Original Article

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Comparison of Outcome of Two Different Methods for the Treatment of Intra-articular Fracture of Distal Radius

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ABSTRACT

Objective: To compare the two most commonly used techniques for the surgical management of distal radius fractures comparing open reduction and internal fixation with percutaneous K-wire fixation

Methodology: A randomized controlled trial was conducted in the Orthopaedics Department, Shaikh Zayed Hospital, Lahore for one year; from April 2017 to March 2018. Total 90 patients were selected in the study by 'non-probability, consecutive sampling technique' with 45 patients in each group of the study; Group-A (fixation method: Open reduction with internal fixation with volar plate) and Group-B (Fixation method: Kirschner-wire known as K-wire).

Results: The mean age in group A and group B was 53.7 ± 11.8 years and 55.2 ± 12.3 years respectively. There were 58 males and 32 females in the study. The differences in volar tilt, radial inclination, radial length, and modified Mayo score were significantly better in group A than group B (p-value < 0.05). The differences were not significantly different for articular step off in the two study groups (p-value > 0.05).

Conclusion: Open reduction with internal fixation using volar locking plates yielded significantly better radiological and functional outcomes than percutaneous fixation using K-wire in the 6 months postoperative period.

Keywords: Kirschner wire, distal radius, volar plate and intra articular fracture.

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Introduction

One of the most common injuries encountered in orthopedic practice is Distal radius fractures (DRFs), which accounts for 8%−15% of all bony injuries in adults[1].

Intra-articular component in DRFs usually signifies high-energy trauma occurring in young adults resulting in displacement of the fracture fragments.[2,3]

Restoration of functional activity and anatomy depends upon the patient's age, fracture anatomy, displacement, stability, and articular incongruity of fractures. DRF could result in permanent impairment and substantial economic costs annually, which is increasing with the aging of the population worldwide. Therefore, choosing effective and evidence-based treatment methods is crucial.[4]

Various treatment options for the intra articular DRFs include open reduction and internal fixation (IF) with volar locking plate (VLP), casting, closed reduction with external fixation (EF), closed reduction and percutaneous K-wire fixation.[5]

External fixation is a simple and rapid technique, and it is mainly reserved for severely comminuted and unstable fractures of distal radius. In this technique, also known as ligamentotaxis, the fracture fragments are indirectly pulled out to length by longitudinal traction. EF, however, does not directly cause reduction and maintenance of intra-articular fragments and dorsal tilt.[6]

The better treatment modality of the intra articular fractures is open reduction internal fixation (ORIF) with plate osteosynthesis. The advantages include reduced

swelling, less pain, improved range of motion accompanied with early mobility and early return to work when compared with other methods.[7]

However, some disadvantages of ORIF include the potential risk of infection, neurovascular injury, tendon irritation or rupture, carpal tunnel syndrome and requires more operational resources.[8]

K-wire method, which is comparatively less invasive, has led to a poor reduction, the late collapse of the fracture after removal of wires and stiffness due to several weeks of joint immobilization.[8]

Some disadvantages occur with K-wire; primarily pin track infection, poor or incomplete reduction, joint stiffness, superficial branch of radial nerve injury, and a chance of delayed collapse of the fractured after the wires have been removed.[7,9]

We conducted this study to compare the two most commonly used techniques for the surgical management of distal radius fractures comparing open reduction and internal fixation with percutaneous K-wire fixation. The results of study were expected to reveal an evidence-based guideline for further management of these patients in our settings.

Methodology

This randomized controlled trial study was conducted in the Department of Orthopaedics Shaikh Zayed Hospital, Lahore for a period of 1 year, from April 2017 to March 2018. Non-probability, consecutive sampling technique was applied. A sample size 0f 90 (45 in each group) was estimated using 90% confidence level, 80% power of test with an expected mean Mayo score in Distal Radius Fractures (DRF) with close reduction and percutaneous K-wire fixati0n 72.5±19.5 and 0pen reducti0n internal fixation 60.7±11.3.[10] A total of 90 patients of both genders, between 20 to 60-year age, with history of 2 weeks fracture distal radius (AO 23 B), were collected. They were equally divided into 2 groups; Group-A (open reduction with internal fixation) and Group-B (Kirshner-wire). Those patients, having Rheumatoid arthritis, previous ipsilateral fracture, high risk for anesthesia and open fracture were not included in the study.

