

COMMINUTED INTRA-ARTICULAR FRACTURE OF THE DISTAL RADIUS - RESULTS OF EARLY OPEN REDUCTION AND INTERNAL FIXATION

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ABSTRACT

Comminuted intra-articular fracture of the distal radius remains a challenging problem. This article reviews the results of 15 consecutive cases which were treated with open reduction and internal fixation with T-plate after failing to achieve articular congruency with closed reduction. The follow-up ranges from 20 months to 28 months. In thirteen cases, articular congruency was restored. However, 4 of these 13 cases later lost some of the articular congruency. This suggests the need for supplementary bone grafting. Reduction of the extra-articular portion of distal radius was generally well maintained. There was an average of 2.4 mm loss in styloid height, an increase of 1.2 mm in ulnar variance and loss of 12.5 degrees of volar tilt. Seven patients (46%) were completely pain-free, with the remaining 8 patients (53%) experiencing mild pain associated with forceful activities involving the wrist. All patients achieved a functional range of motion. Grip strength averaged 81% of the uninjured side. Of the 12 patients who were engaged in active employment, 10 returned to their previous job within 4 months of injury (average 8.5 weeks). The only complication in this series was the development of reflex sympathetic dystrophy in a 68-year-old housewife. We recommend open reduction and internal fixation if closed reduction fails to achieve articular congruency in comminuted distal radius fractures.

Keywords: Comminuted intra-articular fracture, articular congruency, open reduction, internal fixation, bone grafting.

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INTRODUCTION

Comminuted intra-articular fracture of the distal radius remains a challenge. Problems in management include difficulty in achieving congruous reduction, as well as difficulty in maintaining the reduction. Late complications include wrist deformity, wrist stiffness, pain and secondary osteoarthritis. Knirk and Jupiter⁽¹⁾ had established that the single most important factor in achieving a good result and preventing secondary osteoarthritis is the restoration of articular congruency. Reduction of the extra-articular components (radial styloid height, ulnar variance, palmar tilt) are also important. The goals of treatment are restoration of articular congruency, maintenance of reduction, and preservation of motion and function⁽²⁾.

Reduction and immobilization in plaster cast with or without incorporation of percutaneous wires are associated with a high rate of displacement, pin tract infection and pin loosening⁽²⁻⁴⁾. The use of an external fixator with varying degrees of success has been reported since the seventies. Its major problems include failure to achieve congruous articular reduction in a significant number of cases^(2,5) especially when there is a depressed 'die punch' medial fragment⁽⁶⁾. In Axelrod's⁽⁵⁾ series of 20 patients who required open reduction and internal fixation, 11 cases had previous treatment with external fixator. Application of an external fixator across the wrist joint prevents early mobilization. Pin tract infection and pin loosening are common complications. More authors now advocate open

reduction and internal fixation if manipulation or distraction with external fixation fail to achieve satisfactory articular congruency^(2,4,7).

Manipulation and reduction remain the first line of management. If the reduction is satisfactory, the fracture is stabilized in an above elbow plaster cast. The position is checked weekly with an X-ray. Failure to achieve satisfactory reduction or re-displacement while in cast constitutes an indication for open reduction and internal fixation.

MATERIALS AND METHODS

Between January to September 1989, 15 cases of comminuted intra-articular fracture of the distal radius (Frykman type VII & VIII)⁽⁸⁾ were treated with open reduction and internal fixation in the Department of Orthopaedic Surgery 'C', Singapore General Hospital. All the fractures were operated within the first few days of the injury. The age of the patients ranged between 23 and 68 years. There were 13 males and 2 females. Six cases were due to road traffic accident, 3 cases due to industrial accident and 6 cases due to domestic accidents. All domestic accidents involved patients over 40 years old. All patients under 40 years were involved in high energy trauma ie road traffic accidents or industrial accidents (Table I). Follow-up ranged from 20 to 28 months (mean 24 months).

Prior to surgery, plain antero-posterior and lateral radiographs of both the injured and uninjured wrist were taken for comparing the integrity of the reduction. Surgery was done through a volar approach. Three cases required extension of incision distally to decompress the carpal tunnel because of median nerve compression. Following reduction of volar fragments, a T-plate was applied over the volar cortex and the fragments were held with fully threaded cancellous screws. Three cases required bone grafting because of dorsal comminution. Bone grafting was done through a separate dorsal approach. An intra-operative X-ray was done to ascertain the quality of reduction and the placement of implants. A well-padded dressing was applied after the wound closure. The patient was encouraged to start gentle wrist mobilization immediately post surgery. Following discharge, they were reviewed at the Outpatient Clinic fortnightly for the first month, monthly for the next three months, and three monthly thereafter. Fol-

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low-up radiographs were done at 6 weeks, 3 to 6 months post operatively and at the last follow-up visit.

