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Displaced intra-articular fractures of distal radius: a comparative evaluation of results following closed reduction, external fixation and open reduction with internal fixation

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Abstract

Fractures of the distal end of the radius are common injuries and are the commonest bony injury around the wrist. Management of these fractures has remained controversial as far as modality of treatment is concerned. In this study 90 adult cases of acute displaced intra-articular fractures of the lower end of the radius were classified according to Frykman's and AO classifications after obtaining radiographs in antero-posterior and lateral planes. These were randomly treated by one of three methods: (1) closed reduction and plaster immobilisation, (2) external fixation and (3) open reduction and internal fixation, and were followed for an average of 4 yr. In the final functional assessment (Sarmiento) the results were (1) plaster 43% good and excellent, 50% fair and 7% poor, (2) external fixator 80% good and excellent, 20% fair and poor results, (3) open reduction and internal fixation 63% good and excellent, 26% fair, 11% poor. We recommend that displaced severely comminuted intra-articular fractures should be treated with an external fixator. © 2000 Elsevier Science Ltd. All rights reserved.

1. Introduction

Fractures of the distal end of the radius have often been considered primarily extra articular injuries of elderly female. The distal end of the radius is being exposed to increasingly severe trauma in younger patients. The carpus is drawn into the distal end of the radius like a diepunch resulting in comminution of its articular surface. The reports of treatment methods and results are conflicting. Treatment of such injuries is often difficult and demanding, particularly when the fracture is severely comminuted or displaced. Varying patterns of intra-articular fractures are common in adults. They are commonly referred to as Colle's Barton's or Smith's, depending upon the pattern of involvement of the distal radio ulnar and radio carpal joint surface and the displacement. Nonoperative management often includes the acceptance of some degree of displacement and emphasis is placed on function [1]. Cooney et al. [2] had stressed the importance of anatomical correction and chose various methods of external fixation to achieve it. Bradway et al. [3] had laid emphasis on achieving and maintaining an anatomical reduction of fracture fragments by open reduction and internal fixation. The study was undertaken to evaluate the results of various modalities of treatment in displaced intra-articular fractures of the distal radius.

2. Materials and methods

The study has been carried out in the department of orthopaedic surgery, Maulana Azad Medical College and associated LNJP and G.B. Pant Hospitals between July 1991 and July 1996.

Ninety adults cases of acute displaced intra-articular fractures of the lower end of the radius were included in the study and were followed up for an average of 4 yr. Assessment of the fracture was based on Frykman's and AO classifications [7] after obtaining anteroposterior and lateral radiographs. The patients were treated

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at random by any one of the following three methods (see Figs. 1 and 2).

1. Closed reduction and plaster immobilisation.
2. External fixation.
3. Open reduction and internal fixation.

For closed reduction and plaster immobilisation X-rays were taken at 1 and 6 weeks. One more attempt at closed reduction under anaesthesia was performed if the reduction was unacceptable. The plaster was maintained for 6–7 weeks.

We used the Roger and Anderson type of external fixator. Patients treated with the external fixator were taught daily pin track dressings and also encouraged to use the limb for activities of daily living like writing, eating, etc. Radiographic and clinical examinations were done at one, two and 6–7 weeks. The fixator was removed as an outpatient procedure after 6–7 weeks and a splint applied for 2 days after which mobilisation was begun.

Patients treated with open reduction and internal fixation by means of Kirschner wires, small T plates or both. Mobilisation began at 2 weeks. Active hand, elbow and shoulder exercises were carried out throughout: wax bath, wrist exercises and grip strengthening exercises were done regularly. Grip strength measurements of both involved and normal wrists were made. Range of motion was measured using a goniometer.

The data obtained were tabulated, analysed and subjected to standard statistical methods. Results were assessed based on the Sarmiento functional score.

The statistical tests included student t-test, p-value or χ^2 tests and coefficient of correlation and ANOVA test (Table 1).

3. Frykman's classification

The three groups were also similar in the fracture distribution according to Frykman's classification. Frykman's type VII and type VIII formed 67% of the study.

