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KEY WORDS: Intra-articular distal radius fracture, volar plating, ligamentotaxis, Quick DASH score.

A COMPARATIVE STUDY OF FUNCTIONAL OUTCOME OF INTRA-ARTICULAR DISTAL RADIUS FRACTURES TREATED SURGICALLY USING VOLAR PLATING VERSUS LIGAMENTOTAXIS.

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ABSTRACT

Background & Objective: Distal radius fractures are most frequently encountered fractures accounting for 17.5% of all fractures in adults. Majority of them are intra-articular. The management has changed from conservative to operative management with better understanding of the nature of injury and pattern of fracture. The study was conducted to compare the functional outcome of intra-articular fracture of distal radius treated surgically using volar plating or ligamentotaxis and to study the post-operative complications in both techniques. **Materials & Methods:** We conducted a prospective interventional study on 45 patients with intra-articular distal radius fractures admitted in department of Orthopedics, Basaveshwar Teaching and General Hospital, Kalaburagi, who underwent surgery either by ligamentotaxis or volar plating. Patients were followed up at 6 weeks, 3 months and 6 month and their functional outcome was assessed at each follow up using Quick DASH score. **Results:** This study included 45 patient, of which 28 were male and 17 were female patients. 14 patients were operated with ligamentotaxis with mean age of 45.2 years and 31 with volar plating mean age of 45.7 years. The average duration of follow up was 6 months. Patients were assessed using Quick DASH score. Among ligamentotaxis group the results were excellent in 1 (7.1%) patient, good in 5 (35.7%) patients, satisfactory in 5 (35.7%) patients and poor in 3 (21.4%) patients. Among volar plating group the results were excellent in 12 (38.7%) patients, good in 14 (45.2%) patients, satisfactory in 4 (12.9%) patients and poor in 1 (3.2%) patient with a p value=0.02 ($p< 0.05$). **Conclusion:** We concluded that volar plating provides better functional outcome in patients with intra-articular distal radius fractures than ligamentotaxis.

INTRODUCTION

Fractures of the distal radius are the most frequent fractures encountered by Orthopaedic Trauma Surgeons. Majority of distal radius fractures are intra-articular which leads to disruption of radio-ulnar and radio-carpal joints. The management of distal radius fractures has changed from conservative management to operative management with the better understanding of the nature of injury and pattern of fracture.[1]

The distal radius fractures account for 17.5% of all fractures in adults. Average age of all distal radius fractures in adult females is reported to be 60 years and in that of males is 40 years.[1] Distal radius fractures are the third most common fractures occurring in old age group with osteoporotic bones after vertebral and hip fractures.[1,2]Fall on to outstretched hand from height is the most common mechanism of injury. Other modes of injuries are high energy trauma, as seen in motor vehicle accidents in young individuals. High energy trauma would result in displaced, communited and unstable fractures of distal end radius.[3]

Frykman classified distal radius fractures into eight groups in 1967. Group 1 includes extra-articular distal radius fracture without distal ulna fracture, Group 2 includes extra-articular distal radius fracture with fracture of distal ulna, Group 3 includes an intra-articular distal radius fracture involving the radiocarpal joint without fracture of distal ulna, Group 4 includes an intra-articular distal radius fracture involving radiocarpal joint with fracture of distal ulna, Group 5 includes an intra-articular distal radius fracture involving distal radio-ulnar joint without fracture of distal ulna, Group 6 includes an intra-articular distal radius fracture involving distal radio-ulnar joint with fracture of distal ulna, Group 7 includes an intra-articular distal radius fracture involving both radiocarpal and distal radio-ulnar joint without fracture of distal ulna, Group 8 includes an intra-articular distal radius fracture involving radiocarpal and distal radio-ulnar joint with fracture of distal ulna.[4]

The goals of operative intervention are to achieve anatomical reduction and early mobilization of the patients. Anatomical reduction with a stable fixation device is the preferred method of treatment for unstable distal radius fractures.