The patients were admitted in the 0rthopaedics Department through emergency and 0utpatient department. Demographic data and history were taken relevant to the mode of injury and time since injury. The diagnosis was confirmed based on clinical and radiographic examination. Lateral view, anteroposterior view of the injured wrist was taken radiologically. Baseline investigations and fitness for anesthesia was obtained preoperatively. Informed written consent was obtained from all patients for surgery and research.

All the patients were operated after the swelling had subsided. Patients in group A underwent surgery using volar plate, whereas patients in group B underwent surgery using percutaneous fixation with K-wires. After the 0peration, the limb was placed in a volar slab. Post-0perative x-rays were done. Drains were removed after 48 hours. Skin stitches were removed after two weeks. Range of movement exercises of wrist were started as soon as pain permitted. K-wires were removed in 6 weeks and the plaster slab was discarded in 6 weeks. The patients were followed in the outpatient department at 1, 3, and 6 months. Radial inclination, radial length, volar tilt, and articular congruity were recorded. Variables of Modified mayo score were calculated and graded.

All the data was entered and processed using SPSS version 22. Radiological parameters like radial length, radial inclination, volar angle and articular congruity at 1, 3, and 6 months were described by mean ± SD for both groups. The comparison between the two groups was made using 't-test'. The functional outcome and complication rates for both groups were described using frequency(n) and percentages (%). The comparison for functional outcomes was performed using 'Chi-square test'. P value ≤ 0.05 was considered statistically significant.

Results

A total no. of 90 patients were included in the study with 45 patients in each group, assigned based on random allotment using the lottery method. The mean age of the patients in group A (volar plate) was 53.7 ± 11.8 years whereas the mean age 0f the patients in the K-wire group was 55.2 ± 12.3 years. The difference in the mean age 0f the patients in each study group was statistically not significant with p-value: 0.819.

There were 58 male patients and 32 female patients in the study. (Table I). The difference in the number 0f patients in different genders in both the groups was not significant (p-value >0.05).

Table I: Gender distribution in study population.

	Group A		Group B	
Sex	**N**	**%**	**N**	**%**
Male	3o	66.7	28	62.2
Female	15	33.3	17	37.8
Total	45	1oo.o	45	100.0

Majority 0f the patients in 0ur study had right hand dominance i.e. 32, (71.1%) in volar plate group versus 34 (75.6%) in K-wire group. Contrarily, 13 (28.9%) patients had left hand dominance in volar plate and K-wire group respectively. The differences in distribution 0f dominant and non-dominant hand in both the study groups were statistically not significant (p-value >0.05).

We evaluated various radiographic parameters in seeing the surgical outcome in the two treatment arm. Volar tilt, radial inclination, radial length and articular step 0ff were evaluated radiologically.

The differences in the volar tilt between the two study groups was statistically significant at postoperative month 1, 3 and 6 with p-values 0f 0.0001, 0.0001 and 0.00001 respectively. Similarly, the differences in the radial inclination between the two study groups were statistically significant at post0perative months 1, 3 and 6 with p-values 0f 0.031, 0.022, and 0.001 respectively. The differences in the radial length between the two study groups were also statistically significant at postoperative months 1, 3 and 6 with p-values 0f 0.029, 0.010 and 0.015 respectively.

Whereas the differences in the articular step off between the two study groups were not significant statistically at post0perative month 1, 3, and 6 with p-values 0f 0.841, 0.61 and 0.32 respectively and the differences in the modified Mayo score were also significantly different at all the postoperative visits with p-values 0f 0.0001, 0.00001 and 0.0021 respectively.

All the radiological and functional parameters yielded better outcomes in the group-A in comparison with Group-B postoperatively (p-value < 0.05). (Table II)

Discussion

Distal radius fractures (DRF) are one of the commonest fractures and there are two peaks of it's incidence. First, in young patients who have sustained high-energy trauma and the other is in elderly patients who have sustained low-energy trauma, as in falls.[11] The surgical treatment options in DRFs, depend upon many factors such as comorbidities, functional or mental health status, and medications being used.[12]

Cochrane Collaboration summary, reported that there is still no proper evidence related to the best surgical treatment for DRFs. The most frequently adopted surgical treatments include, Kirschner wire and locking-plate fixation method.[10]

