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Outcome of ligamentotaxis of fracture distal end radius by distractor apparatus

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Abstract

Background: The radius is one of two long bones that make up the human antebrachium, the other bone being the ulna. With the recent advent of improved implants used for open reduction and internal fixation of distal radius fractures, external fixation of these fractures has fallen out of favour. Hence; under the light of above mentioned data, we planned the present study to assess the outcome of ligamentotaxis of fracture of distal end radius by distractor apparatus.

Materials & methods: Twenty five Cases of age group 20-50 years and of either sex with intra/juxta-articular fractures of distal radius were taken for the present study. As soon as the patient is fit for surgery, the patient was operated under appropriate anaesthesia, taking all aseptic precautions with proper cleaning and draping. Post-operatively patient was advised active movement of the adjacent joints as early as possible. Follow-up was done and all the patients were analysed. Gartland and Werley is a mixed subjective and objective assessment.

Results: Mean duration of surgery was found to be 63.58 minutes. Mean Gartland and Werley score was found to be 4.72. According to Gartland and Werley score grading, excellent results were obtained in 24 percent of the patients (6 patients), while good results were seen in 64 percent of the patients (16 patients). Fair results were obtained in 12 percent of the patients (3 patients). Mean time for complete radiographic union was 14.8 weeks.

Conclusion: The efficacy of ligamentotaxis in neutralizing detrimental compression forces, which are likely to cause displacement of unstable fracture with radial shortening, is a significant and increasingly appealing advance in the management of distal radius fracture.

Keywords: Ligamentotaxis, Radius

Introduction

The radius is one of two long bones that make up the human antebrachium, the other bone being the ulna. A distal radius fracture, commonly known as a wrist fracture, is defined by the involvement of the metaphysis of the distal radius. The fracture may or may not involve the radiocarpal joint, distal radioulnar joint, and/or the distal ulna. This injury is commonly associated with high-energy mechanisms in younger patients and lower energy mechanisms or falls in older patients. The fracture results in acute wrist pain and swelling, and if left untreated, it can result in significant morbidity. [1-3]

The basic principle of fracture treatment is to obtain accurate fracture reduction and then to use a method of immobilization that will maintain and hold that reduction. While the goal of treatment in fracture distal end of radius is restoration of normal function, the precise methods to achieve that desired outcome are controversial. Intra-articular fractures of distal end of the radius can be difficult to treat, at times, with traditional conservative method. A number of options for treatment are available to prevent the loss of reduction in an unstable fracture of the distal end of the radius. [4, 5]

With the recent advent of improved implants used for open reduction and internal fixation of distal radius fractures, external fixation of these fractures has fallen out of favour. Currently, volar fixed-angle fixation with plates and screws is popular; however, published studies have not shown that this technique yields clearly superior results in the long term over other methods of treatment. Furthermore, adequate reduction in unstable fractures can be obtained by distraction and closed manipulation, external fixation with or without the use of percutaneous K-wires has been shown to be an excellent means of treatment. In opposition to

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this technique, several reports in the literature have discouraged the use of external fixators by associating it with complication rates ranging from 10% to 61%. These include pin site problems, loss of reduction, poor patient tolerance, and stiffness. However, the complication of stiffness, which is often mentioned, has not clearly been substantiated by the literature. It has been debated whether this postoperative stiffness is due to the severity of the original injury or the effect of distraction of the external fixator.^[6-7] Hence; under the light of above mentioned data, we planned the present study to assess the outcome of ligamentotaxis of fracture of distal end radius by distractor apparatus.

Materials and Methods

Twenty five Cases of age group 20-50 years and of either sex with intra/juxta-articular fractures of distal radius, admitted in the department of Orthopaedics of Government Medical College, Amritsar were taken for the present study. Patients were included after approval from the Ethical committee. An informed and written consent was taken from the patient before inclusion in the study. Cases were classified according to Fernandez classification and all non-comminuted fracture of distal radius was excluded from the study.