We evaluated our results in terms of the quality of articular reduction, extra-articular reduction, pain, range of motion, grip strength, return to work and complications. Intra-articular reduction was assessed radiologically and graded into "excellent" (congruous reduction), "moderate" (< 2mm displacement) and "poor" (> 2mm displacement). Extra-articular reduction was assessed radiologically by measurement of radial styloid height, ulnar variance and volar tilt angle in comparison with the uninjured side. Radial styloid height was measured on the antero-posterior radiograph and represented by the distance between the two perpendiculars to the long axis of the radius, one at the tip of the radial styloid process and the other at the distal articular surface of the ulnar head. Ulnar variance represented the distance between the medial articular surface of the radius and the articular surface of the ulnar head. Volar tilt was measured by the palmar slope of the distal end of the radius on the lateral radiograph.

The pain was graded into "no pain", "mild" (pain present with forceful activities only), "moderate" (pain restricting vigorous activity) and "severe pain" (pain restricting normal daily activity). Range of motion in flexion, extension and supination/pronation was measured clinically at each outpatient visit. Grip strength was measured with a Preston dynamometer.

RESULTS

a) Articular Reduction

Congruous articular reduction was obtained in thirteen of the fifteen cases initially. Four cases had subsequently lost the congruity and achieved only moderate reduction. Hence the final result was 9 cases (60%) with excellent reduction and 6 cases (40%) with moderate reduction. (Fig 1a, b and c and Table I).

b) Extra-articular Reduction

These were measured in terms of styloid height, ulnar variance and volar tilt angle. The uninjured wrist was used for comparison. There was an average loss of 2.4mm of styloid height, an average increase of 1.2 mm of positive ulnar variance and average loss of 12.5 degrees volar tilt (Table I).

c) Pain

At final review, 7 patients were completely pain-free and the remaining 8 patients experienced mild pain associated with forceful use of the involved hand. (Table II)

d) Range of Motion

The average loss of flexion was 9°. The average loss of extension was 7°. All patients had either normal or near normal range of supination and pronation compared to the uninjured side. (Table II)

e) Grip Strength

Grip strength average 81% of the uninjured side at final assessment. (Table II)

Fig 1(a) - Radiographs of Case No.1 - Pre-operative



Fig 1(b) - Radiographs of Case 1 - 6 weeks Post-operative



Fig 1(c) - Radiographs of Case No. 1, 6 months post-fixation. Excellent articular reduction maintained