Treatment depends on the pattern of fracture, degree of communition, functional requirement of the patient and patient compliance. Acceptable radiographic criteria for an anatomically reduced distal radius fracture includes intra-articular step of less than 2mm, less than 5 degree loss of radial inclination, neutral palmar tilt, radial height of more than or equal to 8mm and ulnar variance of no more than 2mm shortening relative to ulnar head.[4]

Cast immobilization is preferred for undisplaced or minimally displaced fractures and displaced fractures that are stable after reduction. Various surgical procedures includes fixation with closed reduction with K-wires and external fixator, open reduction and internal fixation with plates.[4] Indications for operative intervention are instability, secondary loss of reduction, communition, and distal radio-ulnar joint incongruity.

Surgical modalities that were studied in this study period were:

External fixator: This technique is reserved for highly unstable, severly communited fractures. It relies on the principle of ligamentotaxis, which helps in reduction of fracture fragments with the help of longitudinal traction.[5]

Volar plating: This technique allows anatomical reduction of fragments, bone grafting to elevate the articular surface and provides immediate stability to initiate early range of motion exercises. The plate can be applied on either volar or dorsal surfaces.

This study is taken up to compare the surgical management of intra-articular distal end radius fractures using volar plating and ligamentotaxis.

AIMS & OBJECTIVES:

1. To compare the functional outcome of intra-articular fracture of distal radius treated surgically using volar plating or ligamentotaxis

2. To study the post-operative complications in both techniques.

Classification Of Distal Radius Fractures

In 1951, Gartland and Werley described a classification system, which included articular involvement, comminution, and displacement.They described three groups.[1]

Group 1—Simple Colles fracture with no involvement of the articular surface.

Group 2—Comminuted Colles fracture with fractures of the radial articular surface in which the fragments were not displaced.

Group 3—Comminuted Colles fracture with fractures of the radial articular surface in which the fragments were displaced.

Group 4—Gartland and Werley did not specify whether group 1 fractures were displaced but Solgaard added a fourth group of extra-articular undisplaced fractures.[1]

Frykman classified fractures of the distal radius concentrating on articular and ulnar (styloid or shaft) involvement. He specifically differentiated between radiocarpal and distal radioulnar joint involvement:

Type I: Extra-articular, no ulnar fracture
Type II: Extra-articular, ulnar fracture
Type III: Radiocarpal articular, no ulnar fracture
Type IV: Radiocarpal articular, ulnar fracture
TypeV: DRUJ articular, no ulnar fracture
TypeVI: DRUJ articular, ulnar fracture
TypeVII: Radiocarpal and DRUJ, no ulnar fracture
TypeVIII: Radiocarpal and DRUJ, ulnar fracture.[1]

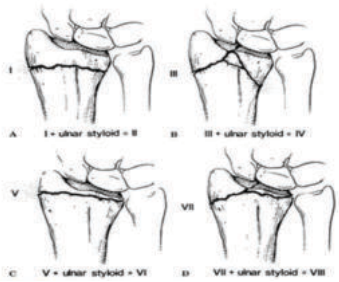


Fig 1- Frykman Classification[6]

Melone classified intra-articular fractures of the distal radius by considering that each fracture consisted of four parts: radial styloid, dorsal medial fragment, volar medial fragment, and the radial shaft. He termed the two medial fragments, which make up the lunate fossa the medial complex and based his classification on the position of the medial complex

Type 1: Undisplaced or variable displacement of the medial complex as a unit. No comminution. Stable after closed reduction.
Type 2: Unstable, die punch. Moderate or severe displacement of the medial complex as a unit with comminution of dorsal and volar cortices.
A—Irreducible, closed.
B—Irreducible, closed because of impaction.
Type 3: As type 2 but with a spike of the radius on the volar side, which may compromise the median nerve.
Type 4: Split fracture, unstable. The medial complex fragments are severely comminuted with rotation of the fragments.
Type 5: Explosion injury. Severe displacement and comminution often with diaphyseal comminution.[1]

