



EVALUATION OF ANATOMICAL AND FUNCTIONAL OUTCOME OF VOLAR PLATING IN TREATMENT OF FRACTURES OF DISTAL END RADIUS

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ABSTRACT

Distal radius fractures remain an injury that fosters considerable interest and debate. Interest in distal radius fractures stems not only from its high incidence but also from developing understanding of outcome variables and influence of technology in evaluation and treatment. For our study we have taken 40 patients with distal end fracture of both the sexes and treated them with plating through volar approach as it is less destructive, same post-op protocol was followed and results were evaluated through anatomical score of healed fracture according to the Sarmiento's modification of Lind Strom Criteria and functional end result of healed fracture according to the merit point system of Gartland and Werley with Sarmiento et al's modification. We came to the conclusion that 88% anatomical and 93% functional, excellent to good results, suggests that stabilizing the fracture fragments with volar plate and screws in the management of the fractures of distal radius, is an effective method to maintain the reduction till union and prevent collapse of the fracture fragments, even when the fracture is grossly comminuted/intra-articular/unstable and/or the bone is osteoporosed. The technique emphasises that open reduction and internal fixation with volar plating has excellent functional outcome with minimal complications thus proving that it is the prime modality of treatment for distal radius fractures. The procedure is applicable for all types of Frykman fractures in young patients with a good bone stock as well as in elderly osteoporotic patients.

KEYWORDS : Distal radius , Volar plating, Sarmiento, Gartland and Werley, Frykman.

INTRODUCTION

Fractures of lower end radius are most common fractures of the upper extremity, encountered in practice and constitute 17 % of all fractures and 75% of all forearm fractures¹.

Close reduction and cast immobilization has been the mainstay of treatment of these fractures but malunion of fracture and subluxation/dislocation of distal radioulnar joint resulting in poor functional and cosmetic results is the usual outcome². The residual deformity of wrist adversely affects wrist motion and hand function by interfering with the mechanical advantage of the extrinsic hand musculature.³ It may cause pain, limitation of forearm motion, and decreased grip strength as a result of arthrosis of the radiocarpal and distal radioulnar joints⁴.

The management of distal radius fractures has evolved over time with different factors such as fracture type, bone stock, associated lesions, age of the patient, and surgeon's experience all playing a role.⁵ Closed reduction and cast immobilization has been the mainstay of treatment of these fractures, but it results in malunion, poor functional, and cosmetic outcome.⁶ Loss of reduction and need for re-manipulation has been seen in 46-67% patients.⁷

Our objectives with this study is to evaluate the role of volar plate in treatment of fractures of distal end of radius and to evaluate the functional results of this treatment in terms of deformity, disability, movements and grip strength.

MATERIAL AND METHODS

Study Design: Prospective

Place of study: Unique Super Speciality Centre, Indore, M.P

Target Number of patients: 40

Duration of study: May 2013 to May 2015

Follow up: 18 months

SELECTION OF STUDY SUBJECTS

Eligibility

* Ages: 18 years & above

*Gender : Both male & female

*Accepts Healthy Volunteers: No

Inclusion Criteria

- Age above & equal to 18 years
- Distal end radius fracture

Exclusion Criteria

- skeletally immature patients
- pathological fracture
- previously operated & non-functional wrist
- patients with local tissue condition making surgery inadvisable
- patients with comorbid conditions preventing surgical intervention

MATERIAL AND METHOD

- As soon as patient with fracture distal end radius arrived at the hospital, the tenderness, swelling, wrist movement, distal neurovascular status were examined thoroughly.
- X-rays taken in AP, lateral and oblique planes. Some cases where comminution was high, 3D CT-scan was done.
- Pre-anaesthetic check-up was done and the patient shifted to operation theatre after being fit for surgery.
- Patients with distal end radius fracture were operated with Volar plates under Regional anaesthesia (supraclavicular block) or General anaesthesia.
- The standard volar approach was undertaken to fix the fragments. In cases initially approaching the radial styloid fragment, dissection between the flexor carpi radialis tendon and radial artery were used. For the die-punch volar fragment, dissection between the median nerve and flexor carpi radialis tendon was used. The distal and radial borders of pronator quadratus were lifted and retracted ulnarly. Open reduction was performed with the aid of intrafocal leverage, traction by an assistant/distractor, and provisional fixation by temporary Kirschner wires followed by definitive volar buttress or locking plate and screws. Image intensifier was used in theatre to assist

the evaluation of fracture reduction and fixation. In few patients along with plate, one K-wire was left for stable fixation for 4 to 6 weeks and then K-wire was removed.

