FUNCTIONAL OUTCOME OF COMMINUTED INTRAARTICULAR DISTAL RADIUS FRACTURES TREATED WITH FRAGMENT SPECIFIC FRACTURE FIXATION

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ABSTRACT

BACKGROUND

Distal radius fractures are one of the most common fractures encountered in orthopaedic practice. Plate fixation of distal radius is one of the commonest modalities of treatment of distal radius fractures. This study focuses on fixation of comminuted intraarticular distal radius fractures based on the fragments involved according to Medoff classification. If the volar rim is involved, volar locking plates are used. If the dorsal wall is involved, dorsal locking plates are used. If the radial column is involved, radial plates are used. For involvement of multiple fragments, combination of plates are used. Various approaches are used for plating on different fragments. Low profile plates are used in this study to avoid soft tissue complications.

The aim of this study is to assess functional outcome of comminuted intraarticular distal radius fractures treated by fragment specific fracture fixation.

Study Centre- Govt. Kilpauk Medical College.

Study Design- Prospective study.

RESULTS

20 patients with comminuted intraarticular distal radius fractures were treated with low profile plates and were assessed with Gartland and Werley scoring system. 15 patients (75%) had excellent results and 5 patients (20%) had good results.

CONCLUSION

We conclude that using low profile plates for distal radius fractures gives excellent outcome and using combination of low profile plates in comminuted intraarticular distal radius fractures is a very good option.

KEYWORDS

Fragment Specific Fracture Fixation, Intraarticular Distal Radius Fractures.

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BACKGROUND

Fractures of the distal end of radius are one of the most common fractures encountered in orthopaedic practice encompassing 16% of all fractures.⁽¹⁾ It is the most common fracture involving the upper limb. About 50% of fractures of the distal radius involve the articular surface. The peak age groups involved are children from 5 to 14 years, males less than 50 years and females more than 60 years. Medoff classified intraarticular distal radius fractures based on the fragments involved.⁽²⁾ This classification is based on the observation that fracture lines along the distal radius propagate along recurrent pathways. According to this classification, the distal radius is divided into 5 fragments (volar rim, dorsal wall, ulnar corner, radial column, central fragment).

This study focuses on fixation of comminuted intraarticular distal radius fractures based on the fragments involved according to Medoff classification. If the volar rim is involved, volar locking plates are used. If the dorsal wall is involved, dorsal locking plates are used. If the radial column is

involved, radial plates are used. For involvement of multiple fragments, combinations of plates are used. Various approaches are used for plating on different fragments. Low profile plates are used in this study to avoid soft tissue complications.

Aim of the Study

To study the functional outcome of comminuted intraarticular distal radius fractures, treated by fragment specific fracture fixation.

MATERIALS AND METHODS

This prospective study on 'Functional outcome of intraarticular distal radius fractures, managed by fragment specific fracture fixation' was conducted in the Department of Orthopaedic Surgery, Govt. Kilpauk Medical College and Hospital, Chennai from September 2014 to July 2016 after ethical committee clearance was obtained.

Inclusion Criteria

A sample size of 20 patients were taken who satisfied the following inclusion criteria-

1. Age 18-50 years.
2. Patients > 50 years with high functional demand.
3. Intraarticular distal radius fractures with more than 2mm articular step-off.
4. > 0 degree dorsal tilt.
5. 2 mm or more of radial shortening.
6. Loss of 5 degrees or more of radial inclination.

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Exclusion Criteria

1. Skeletal immaturity.
2. Extraarticular fractures.
3. Non-displaced intraarticular fractures.
4. Open fractures.
5. Pathological fractures.
6. Old fractures.
7. Associated neurovascular injuries.

Radiological Evaluation

Standard Posteroanterior and Lateral views of the involved wrist joint.

CT of the involved wrist joint.

CT and the x-rays are used to assess the morphology of the fracture, based on which the implants to be used and the surgical approach to the fracture are decided.

This study is based on Medoff classification of intraarticular distal radius fractures, where distal radius was divided into 5 fragments based on the observation that fracture lines in the distal radius tend to propagate in recurrent pathways. The goal of the treatment is to achieve perfect reduction without any intraarticular step-off, so that the patients can have excellent functional outcome and arthritis can be avoided. Hence, we approach each fracture according to its morphology and specific approaches and specific implants are used to stabilise each fragment.

Implant Choice

- Volar fragment fracture- 2.4 mm volar LCP.
- Radial column fracture- 2.4 mm straight LCP/ K-wire fixation.
- Dorsal fragment fracture- 2.4 mm dorsal T-LCP.
- If multiple fragments are involved, double plating of involved columns are done.

Implants Used

From Left to Right

- Volar T-oblique plate.
- Volar straight T plate.
- Dorsal T-oblique plate.
- L plate.
- Radial styloid straight plate.
- Short L plate.
- L-oblique plate.
- Dorsal T plate.