It was reported, that the main advantage of plating internal fixation for distal radius fractures could be the early functional recovery as well as the possibility of gaining an optimal restoration of the wrist anatomy and also the maintenance of the achieved reduction.[13]

The outcomes of the current study portrayed some strengths of volar locking plates. We found better functional outcomes for patients undergoing open reduction and plate fixation in terms of a better modified Mayo score (p-value < 0.05). Quantitatively calculated from the data of the studies, previous studies have also confirmed these findings, and the volar locking plates groups scored better DASH or Quick DASH in different centers.[14,15]

Some studies have shown that K-wires have comparable results to plates at last follow-up.[16] The grip power, when compared quantitatively, was also the same for both groups. It was further observed that improvement in DASH score with plating was temporary.[17] So the middle

Table II: Differences of all Radiological and functional outcome parameters during follow-ups

Follow Up (months)	**Volar Tilt (degree)**		**Radial Inclination (degree)**		**Radial Length (mm)**		**Articular Step Off (mm)**		**Modified Mayo Score**	
	Group A	**Group B**	**Group A**	**Group B**	**Group A**	**Group B**	**Group A**	**Group B**	**Group A**	**Group B**
1	8 ± 2	2 ± 7	20 ± 4	18 ± 3	10 ± 2	9 ± 3	0 ± o.6	1 ± 1	72.3 ± 19.5	60.1 ± 12.1
2	8 ± 2	2 ± 9	21 ± 5	19 ± 4	10 ± 3	9 ± 3	0 ± 0.4	1 ± 1	8o.2 ± 2o.1	66.5 ± 11.1
3	9 ± 3	3 ± 9	22 ± 5	20 ± 4	10 ± 3	9 ± 2	0 ± 0.5	1 ± 0.5	85.2 ± 18.2	7o.2 ± 10.1
p-value on last follow-up	**0.00001**		**0.001**		**0.015**		**0.32**		**0.0021**	

and long term results of plating had no significant benefit over K- wiring.[18,19]

The overall rate of complications has been reported to be lower with the volar locking plates but the difference with K-wiring has not been statistically significant. A meta-analysis proved significantly lower rates of infections and higher rates of tenosynovitis and tendonitis. Complications like implant failure and malunion were relatively less with plating but these patients had to go for another surgery for implant removal.[20] A few pin tract infections in K-wire group whereas superficial wound infections in the ORIF group were observed in a study and future studies are recommended, dedicated on an estimation of complication rate of various surgical techniques postoperatively in the patient population.[21]

In another study, better restoration of ulnar variance was provided by VLP after 6 weeks, although the radiological outcomes were similar in both. Another difference noted was that the risk of complication was 18% higher while using K-wires whereas the rate of reoperation was higher in case of using VLP (4.6% versus 3.2%).[22]

It has also been reported that closed reduction and percutaneous pinning of distal radius fracture doesn't give an excellent result after short period of follow up and is a satisfactory treatment in old age group.[23]

According to the results of the radiological evaluation criteria obtained in a study, by the use of VLP, the nearly complete anatomical reduction can be obtained. Careful surgical techniques should be performed while keeping in mind the complications that can occur in distal radius anatomy. The use of shorter screws should be prefered rather than long ones, especially when most distal screws are applied during surgery, and also to use tangential radiography as intraoperative radiological imaging. The results showed stable fixation, early and systemic rehabilitation during patient recovery.[24]

Given the current drive to cost reduction, it is important to note, whether it is beneficial to use expensive equipments or longer time of surgery, requiring more anaesthesia with eventually producing similar results at the end. In a systematic review, comparison was made regarding costs of surgical management and their outcome. The comparison showed that despite having similar results using the two treatment methods, cost and expenses were more while using volar locking plates.[25]

Another study suggested better results with volar plating in terms of radiological and functional outcomes. However, long-term follow-up showed no significant benefits of plating over K- wiring. Also, in old age people, minimum differences radiologically do not confer substantial clinical deficiencies.[26, 27]

Till now the current study was the only one of its type conducted in our unit. Our focus was to compare the two treatment modalities in terms of their results. The results presented in our study are very much likely to provide orthopedic surgeons with deeper understanding of the outcome of these two commonly used surgical techniques.

Conclusion

Open reduction with internal fixation using volar locking plates yielded significantly better radiological and functional outcomes than percutaneous fixation using K-wire in the 6 months postoperative period.

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