Patient was admitted in the emergency and OPD Department. After that patient was examined with respect to the injuries and special attention was given to circulation and neurological status of the limb. Primary treatment in the form of antibiotics, analgesics, immunization against tetanus, intravenous fluid, thorough wound debridement and antiseptic dressing in case of open fracture, and splinting was done.

As soon as the patient is fit for surgery, the patient was operated under appropriate anaesthesia, taking all aseptic precautions with proper cleaning and draping. The fracture was stabilized by transarticular external fixator device. The implant used for osseous fixation was either schanz pin or kirschner wire depending upon the type of fracture. Proximal hold will be provided by 2 pins one 2 cm proximal to the fracture site and other further proximal to that. Distal hold was with 2 pins into 2nd and 3rd metacarpal (if necessary in 4th metacarpal) thus bypassing the fracture site. The proximal and distal holds were connected by connecting rods, distractor and

hinges which were used if needed for further adjustment. C-arm fluoroscopy was used for adjustment after reduction. Traction on ligaments and soft tissue around the fracture was applied to reduce the fracture according to the principle of ligamentotaxis and reduction was maintained. Distractor was preferred as these can help in future adjustment. If any additional procedure was required such as bone grafting it was planned either at the same time or later. Entry points of wires/pins were covered with betadine soaked gauze for 24-48 hours.

Post-operatively patient was advised active movement of the adjacent joints as early as possible. Follow-up was done and all the patients were analysed. Gartland and Werley is a mixed subjective and objective assessment that included residual deformity (3 points), subjective evaluation (6 points), objective evaluation based on range of movement (5 points), and complications including pain (5 points). With excellent being 0 to 2, good 3 to 8, fair 9 to 20, and poor ≥ 21 . All the results were analysed by SPSS software. Chi-square test and one way ANOVA were used for assessment of level of significance. P-value of less than 0.05 was taken as significant.



Fig 1: Fixation of Connecting rod with clamps



Fig 2: a) Preoperative X-ray Lateral and AP View, b) Immediate Postoperative X-ray AP View, c) Postoperative 6 weeks, d) Postoperative 6 months

Results

Mean age of the patients was found to be 49.74 years. 56 percent of the patients (14 patients) were males while the remaining 44 percent patients (11 patients) were females. In 60 percent of the patients (15 patients), mode of injury was fall from height while in the remaining 40 percent of the patients (10 patients), mode of injury was road traffic accident. Right side involvement occurred in 64 percent of the patients (16 patients) while left side involvement occurred in 36 percent of the patients (9 patients). Mean duration of surgery was found to be 63.58 minutes. Mean Gartland and Werley score was found to be 4.72. According to Gartland and Werley score grading, excellent results were obtained in 24 percent of the patients (6 patients), while good results were seen in 64 percent of the patients (16 patients). Fair results were obtained in 12 percent of the patients (3 patients). Mean time for complete radiographic union was 14.8 weeks. In 44 percent of the patients (11 patients) and 24 percent of the patients (6 patients), time for complete radiologic union was between 14 to 17 weeks and 11 to 13 weeks respectively. Superficial pin tract was found to be present in 8 percent of the patients (2 patients). Wrist stiffness was present in 8 percent of the patients (2 patients). Malunion and pain on exertion were found to be present in 1 patient each (4 percent). Mean palmar tilt on follow-up was found to be 7.5° , while mean radial angle was found to be 16.1° respectively. Mean radial height on follow-up was found to be 7.75 mm. Mean dorsiflexion and palmar flexion was found to be 58.4 and 52.4 respectively. Mean radial deviation and ulnar deviation was found to be 17.5 and 22.8 respectively. Mean supination and pronation was found to be 75.9 and 70.1 respectively.