Instruments Used

From Left to Right

- 2 mm tap.
- 2.4 mm screw driver.
- 2 mm drill bit (2 in nos.).
- Locking sleeve.

Surgical Technique

After regional anaesthesia, patient in supine position with the arm in a radiolucent forearm table and under strict aseptic precaution parts were painted and draped upto midarm.

The C-arm is draped with sheets and is positioned perpendicular to the fracture table for further use during surgery to check for articular reduction and plate positioning.

Surgical Approach

- Volar fragment.
- Modified Henry's approach is used to reach volar fragment.

Figure 1. Skin Incision is made along the Radial Border of Flexor Carpi Radialis Tendon

Figure 2. Incision is Deepened between Flexor Carpi Radialis and the Radial Artery

Figure 3. The Pronator Quadratus Muscle is Elevated using an L Shaped Incision

Figure 4. The Fracture is Reduced under C-Arm Guidance and Fixed with a Plate which is Checked under C-Arm

Figure 5. Once Plate Positioning and Fixation are Confirmed with adequate C-Arm views Wound is Washed and Closed over a Suction Drain

Radial Fragment

A Straight Skin Incision is made over the Anatomical Snuff Box with the Distal and Proximal extent as necessary. The Superficial Cutaneous Branch of the Radial Nerve is Identified and Protected

The First and Second Dorsal Compartments are Elevated and Radial Styloid is Exposed

The Fracture is Provisionally Fixed under C-Arm Guidance with K-Wires

Once Provisional Fixation is Obtained Fracture is Fixed with a Straight Lateral Plate after Plate Positioning is confirmed under C-Arm Guidance

Dorsal Fragment

The intermediate and radial columns may be approached through a single dorsal skin incision. The skin incision is put in line with the third metacarpal with the proximal and distal extents as necessary.

The Third Extensor Compartment is Opened in Line with the Extensor Pollicis Longus Tendon. The Distal Part of Extensor Retinaculum is maintained, so that the EPL Tendon can still Glide over the Thumb

The Fourth Extensor Compartment is Elevated Subperiosteally for Adequate Exposure of the Fracture Site

Postoperative Care

Strict limb elevation was maintained for all patients postoperatively. In the immediate postoperative period, adequate pain relief was given in consultation with anaesthetists. Intravenous antibiotics were given till the 2nd postoperative day, following which oral antibiotics were started.

Postoperative x-ray was taken on the 1st postoperative day. Check dressings were done on the 2nd and 5th postoperative day. Drain removal was done on the 2nd postoperative day. Suture removal was done on the 12th postoperative day.

Patients were reviewed at 3 weeks, 6 weeks, 3 months, 6 months and 1 year, and subsequent x-rays were taken to assess union. Finger and elbow mobilisation was started immediately after surgery. Wrist mobilisation was started 1 week postoperatively as pain tolerated. Strengthening exercises were started 6 weeks postoperatively.

IV Antibiotics	First Five Days after Surgery
Check dressings	2 nd and 5 th postop days
Suture removal	12 th postop day
Finger and elbow mobilisation	Immediate postop
Wrist mobilisation	1 week postop
Strengthening exercises	6 weeks postop

Outcome Assessment

Functional outcome was assessed using Gartland and Werley scoring system.

CASE REPORTS

Case 1.

Pre-op X-ray

Pre-op CT

Immediate Post-op X-ray

3 Months Followup

6 Months Followup**Clinical Pictures** **Case 2** **Pre-op X-ray** **Pre-op CT** **Immediate Post-op X-ray**

6 Months Followup

RESULTS

Range of Motion

Movements	Average (Mean + SD)
Palmar flexion	57.1 with SD 3.5
Dorsiflexion	63.3 with SD 3.2
Radial deviation	17.6 with SD 3.0
Ulnar deviation	24.1 with SD 4.4

At the end of six months, four patients had stiffness of wrist with reduced radial deviation.

Subjective Evaluation

Symptoms	Score	No. of Patients
No pain	0	13 (65%)
Occasional pain	2	7 (35%)
Occasional pain with slight limitation of motion	4	0 (0%)
Pain with severe limitation of motion	6	0 (0%)

Residual Deformity

Deformity	Score	No. of Patients
Prominent ulnar styloid	1	4 (20%)
Residual dorsal tilt	2	0 (0%)
Radial deviation of hand	3	0 (0%)

Objective Evaluation

Movements	Score	No. of Patients
Loss of dorsiflexion	5	0 (0%)
Loss of ulnar deviation	3	0 (0%)
Loss of supination	2	0 (0%)
Loss of palmar flexion	1	0 (0%)
Loss of radial deviation	1	4 (20%)
Loss of circumduction	1	0 (0%)
Pain in DRUJ	1	3 (15%)