- They got discharged at appropriate time.
- They were followed up at the end of first, fourth, sixth week, after 3 months and then once in 2 months upto 18 months.
 - AP and lateral x-rays were taken on fourth, eighth week and then on second month, sixth month and twelfth month and patients were instructed about the exercises of the elbow, digits and shoulder.
- At the end of fourth weeks, active motion of the wrist consisting of wrist movements, supination, pronation, finger grip were started.
- Patients were assessed, which includes the subjective impressions of the patient, objective grading of function and deformity, comparison of final and initial radiograph. A detailed questionnaire was completed with each patient to evaluate subjective factors such as pain, functional limitations and occupational considerations.
- Objective examination included inspection of the wrist for deformity, tenderness, abnormal mobility of the distal radioulnar joint, measurement of the range of movements and grip strength.
- The subjective, objective and radiographic findings was quantified by Lidstrom's system and Demerit point system. The outcome of each fracture has been graded as excellent, good, fair or poor.

LIDSTROM'S CRITERIA FOR FUNCTIONAL END RESULTS: EXCELLENT:

- No deformity
- No residual disability
- Full wrist and forearm movements
- No loss of grip strength

GOOD

- Minimal deformity
- Residual disability
- Loss of movements upto 20°
- Slight loss of grip strength

FAIR

- Moderate deformity
- Moderate disability
- Loss of movements upto 40°
- Moderate loss of grip strength

POOR

- Gross deformity
- Gross disability
- Gross limitation of wrist and forearm movements
- Severe loss of grip strength

Radiological assessment done in terms of residual dorsal angulation, radial shortening and loss of radial inclination and the results were graded according to the Sarmiento's modification of Lind Strom⁸ Criteria. These parameters were assessed during the follow up of the patient to assess the quality of reduction and the ability of the technique to maintain the reduction.

ANATOMICAL EVALUATION – SARMIENTO'S MODIFICATION OF LIND STORM CRITERIA⁸

	Deformity	Residual Dorsal Tilt	Radial Shortening	Loss Of Radial Inclination
Excellent	No or insignificant	0°	< 3 mm	< 5°
Good	Slight	1 – 10°	3 to 6 mm	5 to 9°
Fair	Moderate	11 to 14°	7 to 11 mm	10 to 14°
Poor	Severe	Atleast 15°	Atleast 12 mm	>14°

ANATOMICAL EVALUATION RESIDUAL DORSAL TILT

The dorsal tilt (from a neutral of 0 degrees) of the distal radial articular surface varied from 4 degrees to 26 degrees. The dorsal tilt decreased from an average of 13° before the reduction to an average of 0.6° at the most recent follow up evaluation.

Postoperatively the dorsal tilt could be corrected to the anatomical palmar tilt or atleast a neutral angle in 34 patients (85%) while in 6 patients (15%) the dorsal tilt could not be restored even to a neutral angle.

Out of these 6 patients, 2 had Frykman Type I fracture, 2 had Type III fracture while one had Frykman Type IV fracture and one had Frykman Type VII fracture.

At the final follow up, two patients (5%) had some loss of correction of dorsal tilt. These patients had a comminuted intra-articular fractures (Type IV and VII).

In 95% of the patients the correction of tilt achieved at surgery was maintained till healing.

	0°	1-10°	11-14°	Atleast 15°
Pre op	0	17	6	17
Post op	34	6	0	0
Final Follow up	34	6	0	0

RADIAL LENGTH

The radial shortening varied from 4 mm to 26 mm. It decreased from an average of 11 mm before the reduction to an average of 0.65 mm postoperatively and to 0.8 mm at the most recent follow up.

