or suitable therapies for distal radial fractures. A strong analysis can be found on which effective way of treatment is. The aim of the analysis of the radiological, drawback rate, and clinical and useful results among the two groups of suffering treated either by a clear reduction or inner fixation, external obsession for unsteady distal radial fractures.[3,5]

Although, open reduction or internal fixation is an excellent process than outward fixation in the surgical therapy of unsteady distal radial fractures.[6] Similarly, there has no other option for distal radius fracture (DRF) treatment and pins and plaster are the routes of external fixation and internal fixation is the main substitute for further medication modalities.[4,6] Furthermore, DRF cannot be evaluated as a small pain since it can bring outcomes of a strong injury and distress. It is incomplete if surgical treatment for the most of fractures type must always result in understanding the importance of results. But both surgical and non-surgical therapies have the potential to produce unsatisfactory results.[2,4-6]

The "American academy of orthopedic surgeons clinical practice guideline from 2010" has found that a logical review of the published analysis is unstable to suggest or against the other particular surgical procedure for the obsession of DRF.[3-5] To evaluate pinning plate systems with alternative treatments, well-designed medical, biomechanical, and price research is required. However, when results and benefits are properly shown by scientific theory, the present optimism for medial and lateral fixed-angle plates must be limited. The aim of treatment of these injuries must be the anatomical recovery of the structure, regardless of the method utilised.[5,7]

A significant proportion of physicians cannot do surgery if the joint imbalance is greater than 2 mm.[8] Similarly, the medial angle is more than 10 degrees, or the radial reduction is more than 3 mm. To use the self-reported questionnaire as the research aim, and also physical function and radiological parameters make an excellent.[5] Furthermore, the purpose of this study was to make comparisons between ORIF in the therapies of distal radius fractures with that of CREF. Further, the study aimed to find out the complications of these two interventions and the reduction of disability caused to the patients by using these two interventions.

METHODS

Research design

The study was conducted prospectively from December 2021 to September 2022. The patients with distal radial fracture who came to the outpatient department of PT Birta city hospital, Nepal, were only considered. The patients were either given open reduction and internal fixation or CREF. The patients were given one of the previously mentioned treatments randomly. Based on the treatment they received, the patients were assigned into 2 groups, namely, "open reduction" group (those who received open reduction and internal fixation) and "closed reduction" group (CREF). Fractures which are displaced are reduced and casted while non-displaced fractures were managed by using plaster cast for 4 to 5 weeks. Surgical interventions were provided to those patients whose fracture was unstable even after its reduction.

The patients, receiving reduction and fixation, were followed up after 4 weeks, 8 weeks, 12 weeks and 15 weeks. The outcome of the study process was determined by the DASH score which were determined before the intervention (reduction and fixation) and at 8th week. Comparative analysis was conducted between the two groups of patients and the complication between the two groups were analyzed. Also, the number of days the patients took sick leave in each group was recorded and analyzed statistically.

Table 1: DASH score and its classification.

Classification	DASH score
Excellent	0 to 5
Good	6 to 15
Satisfactory	15 to 35
Poor	More than 35

Intervention

The patients underwent the operation by specialized had surgeons and stabilization was done by using bone graft, K-wires and bone substitutes. For open reduction and internal fixation was done by giving 2 incisions on the 1st and 4th extensor compartments. The reduction was done by 2 pins which were used at the tip region of styloid of radius bone in the oblique and proximal direction while leaving the cortex of radius proximally on the ulnar aspect. Post-operatively, the patients were managed by plaster cast for

2 weeks and active mobilization was done under the professional guidance of registered physiotherapists.

CREF was done by bridging external fixator (Hoffman type fixator) which was later changed to radiolucent wrist fixator. Pins were used for insertion into second metacarpal and into the radius (proximal to fracture). The fixator was removed after 6-7 weeks and active mobilization was done under the supervision of registered physiotherapist in the following days.

Inclusion and exclusion criteria

The sampling was done according to the inclusion and exclusion criteria. The patients, ranging from 18 years old to 62 years old, were included. The included patients are those, who had injury of less than 12 days, dorsal angulation of more than 20° and axial compression of more than 2, followed our study protocol and did not opt out in middle of the study and gave required consent.

The patients who had history of ipsilateral fracture, volar fracture with displacement, open fracture, undergoing chemotherapy or radiotherapy, psychiatric disorder, drug abuse or any other underlying chronic condition which may affect bone metabolism like vitamin D deficiency or abnormality in parathyroid hormone production or secretion. After applying inclusion and exclusion criteria, this current study has considered 80 patients, with 42 patients in "open reduction" group and 38 patients in "closed reduction" group.