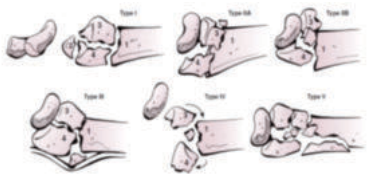


Fig 2- Melone Classification[1]

Most widely used classification system in current use is the AO classification and has been renamed as the AO/OTA classification. This is an inclusive, alphanumeric classification and has 27 different subgroups. Three different types (A—extra-articular, B—partial articular, and C—complete articular) are divided into 9 main groups and 27 different subtypes depending on comminution and direction of displacement.[1]

2R3A2: Radius, distal end segment, extra-articular, simple fracture
2R3B1: Radius, distal end segment, partial articular, sagittal fracture
2R3C1: Radius, distal end segment, complete, simple articular and metaphyseal fracture.[7]

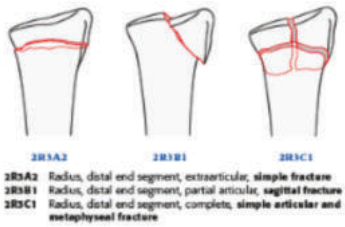


Fig 3- Ao/ota Classification[7]

Fernandez taught that a better understanding of the mechanism of injury can provide a better overall assessment of the injury, potential soft-tissue damage and a better algorithm for treatment modalities. It might provide better prognostic information because the complexity of the bone and soft-tissue lesions increases consistently from type I through type V fractures. There are five types.

Type I: Bending fracture of the metaphysis
Type II: Shearing fracture of the joint surface
Type III: Compression fracture of the joint surface
Type IV: Avulsion fractures, radiocarpal fracture, dislocation
TypeV: Combined fractures (I, II, III, IV); high-velocity injury.[7]

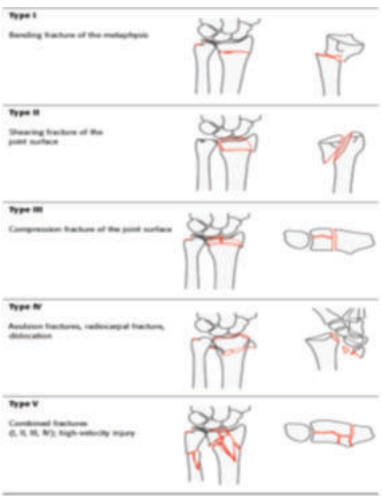


Fig 4- Fernandez Classification[7]

Treatment Measures

Various treatment modalities are available for treatment of distal radius fractures, which includes non-operative intervention and operative intervention. The purpose of treatment of a distal radius fracture is to maintain normal strength, mobility, and function in the hand and wrist.

Non-operative intervention includes closed reduction and casting. Non operative treatment is indicated in patients with undisplaced fractures or with the displaced fractures that are stable after reduction. The patient is immobilized in cast for a period of 5-6 weeks.[1]

Operative treatment includes closed reduction and internal

fixation with percutaneous pinning using Kirschner wires (K wires), or external fixation and open reduction and internal fixation volar or dorsal plating.

Outcome Measure

The most frequently used physician-based scores for distal radius fractures are the Mayo wrist score, the Gartland and Werley score, and the Green and O'Brien score.[1] The patient reported outcome measure includes the Disabilities of Hand, Arm and Shoulder (DASH) Score, Quick DASH score.[1]

METHODOLOGY

Study Design- A prospective interventional study.

Study Duration- 18 months (from 1st March 2021 to 31st August 2022).

Study Population- Clinically and radiologically diagnosed patients with intra-articular distal radius fracture were included in the study.