Table 1: Age-wise distribution of patients

Age group (years)	Ligamentotaxis	
	Number of patients	Percentage
18 to 30	3	12
31 to 40	5	20
41 to 50	9	36
51 to 60	8	32
Total	25	100
Mean age (years)	49.74 \pm 10.39	

Table 2: Duration of surgery

Duration of surgery (Minutes)	Ligamentotaxis
Mean	63.56
SD	6.77

Table 3: Gartland and Werley score

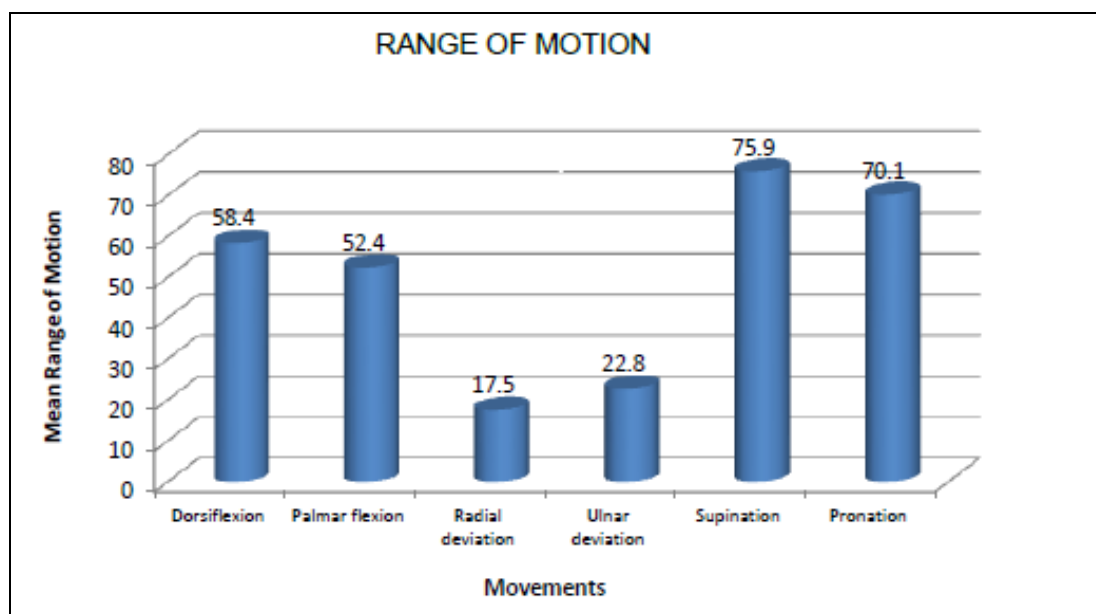
Parameter	Ligamentotaxis
Gartland and Werley score	4.72
SD	3.88

Table 4: Gartland and Werley score grading

Gartland and Werley score grading	Ligamentotaxis	
	Number of patients	Percentage
Excellent	6	24
Good	16	64
Fair	3	12
Poor	0	0
Total	25	100

Table 5: Time for complete radiographic union (weeks)

Time for complete union (weeks)	Ligamentotaxis	
	Number of patients	Percentage
8 to 10 weeks	4	16
11 to 13 weeks	6	24
14 to 17 weeks	11	44
18 to 20 weeks	4	16
Total	25	100
Mean	14.8 \pm 3.31	



Graph 1: Range of motion

Discussion

Fractures occurring at the distal end of the radius are seen frequently in emergency departments, representing approximately one sixth of all fractures. Based on decades of extensive research, surgeons have developed multiple approaches for the treatment of distal radius fractures, including both conservative and non-conservative options. These options include closed reduction and casting, closed reduction and percutaneous pinning, external fixation, and open reduction with internal fixation (ORIF). The conservative treatment of closed reduction and casting has historically been the mainstay of treatment for distal radius fractures, however, owing to the increased complication rate associated with this treatment such as fracture collapse, surgical options, specifically ORIF, are becoming more common.^[7-9]

External fixation is generally accepted as superior to plaster immobilization in young patients with intra-articular comminuted displaced distal radius fracture. The successful use of external fixation in the management of unstable intra-articular fractures necessitates careful assessment of the fracture pattern, appropriate patient selection, meticulous surgical technique, appropriate choice of fixation devices, judicious augmentation with internal fixation and bone grafting, careful postoperative monitoring, and aggressive early rehabilitation.^[10]

The present study was conducted in the department Orthopaedic Ward of Guru Nanak Dev Hospital/Government Medical College, Amritsar. Twenty five Cases of age group 20-50 years and of either sex with intra/juxta-articular fractures of distal radius were taken for the present study.