The dominant side was involved in 65% of cases. The three groups were followed up for an average of 4 yr. On comparing loss of dorsiflexion and palmarflexion we found the least loss with the fixator following by open reduction and internal fixation and then plaster (Fig. 3).

3.1. Grip strength

For restoration of grip strength, the fixator was significantly better than plaster immobilisation ($p = 0.05$).

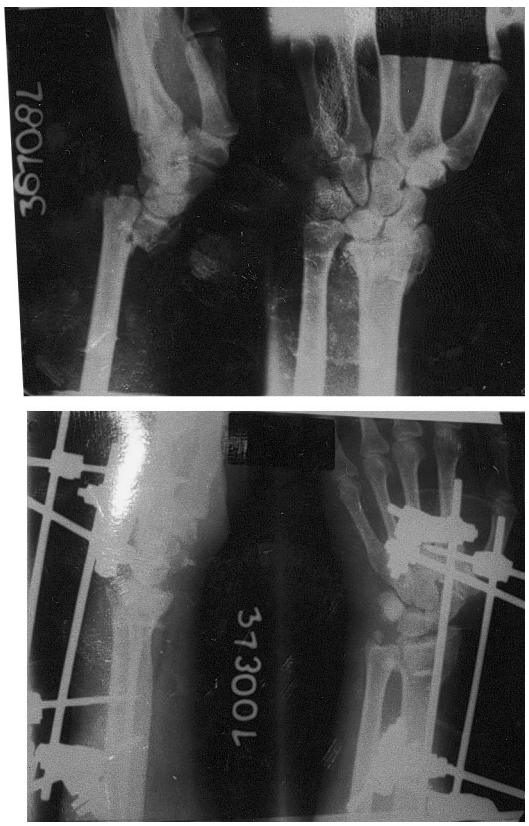

Fig. 1. Preoperative Radiograph showing fracture lower end radius. Postoperative radiograph with external fixator in situ.

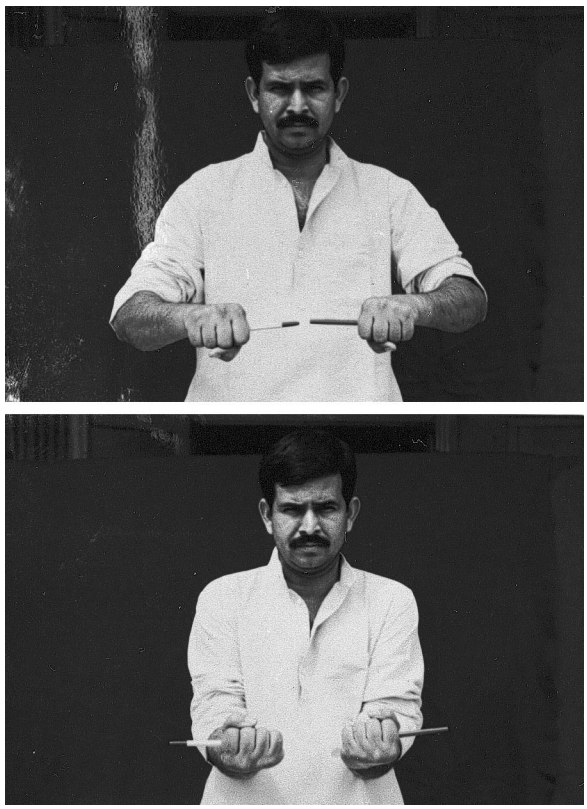

Fig. 2. Full range of pronation and supination in the same patient.

Table 1
$\chi = 2.33$, df 2, $p = 0.31$ (not significant)

Mode of treatment	Male	Female	Total cases	Type VIII	VII	III	IV
Plaster	26	7	33	17	8	2	6
Fixator	20	8	28	15	4	2	7
Open reduction	19	10	29	13	3	5	8
Total	65 (72.2%)	25 (27.8%)	90				

3.2. Dorsal tilt

Correction of dorsal tilt was achieved best by open reduction and internal fixation and fixator technique. Increase in dorsal tilt due to late collapse was seen as follows:

