



Review of Outcome of Intra-Articular Fractures of the Distal Radius Treated by Volar Locked Plates

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ABSTRACT

Having been recognized for nearly two centuries, fractures of the distal radius recently have become the focus of an intense resurgence in interest regarding optimal management. Formerly considered relatively innocuous injuries incurred principally by the elderly, these fractures are now acknowledged as serious disruptions of wrist anatomy, with a considerable incidence of complications that affect a much larger segment of the populations. Frequently occurring intra-articular fractures, preservation of distal radial articular contours, is an absolute prerequisite. Residual joint incongruity of any extent is prone to the inevitable development of disabling arthritis. The study is intended to find out and assess both conceptual and practical guidelines for precision treatment with an expectant favourable result. Based on our study, we conclude that volar plating in unstable intraarticular fracture of distal end radius using locked plates had become an effective tool in the management of difficult injuries.

KEYWORDS: Frykman classification, volar plating, intra-articular fracture lower end radius.

● Introduction:

Gartland and Werley (1951) reported 31% unsatisfactory results with traditional "manipulation and cast treatment". Spira(1954) had 51% poor results with same. Frykman G.K. (1967) showed 19% incidence of radioulnar arthrosis in comminuted intra-articular fracture distal end radius treated by cast immobilization. Prominent among these concepts is that functional recovery closely parallels the accuracy of skeletal restoration. Radio carpal congruity is the single most important factor with 91% incidence of arthritis in incongruent cases.

Furthermore it is increasingly evident that well conceived treatment for the diverse spectrum of distal radius fractures is contingent upon strict definition of specific fracture configuration, extent of displacement, the degree of articular disruption, the stability and the reducibility of each fracture, repair of concomitant injuries and rehabilitation supervised by highly skilled therapists, as well as any concurrent injury to adjacent nerves.

● Biomechanics:

The radiocarpal joint is an ellipsoid biaxial synovial joint. The dorsiflexion and palmarflexion takes place around the long axis of eclipse whereas adduction (ulnar deviation) and abduction (radial deviation) of hand takes place around a shorter axis. The axis of pronosupination passes through the centre of radial head above and base of ulnar styloid below and is a dynamic axis shifting laterally in pronation and medially in supination. The three column concept is a helpful biomechanical model for understanding the pathomechanics of wrist fractures. The radial column includes the radial styloid and the scaphoid fossa, the intermediate column consists of the lunate fossa and sigmoid notch (distal radioulnar joint) and ulnar column comprises of ulnar head with triangular fibrocartilage complex. Under normal physiological conditions a large proportion of load is transmitted across the lunate fossa to the intermediate column.

Fall on an out-stretched hand with wrist in hyperextension is usual mode of injury. The radiocarpal joint has exceptionally strong dorsal and volar radiocarpal and palmar ulnocarpal ligament. A high tensile loading of the palmar radiocarpal ligament is necessary to transmit tensile force to the anterior cortex of distal radius and results in a transverse fracture line. Mervyn Evans explained that fracture sustained in supination will angulate forwards. With forearm locked in supination, the weight of the body twists the hand into sudden pronation resulting in volar compression fracture.

● Imaging:

The standard series of postero-anterior, lateral and oblique x-ray views is useful to visualize a distal radius fracture. The tilted lateral view is a lateral view taken with a pad under the hand to incline the radius 22 degrees towards the beam. It is useful to assess (a) residual depression of the palmar lunate facet and (b) possible hardware penetration into the articular surface. Anteroposterior and lateral traction views are taken with manual traction or finger traps applied after reduction. They give idea regarding whether or not open reduction will be required.

● Predictors of outcome of distal radius fracture:

The treatment goal of these fractures is a wrist that provides sufficient pain-free motion and stability to permit vocational and avocational activities without the propensity for future degenerative changes. Several studies have shown that clinical outcome of a healed distal radius fracture depends on certain key radiographic parameters which must be duly addressed while treating them.

1) Intra-articular incongruity:

Radiocarpal articular congruity remains the most clinically significant radiographic parameter regarding both functional outcome and future degenerative changes. If 2 mm of incongruity is present, there is a 100% incidence of degenerative changes on plain x-rays. Trumble et al. evaluated 52 intra-articular fractures and found that the strongest correlation with outcome was articular congruity.

2) Palmar tilt:

Clinical studies have implicated the loss of the normal 11 to 12 degree of palmar tilt as having a significant effect on functional outcome. Gartland and Werley concluded that residual dorsal tilt has a more direct effect on outcome than residual radial deviation, radial shortening, or loss of integrity of the radioulnar joint.

3) Radial length:

Collapse of the lunate facet results in radiocarpal incongruity whereas collapse of the radial metaphysis results in radioulnar incongruity. McQueen⁹ found that more than 2 mm of radial shortening resulted in symptomatic loss of strength and also correlated with ulnar sided wrist pain.

4) Radial inclination:

Cadaver data indicate that the carpus shifts ulnarly in response to loss of radial inclination, thereby resulting in increased load on the triangular fibrocartilage complex (TFCC) and the ulna. This effect is not

as severe as other deformities, but clinical studies show a correlation between decreased radial inclination and decreased grip strength. In addition, long-term follow-up indicates that this increases the risk of degenerative changes by 90%.