In the present study, Mean age of the patients was found to be 49.74 years. In a previous study of 40 patients conducted by Horesh *et al* between 1983 and 1987, the average age was 48 years. The fractures were common in the age group 41-50 years of age. The average age in a study of 132 fractures conducted by Jakim *et al*, showed that the average of all cases was 35 years.^[11, 12]

In the present study, right side involvement occurred in 64 percent of the patients (16 patients) while left side involvement occurred in 36 percent of the patients (9 patients). Right side preponderance might be due to the fact that majority of the proportion of the population is right handed, so as a reflex, right side is usually exposed first to harsh environmental stress. Also, India being a left hand drive country, there are more chances of injuries involving the right side of the person during road traffic accidents.

In the present study, Mean Gartland and Werley score was found to be 4.72. According to Gartland and Werley score grading, excellent results were obtained in 24 percent of the patients (6 patients), while good results were seen in 64 percent of the patients (16 patients). Fair results were obtained in 12 percent of the patients (3 patients). In a study conducted by Tontanahal S *et al*, overall we obtained "excellent" results in 37.14%; "good" in 46% cases; "fair" in 15.14% and "poor" in 1.72% cases with a mean G & W score of 6.35. Therefore a satisfactory result was obtained in 83.14% cases.^[13]

In another study conducted by Rakesh Yalavarthi *et al*, good to excellent results were obtained in 88 percent of the patients while fair to poor results were obtained in 12 percent of the patients.^[14] In the present study, mean time for complete radiographic union was 14.8 weeks. Our results were in concordance with the results obtained by Vishwanath C *et al* who also reported similar findings. In a previous study conducted by Vishwanath C *et al*, authors reported that in

twenty patients, seven patients were found to with rate of union in 8–10 weeks, 12 patients were found radiological union evident on 11–13 weeks, 23 patients were found radiological union in 14–17 weeks, eight patients were found radiological union in 18–20 weeks.^[10]

In the present study, mean palmar tilt on follow-up was found to be 7.5°, while mean radial angle was found to be 16.1° respectively. Mean radial height on follow-up was found to be 7.75 mm. Our results were in concordance with the results obtained by Pradhan U *et al* who also reported similar finding in their respective study. They reported that mean palmar tilt, mean radial angle and mean radial height on follow-up was 7.26°, 16.6° and 7.93mm respectively.^[15] In a previous study conducted by Pradhan U *et al*, analyzed radiological and functional outcome after surgical fixation of intraarticular fractures of distal end of radius by external fixator verses locked volar plate. Fifteen patients underwent open reduction and palmar locking plate fixation, and 15 patients underwent closed reduction and K-wire augmented external fixation on random basis. For functional and radiological assessments, Demerit score were used and grip strength was measured using a Dynamometer. Subjective functional assessment was made using the DASH scale. The follow-up period was at least 6 months. The radiological parameters at three and six months were better in patients treated with plate group. Patients in the plate group had better functional outcome score (DASH). The findings were statistically significant at three months period but did not show any significance at six months period. Functionally and radiologically plate group had better score. The findings were statistically significant in three months period, but did not show any significance at six months period. Patients in the plate group showed better grip strength. In patients whose right hand was involved the findings were statistically significant at three months but at six months there was no statistical significance. Treatment with open reduction and internal fixation for intra articular fractures of distal end of radius provides good radiological results.^[15]

Conclusion

From the above results, the authors conclude that Treatment of distal end radial by principle of ligamentotaxis is an easy, cost effective, reliable and most suitable line of treatment. The efficacy of ligamentotaxis in neutralizing detrimental compression forces, which are likely to cause displacement of unstable fracture with radial shortening, is a significant and increasingly appealing advance in the management of distal radius fracture.

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