Statistical analysis

The study used SPSS 25 and excel software for effective statistical analysis. The descriptive measurements were expressed as mean ± standard deviation. DASH score between the groups was analytically compared by using Mann Whitney U-test. The complications of the patients were compared between the two groups by using Fisher's exact test. The level of significance was considered to be α=0.05.

RESULTS

The study found that the mean age of the patients in "open reduction" group was found to be 48.25±14.12 years old while "closed reduction" group was 45.66±15.22 years old. Table 2 shows the detailed demographic characteristics of this study.

The study has found DASH score in each group. Table 3 shows the detailed DASH score of the two groups before the intervention and at 8th week of the intervention.

The study has found the complications in each group and their respective statistical significance. The complications were classified according to their severity.[6] Table 4 shows the detailed findings of the complication that was recorded in each group of patients after 12 weeks of intervention.

The study found that there are 18 patients with complications in "open reduction" group while there are 37 patients with complications in "closed reduction" group and the difference between these two were found to be statistically significant ($p<0.05$). The complications were classified according to its severity. Individually compared, neither of the complications showed any significance between the two groups in terms of number of patients but prolonged postoperative pain found to be significant between the two groups. There were 4 patients from "open reduction" group and 11 patients from "closed reduction" group who had shown to have Prolonged postoperative pain, which was statistically significant difference ($p<0.05$).

Table 2: Demographic characteristics in both the groups of this study.

Demographic characteristics	Open reduction group	Closed reduction group
Number of patients	42	38
Age (years; mean±SD)	48.25±14.12	45.66±15.22
Gender (male/ female)	(28/14)	(23/15)
BMI (kg/m^2; mean±SD)	22.55±1.58	22.61±1.41
Duration between injury and receiving the intervention (days; mean±SD)	8.5±2.9	8.1±2.6
Mechanism of injury		
Fall during standing/ walking	9	8
Fall during running	5	6
Fall during jumping	3	1
Fall during cycling	11	8
Fall from stairs	14	15

Table 3: DASH score in both the groups before the intervention and at each follow-up study and their statistical significance.

Time of measurement	Open reduction group	Closed reduction group	P value
Before the intervention	2.2±1.5	2.4±1.3	<0.05
4 weeks after intervention	32.5±5.26	31.32±4.85	<0.05
8 weeks after intervention	21.52±3.69	25.66±3.25	<0.05
12 weeks after intervention	13.98±4.5	21.69±4.95	>0.05
15 weeks after intervention	4.27±1.26	16.28±2.62	>0.05

Table 4: Complications found in each group at 12th week of intervention classified according to severity.

Complications	Open reduction group, n=42	Closed reduction group, n=38	P value
Minor complications			
Skin adherences	2	3	>0.05
Radial neurapraxia	3	7	>0.05
Prolonged postoperative pain	4	11	<0.05
Pin-tract infection	1	3	>0.05
Moderate complications			
Postoperative CTS	1	1	>0.05
Radial neurapraxia	1	2	>0.05
APL dislocation	2	3	>0.05
Radial pin irritation	1	2	>0.05
Major complications			
CRPS	1	1	>0.05
Malunion	1	2	>0.05
Metacarpal fracture	1	2	>0.05
Total number of complications	18	37	<0.05

The study also evaluated the sick leaves or number of days the patients of each group did not attend the workplace. The study has found that the number of days taking patients took sick leave from field work is significantly more in "closed reduction" group as compared to "open reduction" group ($p<0.05$). But the number of days patients with desk jobs, took sick leave in each group is not significant between the two groups ($p>0.05$). Again, the number of days patients took sick leave is significantly higher in “closed reduction” group as compared to “open reduction” group ($p<0.05$). Table 4 shows the detailed findings of sick leaves by the patients in each group and their respective significance.

Table 4: Patients taking sick leaves in each group and their significance.

Nature of work	Open reduction group, n=42	Closed reduction group, n=38	P value
Field work	42.58±5.95	59.25±7.55	<0.05
Desk work	25.55±2.85	35.11±4.45	>0.05
All the patients	48.51±4.56	52.42±6.85	<0.05

DISCUSSION

In contrast to most other injuries, many randomised trials have been carried out on the treatment of distal radial fractures.[7-9] However, after meta-analyses of all randomised radial fracture trials, as described. In addition, in the Cochrane review in which 48 randomized clinical trials and 25 different potential treatments are examined in 3,371 people. Furthermore, no conclusion that the majority can be obtained. In addition, processes are successful in 46 non-randomized trials including external or internal fixation in 1,519 people showed no useful results.[9,10] In addition to the lack of majority rule over the older more experienced approaches. In addition, no prospective randomised or high-quality non-randomized research has yet been performed on the most popular ideas.[9,10]