5) Carpal malalignment:

Although some degree of lateral scapholunate angle widening due to palmar flexion of the scaphoid may be acceptable, it appears that a dorsiflexed lunate (a static DISI deformity) is associated with a poor outcome. The critical shift is in the radiolunate angle, as it indicates a shift of contact forces dorsally on the radius in the intermediate column.

● Guidelines for acceptable reduction following distal radius fractures:

- Intraarticular step-off or gap <2 mm of radiocarpal joint.
- Articular incongruity <2 mm at sigmoid notch of distal radius.
- Radial shortening <5 mm at distal radioulnar joint.
- Radial inclination on posteroanterior radiographs >15 degrees.
- Sagittal tilt on lateral projection between 15 degrees dorsal tilt and 20 degrees volar tilt.
- Ulnar variance of 0 to -2mm.

The older classification with various eponyms like Chauffeur's fracture, dorsal barton fracture, volar barton fracture, Smith's fracture, dorsal marginal fracture etc. was very confusing and often overlapping. Frykman classified these fractures in a simple and clear way, depending on articular comminution and ulnar styloid fracture. There are other classifications also including that of Melone, Universal classification, Fernandez.

● Observation:

This is prospective all inclusive study for outcomes of intra-articular fracture lower end radius using locked plates as a type of implant for open reduction and internal fixation of the fracture fragments. All patients included for this study sustained distal radius fracture grade III to grade VIII according to Frykman classification. We have operated upon patients with plating under brachial block or general anaesthesia, using the volar approach of Henry for the distal radius.

We have compared present series with:-

- 1) Jupiter and Fernandez-49 patients having intraarticular fracture lower end radius.
- 2) Shetty MS Kumar and Kiran – 23 cases of intrarticular fracture lower end radius.

The intraarticular fracture of distal end radius occurs in young and middle aged, physically active individuals with good bone stock and are related more with high velocity trauma.

TABLE – 1
SHOWS THE INCIDENCE OF COMPLICATIONS IN RELATION TO DISTAL END RADIUS FRACTURE

COMPLICATION	PRESENT SERIES	JUPITER & FERNANDEZ SERIES
Pain	9(20.93%)	5(10.20%)
Deformity	5(11.63%)	4(8.16%)
Finger stiffness	10(23.26%)	5(10.20%)
Osteoarthritis	-	2(4.08%)
Complex regional pain syndrome	5(11.63%)	1(2.04%)
Nerve injury	-	3(6.12%)(Carpal Tunnel Syndrome)
Tendon rupture	-	1(2.04%)(Extensor pollicis longus)
Malunion/Nonunion	-	-
Hardware related complications(Implant loosening,backout)	-	-

TABLE - 2

SHOWS THE RESULTS OF PATIENTS FOLLOWING INTRAARTICULAR FRACTURE OF DISTAL END RADIUS TREATED WITH VOLAR LOCKED PLATES

	RESULTS			
	EXCELLENT	GOOD	FAIR	POOR
PRESENT SERIES(ORIF with 3.5 mm locking plate)	26(60.47%)	15(34.89%)	2(4.65%)	-
JUPITER & FERNANDEZ SERIES(47-ORIF with 3.5mm locking plate, 1-ORIF with 4 mm cancellous screws 1-ORIF with 2.7mm locking plate)	31(63.27%)	10(20.41%)	8(16.32%)	-
SHETTY & KIRAN SERIES(ORIF With 2.4 mm volar locking plate)	4(17.39%)	18(78.26%)	1(4.35%)	-

TABLE – 3

SHOWS THE RANGE OF MOVEMENT

DEGREES	0-30	31-60	61-90	91-120	>120
Arc of dorsiflexion to palmarflexion			2(4.65%)	13(30.23%)	28(65.12%)
DEGREES	0-5	6-10	11-15	16-20	>20
Ulnar deviation	-	4(9.30%)	12(27.91%)	14(32.56%)	13(30.23%)
Radial deviation	-	7(16.28%)	21(48.84%)	13(30.23%)	2(4.65%)
DEGREES	0-50	51-75	76-100	>100	
Arc of supination to pronation	-	1(2.33%)	4(9.30%)	38(88.37%)	

● Conclusion:

- Intra articular fractures are more common in young and middle aged males who had sustained high velocity trauma.
- Fracture pattern in most of the patients was unstable with varying geometry and displacement.
- Anatomical restoration of articular congruency along with restoration of radial length and reduction of the dorsal tilt are of great importance with regards to long term outcomes.
- Patients with Frykman type VII and VIII fractures have less favourable outcomes.
- Patients of intra-articular fracture lower end radius treated with volar locked plates have following advantages:-
 - i) Better intra-articular congruity at initial reduction.
 - ii) Maintenance of reduction.
 - iii) Better stability.
 - iv) Better range of motion on physiotherapy.
 - v) Early active mobilization can be started.

Based on our study, we conclude that plating in unstable intra-articular fracture of distal end radius using locked plates had become an effective tool in the management of difficult injuries. With the development of volar fixed angle locking plates, this technique is advantageous in intra-articular lower end radius fractures.

Following are the factors affecting the result of the outcome post-operatively:-

- Anatomical reduction.
- Maintenance of reduction with rigid internal fixation using locked plates.
- Minimum interference to the fracture fragment vascularity and adequate soft tissue respect.
- Maintenance of smooth articular congruity of radiocarpal & distal radioulnar joint after fixation.

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