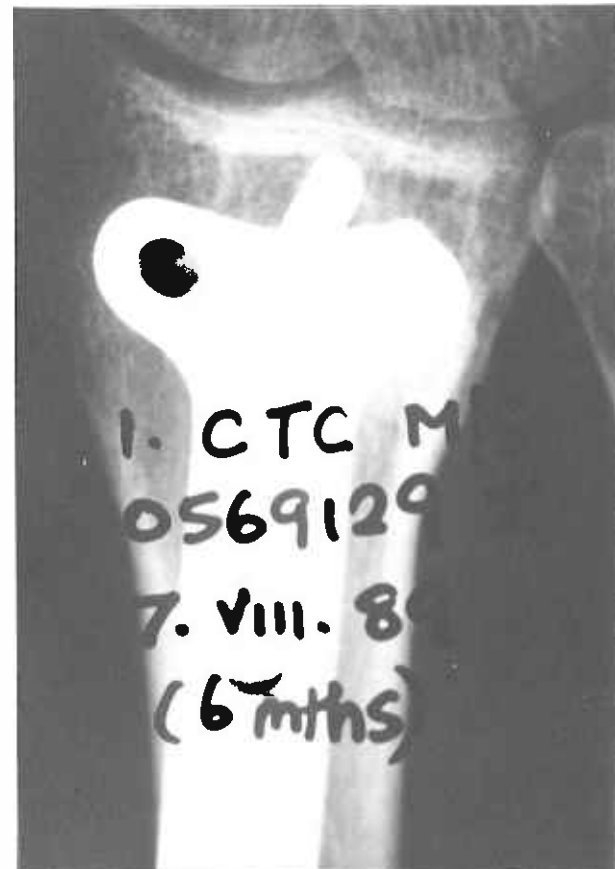


Table I - Analysis of Injury and Operative Reduction

Case No.	Sex/Age	Mode of Injury	Frykman Type	Bone Grafting	Post op articular reduction			Extra-articular reduction		Loss of volar tilt (°)
					0/52	6/52	Final Review	Loss of Styloid height (mm)	Loss of ulnar variance (mm)	
1	M/53	D	VII	NO	C	C	C	4	1	10
2	F/68	D	VIII	NO	C	C	C	4	0	7
3	M/58	D	VII	NO	C	C	C	0	2	15
4	M/43	D	VII	NO	C	C	C	0	0	17
5	M/51	RTA	VII	YES	C	M	M	6	1	30
6	M/26	RTA	VIII	NO	C	M	M	4	2	3
7	M/59	D	VII	NO	C	C	C	5	1	26
8	M/28	RTA	VII	NO	M	M	M	1	2	8
9	M/36	IA	VIII	YES	C	M	M	4	4	15
10	M/23	RTA	VII	NO	C	C	C	0	0	10
11	M/42	IA	VII	NO	C	C	C	1	0	9
12	M/54	RTA	VIII	NO	C	C	C	0	0	0
13	M/39	RTA	VIII	NO	C	M	M	4	2	3
14	M/44	IA	VIII	YES	M	M	M	2	2	21
15	F/43	D	VII	NO	C	C	C	1	2	14

Mode of Injury : D - Domestic, RTA - Road Traffic Accident, IA - Industrial Accident

Articular Reduction : C - Congruous, M - Moderate reduction.

Table II - Analysis of Functional Result

Case No	Pain	Grip (%uninjured side)	FUNCTION				Return to work	Duration of follow-up(months)
			Dorsiflex	Palma flex	Pronation	Supination		
1	Nil	100%	FULL		Full	Full	6 Weeks	28
2	Nil	65%	45/50	45/50	65/70	Full	Housewife	26
3	Nil	89%	Full		Full	Full	Retired	26
4	Mild	84%	50/65	50/70	Full	Full	12 Weeks	26
5	Mild	58%	35/65	60/60	Full	Full	Multiple Injury	26
6	Mild	100%	Full		Full	Full	10 Weeks	25
7	Nil	83%	25/60	55/60	Full	Full	Retired	25
8	Mild	77%	70/75	55/60	Full	Full	14 Weeks	25
9	Mild	57%	40/60	40/75	Full	Full	12 Weeks	24
10	Mild	69%	Full		Full	Full	Multiple Injury	24
11	Mild	100%	Full		Full	Full	6 Weeks	23
12	Nil	60%	Full		Full	Full	12 Weeks	23
13	Nil	86%	60/65	45/65	Full	Full	6 Weeks	22
14	Mild	85%	45/65	45/65	Full	Full	14 Weeks	21
15	Nil	100%	Full		Full	Full	10 Weeks	20

f) Return to work

Of the twelve patients who were engaged in active employment, 10 returned to the same job within 4 months of injury (average 8.5 weeks). Two patients were unable to return to work due to associated limb injuries sustained during their accident. (Table II)

g) Complications

The only complication in this series was the development of sympathetic dystrophy in the 68-year-old housewife. She responded well to physiotherapy.

DISCUSSION

Comminuted intra-articular fracture of the distal radius has remained a difficult problem. Results of conservative treatment with plaster cast is associated with a high percentage of displacement, deformity and articular incongruity. Introduction of the external fixator in the seventies has met with some success. There were some draw-backs due to a high complication rate, notably pin tract infection and pin loosening. Failure to achieve articular congruency and stiffness of the wrist were also important complications. The objectives of treatment of

any intra-articular fracture are anatomical reduction, stable fixation and early mobilization⁽⁹⁾.

Careful observation on the patterns of comminuted intra-articular distal radius fractures convinced the authors that internal fixation with a volar T-plate was in fact feasible. Dorsal comminution was frequently observed, and hence the reason for bone grafting through a separate dorsal approach. Using this method of internal fixation, we were able to achieve articular congruency in 13 cases initially. Some loss of articular congruency occurred in 4 cases. Extra-articular reduction was generally satisfactory and well maintained. None had gross deformity about the wrist. All patients are either pain-free or had only mild pain with forceful grip. This we feel is largely due to good articular reduction. Ability to return to work early was also observed in this group of patients.

We believe that open reduction and internal fixation with T-plate, though technically demanding, has enabled us to achieve good intra-articular and extra-articular reduction. Some loss of reduction was observed in a significant number of cases due to dorsal comminution. The use of bone grafting in significantly comminuted cases has been reported to reduce the loss of reduction⁽¹⁰⁾. However, in two of the three bone grafted cases in our series, some loss of reduction still occurred. These findings as well as the small numbers of cases bone grafted in this series did not enable us to assess the effectiveness of bone grafting in the treatment of these fractures.

CONCLUSION

In our experience, open reduction and internal fixation with T-plate has been found to be an effective method of achieving

intra-articular and extra-articular reduction in comminuted intra-articular fractures of the distal radius.

Some loss of reduction can be expected if there is a significant degree of comminution. Results of internal fixation in this group can probably be improved by supplementing with bone grafting.

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