Functional and Radiological Outcomes of Distal Radius Fractures Treated with Closed Reduction and Percutaneous Five Pin Technique – A Prospective Cohort Study

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Research Article

Abstract: Distal radius fractures are one of the most common fractures occurring in adults. Despite several advances, the ideal treatment is yet to be agreed upon. Traditional methods of reduction and plaster have been associated with stiffness of hand and latemetaphyseal collapse, while open reduction techniques have the risk of devascularisation and non-union. The search is still on for the ideal compromise. Closed pinning with 2or 3 pins has been tried before with limited success. In this study a new technique with five pins ,was used and the ulna was also engaged in the fixation .**Materials and Methods**: All consecutive cases of distal radius fractures, A.O. types A,B and C, presenting to the casualty or Outpatient department and aged between 20 to 70 years of age, without concomitant ulnar fracture were recruited. Anatomical and Radiological results were graded according to Sarmiento's modification of Lindstrom's criteria; the results were evaluated using Wilcoxon signed rank test for statistical significance. The functional results were graded according to Mayo's Wrist score. Excellent and good results were taken together as acceptable. **Results**: The average follow up was 5 months ranging from 3 to 6 months..On evaluation of anatomical results 80% had excellent, 13.33% had good and 6.66% had fair results. No patients had poor results in our series. Comparison of pre and postoperative scores showed statistically significant improvement with P value< 0.05.Functionally 33.33% had excellent, 60 % had good and 6.66% had fair results. Lower grades on the function correlated with residual deformity and impaired grip strength. One patient had pin tract infection and one patient reflex sympathetic dystrophy .**Conclusion:** Fractures of the distal radius whether intra or extra articular when treated with percutaneous pinning have excellent to good results in 94%on the restoration of radiological anatomy and about94% on rating of the functional outcome .Loss of volar tilt, radial inclination and radial length has not been observed as in other series suggesting that this technique may be the answer to the questions of stability and the need for early mobilisation.

Keywords: Distal radius fracture, closed pinning, Five, pin technique, functional outcome, radiological outcome, better stability, early mobilisation.

Introduction

Distal radius fracture is one of the most commonly occurring fractures, accounting for75% of all forearm fractures. There is a lifetime risk of distal radius fractures of17%, according to Cummins SR, Kelsey(1).The increasing incidence of osteoporosis predisposes patients to fractures and distal radius fractures are among the commonest fractures in osteoporosis. An increasingly ageing population and a more active lifestyle have magnified the problem. Closed manipulative reduction(CMR) and below elbow cast immobilization has been the mainstay of treatment .However the outcomes are often less than satisfactory with loss of reduction , limitation of function and disabilities. Failure to maintain reduction of the fracture fragments and instability of distal radio ulnar joint are the major pitfalls in obtaining adequate results. Other treatments have ranged from closed pinning and plaster, to external fixation ,to open reduction and plating .Each method has its proponents and opponents. What has been consistently found is an increasing incidence of late metaphyseal collapse and deformity in the fractures treated by closed reduction and plaster, even though an excellent reduction was obtained on initial radiographs The consensus is now for some form of internal fixation to hold the fracture especially during the early weeks .Another problem encountered is stiffness of the fingers and hand following the 6 weeks of immobilisation which can be avoided with early mobilisations. The search therefore is for a fixation method that will provide enough stability to permit early active mobilisation. This would probably be best achieved by volar locked plating. However, for the more comminute fractures traditional open reduction and internal fixation would require extensive soft tissue stripping, periosteal injury and devascularisation of fragments resulting in high rates of infection delayed

union and non-union. After much refinement in treatment of distal radius fractures many problems still remain unsolved, especially in unstable fractures. The gold standard in the treatment of distal radius fractures remains uncertain(1). Percutaneous K-wire fixation was the earliest form of internal fixation established to provide better stability without compromising vascularity. Percutaneous pinning involves the percutaneous insertion of Kirschner wires after closed manipulative reduction (3). Many authors have proved percutaneous fixation of wrist fractures to be a more stable method of fixation (1,2,5,6) but lacked excellent results due to the fact that stability of the fixation was inadequate and early mobilization could not be started (4). However pinning techniques used till date provide stability when used along with casts but do not permit early mobilisation. A biomechanical study by Graham *et al.* on percutaneous pinning of distal radial fractures concluded that constructs in which ulna is engaged provide superior resistance to fracture displacement. A study reported by Rayhack compared radial styloid pinning, radial styloid and posteromedial pinning, and transulnar pinning and concluded that two pin Clancey method was least stiff, followed by radial styloid pinning. The most stiff techniquewas that of transulnar pinning (6).In this prospective study we used a new five pin technique which is capable of providing adequate stability while permitting early active mobilisation in the form of intermittent mobilisation of wrist and fingers except pronation and supination. Objective of the study was to evaluate the functional and radiological outcome of percutaneous five pin technique in the treatment of distal radius fracture in 20 to 70 years age group attending a rural tertiary care hospital in South India and to find the associated factors.