In 1 patient (3%) there was 4 mm of collapse of radial length from the immediate postoperative to the final follow up period. This patient had comminuted fracture Frykman Type VI.

97% of the fractures maintained their postoperative radial length till union.

	<3 mm	3-6 mm	7-11 m	Atleast 12 mm
Pre-op	0	9	13	18
Post-op	7	4	0	0
Final follow up	7	3	1	0

RADIAL ANGLE

The loss of radial inclination varied from 0° to 20°. It from an average of 12.1° before reduction to an average of 0.9° postoperatively to 1° at the final follow up.

In 2 patients (5%) there was loss 3° or 4° of correction of radial inclination. These 2 patients had comminuted intra articular fractures.

	<5°	5-9°	10-14°	>14°
Pre-op	3	13	8	16
Post-op	11	2	0	0
Final follow up	11	2	0	0

CLINICAL AND FUNCTIONAL EVALUATION RESIDUAL DEFORMITY

- Prominent Ulnar Styloid – 4 patients (10%)
- Residual Dorsal Tilt – 4 patients (10%)
- Radial Deviation of hand – 0 patients (0%)

SUBJECTIVE EVALUATION

Subjectively, out of 40 patients, 26 patients (65%) had excellent, 12 patients (30%) had good, and 2 patients had fair (5%) results.

SUBJECTIVE EVALUATION	NUMBER OF PATIENTS	PERCENTAGE (%)
EXCELLENT	26	65

GOOD	12	30
FAIR	2	5
POOR	0	0
TOTAL	40	100

OBJECTIVE EVALUATION

Loss of Dorsiflexion (<45°)	2
Loss of Palmar Flexion (<30°)	2
Loss of Ulnar Deviation (15°)	1
Loss of Radial Deviation (<15°)	1
Loss of Supination (<50°)	1
Loss of Pronation (<50°)	1
Loss of Circumduction	2
Pain at DRUJ	2
Grip Strength <60% of opposite side	1

COMPLICATIONS

Reflex Sympathetic Destrophy	1
Joint Stiffness	2
Paraesthesia in distribution of Radial Nerve	1
Impingement of tendons	0
Median Nerve complications	0
OA wrist	1

DEMERIT POINT SYSTEM OF GARTLAND AND WERLEY⁹:

Elements:

- (1) residual deformity
- (2) subjective evaluation
- (3) objective evaluation
- (4) complications

Criteria for **objective evaluation** indicating minimum for normal function:

- (1) dorsiflexion: 45 degrees
- (2) palmar flexion: 30 degrees
- (3) radial deviation: 15 degrees
- (4) ulnar deviation: 15 degrees
- (5) pronation: 50 degrees
- (6) supination: 50 degree

RESULTS

ANATOMICAL SCORE OF HEALED FRACTURE

The scoring was done according to the Sarmiento's modification of Lind Strom Criteria.

Anatomically 25 patients (63%) had excellent restoration of anatomy, 10 patients (25%) had good restoration, 3 had fair (7%) and 2 had poor (5%) restoration of anatomy.

Thus 88% patients had excellent to good alignment of fragments and good reduction could not be achieved in 12% patients resulting in fair or poor results.

FUNCTIONAL END RESULT OF HEALED FRACTURE

The scoring of healed fracture was done as according to the demerit point system of Gartland and Werley with Sarmiento et al's modification.

Functionally 24 patients (60%) had excellent, 13 good (33%) and 3 patients had fair (7%) restoration of functions. Poor function correlated with residual displacement and poor patient compliance.

CONCLUSION

88% anatomical and 93% functional, excellent to good results, suggests that stabilizing the fracture fragments with volar plate and screws in the management of the fractures of distal radius, is an effective method to maintain the reduction till union and prevent collapse of the fracture fragments, even when the fracture is grossly comminuted/intra-articular/unstable and/or the bone is osteoporosed.

The technique emphasises that open reduction and internal fixation with volar plating has excellent functional outcome with minimal complications thus proving that it is the prime modality of treatment for distal radius fractures. The procedure is applicable for all types of Frykman fractures in young patients with a good bone stock as well as in elderly osteoporotic patients.

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