Four systematic research studies have compared basic reduction and internal fixation to locked or direct reduction, even as it is acquainted. The data has demonstrated that a good finding has been originating from an inner obsession. Another research has shown a lack of important differences or effective useful results in external fixation.[10,11] Different research has also demonstrated a greater flaw fee for inner fixation with a dorsal plate for external fixation. Similarly, it has been assumed that open removal and internal fixation deliver effective articular anatomy in great committed injuries. Furthermore, these effective results have been obtained from external fixation.[12,13]

People evaluated by comparing internal fixation with the dorsal Pi-plate, mini-open reduction.[13] In addition, external fixation and discovered that the Pi-plate had an increased number of complications. It has been observed that the external group tends to be better, even at the moment of surgery. Similarly, a lot of people have wanted to switch from the indirect group to the open community, and also many people cannot be discovered again. People who have been addressed with external fixation have been more likely to get an infectious disease or have their equipment recess. People who have been managed with internal fixation are much more likely to have problems with their tendons.[12-14]

Though, both experiments has shown that the shapes of health problems are unique for each method. This might help the orthopedic surgeon decide to use external or internal fixation. People have found a high rate of problems, but the majority of them have been small and short-lived. From the group that has had external fixation, a higher number of major problems. For example, re-dislocation requires stitches again and then the complex regional type of medicine. Other research has shown that external fixation causes around 20% and 85% of problems, most of which are small.[15] When examining various surgical treatments, this same value of non-union is an essential ultimate determinant that must be considered in the judgment as a whole.[14] In this study, 5 of the people in the external fixation group as well as 1 of the people in the

internal fixation team have needed multiple surgeries. Similarly, their bones do not work correctly. Five other persons in the C group and two persons in the O team had radiological and no other problems.[14-16] McQueen found the same thing when he tried to compare non-bridging outer fixation to trying to bridge external fixation. In addition, 14 out of participants who have been treated with a connecting external fixator used to have a mal-union. Discussing strength and balance, which is the final result of the statistical method. The team that has been controlled with internal fixation plays better, which may not be interesting at seven days but becomes more essential at twelve months.[15]

Similarly, when it goes to right arm rotation, the internal fixation (O) group does better at all of the find journeys. The values of physical functioning and the range of motion in this survey have been similar to those found in other analyses, both for the C group and the O group.1[7] For the O team, that is correct when compared to the TriMed framework or the latest alignment trends of angle-stable medial plating. It could be more than one purpose why the internal fixation group's motion range and physical function have gotten better within a year. The injuries in the O group may well be designed to align during surgery, or a better decrease might be maintained while the spine heals.[15,16]

It would make the joint match together best. In the O group, recovery tends to start 3 days prior, which can also explain why there is a difference between the two groups early on. In addition, both aspects of the range of motion and physical function, as has been discovered in previous studies.[16] In this research, however, this success during the entire first year. Furthermore, when it arrives at the open-to interpretation results. The O group has tended to also have a positive outcome.[18] The overall DASH scoring system in this data is 16 for the volar plate. Thus, 9 to 17 for the TriMed method, and 7 to 17 for fracture fixation.[17,18]

The overall result in both groups is excellent, considering that people have compared internal and external treatments for the most unstable distal radial fracture.[19] In people with unstable injuries, the operation is their only option. After one year, both methods will produce the best DASH numbers, physical function, and movement range. Therefore, given both subjective and objective results, severe problems, and sick leave, humans consider internal fixation provides a superior result and is the option of choice. However, external fixator outcomes are also still excellent.[18-20] Further randomised studies must identify the most effective method for internal stabilizing fracture. Considering smaller variations between both the 2 approaches, new and much more sensitive objective outcome tools. Moreover, it will be required to decrease the number of people needed to demonstrate a change.[17,19,20]

This study has some limitations. The sample is smaller and it is a single-centred study. This study also did not consider the nutritional aspect and built of the patients, both of which considerably influence the healing of fracture.

CONCLUSION

The study has concluded that the disability of the patients who received open reduction and internal fixation decreased significantly as compared to those who received CREF and after 15 weeks of the intervention, the patients in open reduction group had shown excellent DASH score which implies their clinically significant improvement from the fracture. The study further added that the patients in open reduction group had significantly less number of complications as compared to closed reduction group. This shows the safety profile of open reduction and internal fixation is clinically safe intervention. Moreover, the study also has shown that the sick leaves of the patients who underwent open reduction and internal fixation was much-less number of days as compared to those who underwent CREF.

However, the author suggests that there should be more studies be conducted on larger number of patients with varied population characteristics. Finally, the study highlights that the open reduction and internal fixation is the intervention of choice in distal radial fracture of individuals of any age.

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