Plaster: eight cases
Fixator: four cases
ORIF: two cases

There were 11 cases of volar angulation of the distal fragment

Plaster: three cases
Fixator: three cases
ORIF: five cases

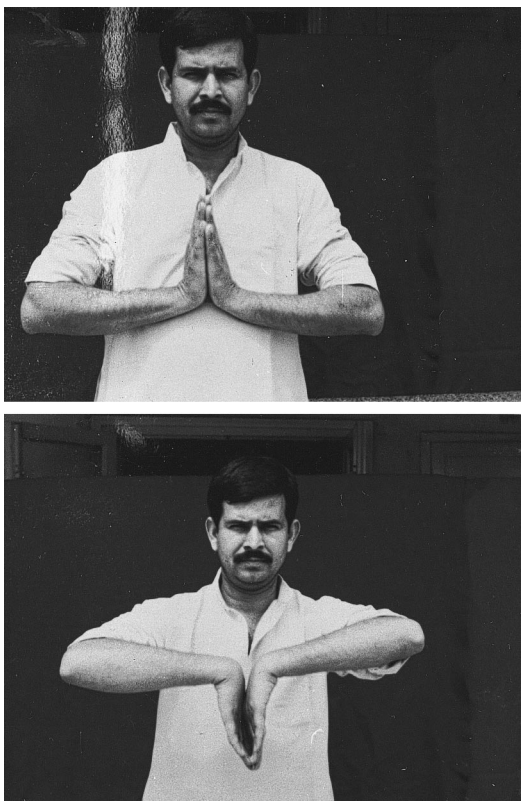

Fig. 3. Full range of dorsiflexion and palmarflexion in the same patient.

3.3. Radial length

Radial length was best restored with fixator, followed by open reduction and internal fixation and then plaster immobilisation.

3.4. Articular step off

Open reduction and internal fixation is better than plaster immobilisation for reducing articular step off while fixator is also better than plaster immobilisation for reducing the articular step off. The maximum percentage of excellent and good anatomical results are seen with open reduction followed by external fixation then plaster application.

3.5. Functional score

It includes residual deformity, subjective evaluation, objective evaluation and complications. The maximal percentage of excellent and good functional results were seen with the external fixator followed closely by open reduction and internal fixation. These findings are not statistically significant. (Table 2).

3.6. Complications

3.6.1. Plaster

Four patients had severe finger stiffness after plaster removal which gradually resolved with physiotherapy. One patient had carpal tunnel syndrome which resolved spontaneously without operative treatment.

3.6.2. Fixator

One case of pin track infection controlled with antiseptic dressings and antibiotics. Two cases of residual cosmetic deformity, one case of sympathetic dystrophy resolved by physiotherapy.

Table 2
Optained results

	Excellent	Good	Fair	Poor
PLASTER	2	8	11	2
FIXATOR	6	8	2	2
Open reduction	7	5	5	2

3.6.3. ORIF

One case of superficial infection subsided with antibiotics and antiseptic dressings. The fixation was not rigid in four cases with severe comminution and all these cases had fair and poor functional results.

4. Discussion

The three groups were similar in age, sex and deformity. The average age was 39 yr. In other reported series the average age was 63 [2], 27.6 [4] and 37 [5].

The mode of injury was road traffic accident in seventy percent of cases. This is similar to the findings of Jupiter and Knick [4].

The average loss of the arc with plaster was 37° in comparison with 19° by external fixator. Cooney et al. [2] reported an average loss of 17° by external fixator with loss of 10° if pronation and supination and loss of 14° of radial and ulnar deviation. With the external fixator loss of pronation and supination was 23° and radial and ulnar deviation 13°. Our results tally with the work of Cooney et al. [2]. With the use of a plaster case, the average loss of dorsiflexion and palmar flexion was 37°, radial and ulnar deviation was 16° and pronation–supination was 40°. This is in conformity with the work of Kongsholm and Olerud [6] who in their comparative study between plaster cases and fixator found a similar high loss of range of motion with the use of a cast. With open reduction and internal fixation, the average loss of dorsipalmar flexion was 30°, radio-ulnar deviation was 15° and pronation–supination was 30°. Similar loss of motion was seen in the study by Bradway et al. [3] on open reduction and internal fixation of displaced intra-articular fractures of the distal radius.