Methodology

This prospective cohort study was conducted in a rural tertiary care hospital for a period of 6 months between August 2013 and March 2014, after getting scientific and ethical clearance from institutional research board. All consecutive patients with distal radius fracture coming to the outpatient or emergency department were offered treatment by this 5 pin technique. Patients with AO classification A (1,2,3), B (1, 2, 3) and C (1, 2, 3) and between the age group 20 to 70 years were included for the study. Patients with concomitant fractures of distal ulnar shaft and outside the age group were excluded. Written informed consent was taken from all participants enrolled for the study .Pre-operative x-rays ,deformity, Frykman Grading, A.O. classification were recorded .Postoperative deformity ,X rays of wrist and hand were taken, Range of motion etc was recorded .Patients were reviewed periodically initially every 3 days then once a week, range of motion was recorded and both active and active assisted exercise was done under supervision . Results were evaluated using Sarmiento's modification of Lindstroms criteria for anatomical outcome and Mayo's Wrist score for functional outcome

Surgical Technique

With Patient under anesthesia, general or regional,closed manipulative reduction is done and confirmed using image intensifier.A 1.8mm Kirschner wire is passed, from distal ulna, through the inferior RadioUlnar joint parallel to wrist joint line to stabilize the distal radio carpal joint.Second K- wire is passed from volar radial styloid to proximal radial cortex medially at an angle of 45^0.The third wire from Lister's tubercle to proximal radius in volar direction to prevent dorsal tilt.The fourth wire from the ulnar side of dorsal part of distal radius to proximal fragment.Fifth wire is from the ulna to radius proximal to fracture site which stabilizes the proximal fragment.Tips of all wires bent 90 degrees. Special care is given to avoid superficial radial nerve injury while inserting radial styloidwire.

Post-operatively a wrist immobilizer is applied in functional position with intermittent mobilization. Patients were discharged on second post-operative day and reviewed weekly for pin care andphysiotherapy .Proximal Ulno Radial pin was removed at 4 weeks and forearm exercises started(supination and pronation), Remaining pins were removed at 6-8 weeks after an X-ray. Reviews were done every 2 weeks for physiotherapy for 6 weeks. X-rayswere taken at 6 weeks to confirm healing and to rule out any bony collapse. Further reviews at 3 months,5 months and 6 months.

Results

Data analysis was conducted using statistical package, SPSS 17. Percentage and frequency were used to assess the demographic data like age, sex, mechanism of injury, fracture type etc. Wilcoxon signed rank test was used to assess the significance of association between the pre and post operative anatomical and radiological outcome. The clinical outcome was assessed with Mayo's wrist score. Between August 2013 and March 2014, 15 patients with distal radius fractures were recruited in the study.

Table 1: Distribution of study subjects according to age and gender

Sl. No.	Gender	Age		Total (n=15)
		50-60	60-70	
1	Male	4	2	6
2	Female	8	1	9
Total		12	3	15
Percentage		80%	20%	100%

The mean age of the patients was 58.44 S.D. 6.37 years, the range was from 50 to70 years. The majority were in the 50 to 60 year age group (80%). There were 9 females and 6 males. The right side was affected in 8 cases and the

left in 7 cases. The fracture was extra-articular in 67% and intra-articular in 33%.

Table 2: Distribution according to A.O. Classification of the fracture

Types	Frequency	Percentage
Type A	3	20
Type B	3	20
Type C	9	60

The distribution of patients according to A.O. classification was 3(20%)type A fracture ,3(20%)type B and 9(60%)type C fractures. 33.33% were extra-articular and 66.67% were intra-articular. There was associated ulnar styloid fracture in 5(33%)cases. The mechanism of injury was road traffic accident in 5(33%) of cases and domestic or work place fall in 10 (66%) of cases .The average time to surgery was 2 days. The average duration of follow up was 24 weeks, ranging from 8 weeks to 28 weeks.