Result	Score	No. of Patients
Excellent	0-2	15 (75%)
Good	3-8	5 (20%)
Fair	9-20	0 (0%)
Poor	>20	0 (0%)

DISCUSSION

There are many treatment options for distal radius fractures. Non-displaced stable fractures can be treated conservatively with casting. Unstable fractures can be treated with percutaneous K-wire fixation. Comminuted fractures can be treated with external fixation. But there is a period of immobilisation for the wrist joint when treated with external fixation, which can lead to wrist stiffness.⁽³⁾ There are dynamic external fixators available to treat comminuted distal radius fractures, but the reduction achieved with this method is frequently not satisfactory. Furthermore, reduction of intraarticular fragments could not be achieved to a satisfactory degree with an external fixator.

Open reduction and plating is a very good option to treat comminuted intraarticular fractures of the distal radius. Plates provide stable fixation throughout the entire healing process and also satisfactory articular reduction could be obtained with open reduction.⁽⁴⁾ However, the plates available are of fixed designs and may not be suitable for all fracture patterns. Bulky plates especially in the dorsal aspect can cause irritation of tendons, necessitating even implant removal.

Regonazzi introduced the double plating technique for the distal radius using low profile plates at an angulation of 60 degrees to each other.⁽⁵⁾ On experimentally induced dorsally tilted distal radius fractures in a cadaver, this method showed superior biomechanical stability when compared to 3.5 mm AO 'T' locking plate.

Fragment specific fracture fixation is another method to approach distal radius fractures, based on Medoff classification which seeks to address all fragments involved in the distal radius individually and gives rigid fixation to all of them after anatomically aligning them perfectly.⁽⁶⁾ This allows immediate wrist mobilisation and reduces chances of stiffness.

The efficacy of fragment specific fracture fixation was initially studied by Dodds et al.⁽⁷⁾ They compared fragment specific fracture fixation with augmented external fixation in a experimentally induced comminuted fracture in a cadaver. The biomechanical study showed superior stability in fragment specific fracture fixation in comparison with augmented external fixators.

A study done by Chang et al, where fragment specific fracture fixation was done for a sample of 30 patients with comminuted intraarticular distal radius fractures and

Gartland and Werley scoring was used to analyse functional outcome showed 13 excellent results, 12 good results and 5 fair results.⁽⁸⁾ In our study, we use Gartland and Werley scoring system to assess patients at the end of the study. Among the 20 patients studied, we had 15 excellent results and 12 good results. The average range of motion achieved in our study far exceeded 10 degrees of palmar flexion and 35 degrees of dorsiflexion, which is essential for activities of daily living.

CONCLUSION

Hence, we conclude that fragment specific fracture fixation is an excellent method to treat comminuted intraarticular distal radius fractures. We recommend fragment specific fracture fixation for comminuted intraarticular distal radius fractures because of the following advantages-

- Good articular reduction.
- Early mobilisation and rehabilitation.
- Less hardware complications.
- Lesser morbidity.

REFERENCES

- [1] Obert L, Loisel F, Gasse N, et al. Distal radius anatomy applied to the treatment of wrist fractures by plate: a review of recent literature. *SICOT J* 2015;1:14.
- [2] Chang HC, Poh SY, Seah SC, et al. Fragment-specific fracture fixation and double-column plating of unstable distal radial fractures using AO mini-fragment implants and Kirschner wires. *Injury* 2007;38(11):1259-67.
- [3] Arora J, Malik AC. External fixation in comminuted, displaced intra-articular fractures of the distal radius: is it sufficient? *Arch Orthop Trauma Surg* 2005;125(8):536-40.
- [4] Peine R, Rikli DA, Hoffmann R, et al. Comparison of three different plating techniques for the dorsum of the distal radius: a biomechanical study. *J Hand Surg Am* 2000;25(1):29-33.
- [5] Maschke SD, Evans PJ, Schub D, et al. Radiographic evaluation of dorsal screw penetration after volar fixed-angle plating of the distal radius: a cadaveric study. *Hand (N Y)* 2007;2(3):144-50.
- [6] Medoff RJ, Kopylov P. Immediate internal fixation and motion of comminuted distal radius fractures using a new fragment-specific fixation system. *Orthop Trans* 1998;22(1):165.
- [7] Dodds SD, Cornelissen S, Jossan S, et al. A biomechanical comparison of fragment-specific fixation and augmented external fixation for intra-articular distal radius fractures. *J Hand Surg Am* 2002;27(6):953-64.
- [8] Zhang C, Zhang ZJ, Wang L, et al. Treatment of type C3 distal radius fractures with AO 2.4 mm locking plate system after manipulative reduction. *Zhongguo Gu Shang* 2014;27(11):965-9.