Pronation and supination was best restored with the use of an external fixator. Frykman had pointed out in 1967 that increased range of pronation and supination is due to better alignment of the distal radio-ulnar joint. The realignment of the distal radio-ulnar joint is best achieved with a fixator. Hence a better range of motion is observed with the fixator. Patients were also encouraged to perform pronation and supination as this motion is not restricted by this device.

The average grip strength (in comparison with the normal side) in our groups was fixator 70%, open reduction and internal fixation 68% and plaster 63%. The better grip strength in the wrist treated by external fixation is probably due to a combination of decreased pain and better joint and muscle mechanics as explained by Kongsholm and Olerud [6]. In their comparative study, average grip strength in the fixator group was 90% while in the plaster group was 65%.

Emphasis has been given to restoration of radial length and its relationship with the functional ability of patients [7]. Out study supports this concept. The radial length was best restored and maintained with external fixation. Aro and Koivenum [7] in a study on axial shortening of radius had reported similar findings and suggested that external fixation should always be considered if there are any signs of persistent axial shortening. We find in our study, persistence of some residual radial shortening in the three treatment groups. Aro and Koivenum [7] had suggested that complete restoration of the original radial length inevitably calls for the need of bone grafting to fill the created diastasis between with fracture fragments. Since we did not perform primary bone grafting, some radial shortening persisted. Radial shortening was strongly correlated with the final functional outcome in out study. Jupiter [4] had also found a similar correlation between the ultimate functional outcome and radial shortening.

Cooney et al. [2] had 87% good and excellent results with the use of the Roger Anderson frame external fixator with a follow up 204 yr. With the same fixator assembly, we achieved 82% similar results in an average of 4 yr follow-up. The results are quite similar. Saunders et al. [8] reported 68% good and excellent results with the use of an external fixator.

5. Conclusion

We conclude that primary operative treatment generates significantly better anatomical and functional results than closed reduction and casting. Plaster case is insufficient to maintain the reduction in the majority of displaced intra-articular fractures. Remanipulation is required in a large percentage of cases, reduction slips often, cosmetic deformity persists and there are a large number or associated complications.

Open reduction and internal fixation provides the best articular anatomy and therefore patients treated by this method have the least change of developing secondary osteoarthritis as suggested by the literature. It is the treatment of choice if there is a residual articular stepoff > 2 mm. It should preferably be avoided in severely comminuted fractures as the fixation is not stable and functional results are not good.

Good results are seen with the use of external skeletal fixation in displaced intra-articular fractures. It maintains the radial length best due to sustained counter-traction utilising the principle of ligamentotaxis. Best results in severely comminuted fractures are seen with a fixator. The complications with this procedure are minimal with meticulous pin insertion and pin site care.

References

[1] Sarmiento, Augusto, Prati. Colle's fracture: functional bracing in supination. J Bone Joint Surg (Am) 1975;157-A:311–7.
[2] Cooney WP, Linshield RL, Dobyns JH. External pin fixations for unstable Colle's fractures. J Bone Joint Surg (Am) 1979;61-A:840–5.
[3] Bradway JK, Amadio RC, Cooney WP. Open reduction and internal fixation of displaced comminuted intra-articular fractures of distal end of the radius. J Bone Joint Surg (Am) 1989;71–76:839–47.
[4] Jupiter, K. Intra-articular fracture of distal end of radius in young adults. J. Bone Joint Surg. (Am) 1985;68-A:647–59.
[5] Fernandez DL, Geissler WB. Treatment of displaced articular fractures of the radius. J Hand Surg (Am) 1991;16-A-3:375–84.
[6] Kongsholm J, Olerud C. Plaster cast versus external fixation for unstable intra articular colles fractures. Clin Orthop 1989;241:57–65.
[7] Aro H, Koivunen T. Minor axial shortening of the radius affects outcome of colles' fracture treatment. J Hand Surg (Am) 1991;16(3):392–8.
[8] Saunders RA, Keppel FL, Waldrop JI. External fixation of distal radius fractures. J Hand Surg (Am) 1991;16(3):385–91.