Table 3: Results on Sarmiento's modification of Lindstrom's criteria

Criteria	Pre Op(Mean)	Post Op(Mean)	Z-Score	p value
Loss of volar tilt	14.26 degree	4.13 degree	-3.421	0.001*
Loss of radial inclination	17.33 degree	2.13 degree	-3.416	0.001*
Loss of radial length	13.68mm	2.66mm	-3.428	0.001*

*p < 0.05 is significant

The mean loss of palmar inclination (or dorsal tilt) was 14.26 degrees preoperatively. The goal of reduction was to bring dorsal tilt to 0 degrees if not the exact 11degree volar tilt. The mean loss palmar inclination postoperatively was 4.13 degrees. Acceptable dorsal tilt of 0 to 10 degrees was attained in 13 cases (85%) .In all 13 patients who achieved correction, it was maintained till last follow up. In 2(15%)cases dorsal tilt could not even be restored to neutral. Mean loss of Radial inclination was on an average 17.33 degrees preop ranging from 14 to 21 degrees and decreased to 2.13 degrees post op, Ranging from 1 to 3 degrees postop. The radial inclination achieved at surgery was maintained at last follow up in 95% of patients. The mean loss of radial length preop was 13.68 mm, post op it decreased to2.66mm. .Radial length attained at surgery was maintained in 95% of cases. The Wilcoxon signed rank test was applied to palmar inclination ,radial length and radial inclination and gave a Z score of -3.421,-3.426 and-3.428 respectively. The respective P values for all these parameters were<0.05. This shows a statistically significant improvement between pre and postoperative values. Objective clinical evaluation showed prominent ulnar head in 1 case(6.66%), residual dorsal tilt in 2(13%) and no patient had residual radial deviation. Subjectively satisfaction was expressed by 11 patients(73.33%) as excellent, good in 3(20%) and fair in1 (6.66%).

Table 4: Distribution of the Subjects based on results of treatment

Results	Frequency	Percentage
Excellent	12	80
Good	2	13.33
Fair	1	6.66
Poor	0	0

Restoration of anatomical reduction was graded as excellent in 12(80%) ,good in 2(13.33%) and fair in 1(6.66%) according to Sarmiento's modification of Lindstrom's criteria.

Table 5: Distribution of study subjects based on Mayo's wrist score

Results	Pin Intensity	Functional Status	Range of motion (% of normal)	Grip Strength (% of normal)	Total Score
Excellent	9	8	9	6	5
Good	6	5	3	8	9
Fair	0	2	3	1	1
Poor	0	0	0	0	0

Functional scoring by Mayo's Wrist score showed 33.33% excellent, 60 % good and 6.66%fair results. The mean total Mayo's score was 85.66 with SD 7.07, range was from 75 to 100.Taking good and excellent scores together 94% of patients had acceptable function. Complications like pin tract infections, pin loosening and Reflex Sympathetic Dystrophy occurred in one(6.,66%) patient each. Complications were absent in 12(81%) cases.

Discussion

Distal radius fractures are a major problem encountered today. Their incidence is steadily increasing. Conventional treatment methods like closed reduction and plaster cast immobilisation are associated with loss of reduction in upto35% of cases as reported by Cherubino *et al*. Traditional open reduction and plating is attended with an unacceptably high risk of non-union, delayed union and infection due to soft tissue stripping, nerve injuries in the open reduction group have been reported to occur from 1to 17%.External fixation is attended with problems like poor patient acceptance, prominently visible hardware and pin tract infection. Our results both on the anatomical and radiological criteria of 94%acceptable results and the functional criteria of Mayo's wrist Score of 94% acceptable results compares favourably with those of

earlier studies by Cherubino (9) and Agarwal(11).The excellent stability, range of motion and early mobilisation afforded by this procedure make it an attractive option for the often encountered problem of distal radius fractures and ensures high level of patient satisfaction. The strengths of the study are its prospective nature, the rural Indian setting which affords generalisation of results, the low cost of the procedure as sophisticated implants are not used. The limitations of this study are small sample size, short follow up time and absence of a control group

Conclusion

Closed reduction and pinning with the 5 pin technique for distal radius fractures, gives good short term results and permits early active mobilisation while giving adequate stability and good function. This technique also prevents stiffness in the fingers and wrist, thus affording good wrist and hand function.

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