Source- The study was conducted on patients with intra-articular distal radius fractures admitted in Department of Orthopaedics, Basaveshwar Teaching and General Hospital attached to Mahadevappa Medical College, Kalaburagi.

Sample size calculation: Sample size (n) $= \frac{Z^2pq}{l^2}$

p = Prevalence of Intra-articular distal end radius fracture = 34%[1]

q = 100 – p = 66

l = permissible error of p = 40% of p = 13.7

$$n = \frac{(1.96)^2 34 \times 66}{(13.7)^2}$$

$$= 44.97$$

$$= 45 \text{ cases}$$

Sample size– 45 cases.

Inclusion Criteria:

1. Radiological findings confirming intra-articular fracture of distal end radius.
2. Age group of > 18 years of all genders.

Exclusion Criteria:

1. Open fractures
2. Pathological fractures
3. Neurovascular injuries
4. Poly-trauma

Informed Consent: Written and Informed consent was taken in patient's own vernacular language.

Ethical Clearance: Ethical clearance was obtained from the Institutional Ethics Committee, Mahadevappa Rampure Medical College, Kalaburagi.

Study Methodology: Among the 45 patients, 14 patients were treated with Ligamentotaxis, 31 patients with Volar Plating based on patient's choice, who fulfilled the inclusion criteria and exclusion criteria of the study. The patients were followed up at 6weeks, 3months and 6 months. During the follow up X-rays were taken and the functional outcome was assessed with Quick DASH score. Grading of Quick DASH[8] score is as follows:-

Table no 1- Assessment of Quick DASH score[8]

Quick DASH Score	Grade
0-5	Excellent
6-15	Good
15-35	Satisfactory
>35	Poor

The age of patients range from 20-67 years. 28 patients were male and 17 were female. The mechanism of injury was a fall on an outstretched hand in 16 patients, road traffic accident in 29 patients. The right wrist was injured in 26 cases and left wrist in 19 cases.

All patients had closed fractures of the distal end radius and all were intra-articular fracture. According to the Frykman classification, Out of 45 patients, 7(15.5%) were Type III, 8 (17.7%) were Type IV, 5(11.1%) were Type V, 9(20%) were Type VI, 5(11.1%) were Type VII and 11 (24.4%) were Type VIII.

Pre-operative Planning

When the patient arrived, a brief history was taken, patient's vitals including pulse rate, BP, temperature were recorded. Patient was hemodynamically stabilized and clinical evaluation showed deformity and swelling on inspection, on palpation the distal end of radius was tender and the position of styloid process of the radius and the ulna were examined. Movements at the wrist were painful and restricted. Neurovascular examination was done to rule out neurovascular deficits. Then the affected limb's X-ray was taken, once the diagnosis was confirmed radiologically below elbow PoP slab was applied and limb was kept elevated. Routine investigations were done which included CBC, PT INR, RFT, LFT, Serum Electrolytes, Urine Routine, Blood Grouping, HIV, HBsAg, RBS, ECG, Chest X-ray, X-ray wrist AP and Lateral view, CT-Wrist. Preparation of the part was done on the day of surgery. Prophylactically Tetanus Toxoid injection and intravenous analgesics were given and intravenous antibiotics were given if required to all patients pre-operatively.

Radiographic Examination

Standard radiographs were taken in two planes i.e. antero-posterior and lateral views were taken for confirmation of the diagnosis and to classify the fracture. CT scan was done for diagnosis in few patients who had complex fractures. The fracture fragments were analyzed and involvement of distal radioulnar joint and radio-carpal joint positions were assessed and classified according to the Frykman's classification.

Surgical Procedures

The duration from the date of injury to date of surgery ranged from 1-4 days, average was 2.69 days. All the surgeries were performed under brachial block.

EXTERNAL FIXATION (LIGAMENTOTAXIS)

Surgical Technique

Under the action of brachial block the patient was placed supine on the operating table. The injured limb was placed on the side arm board. Longitudinal traction was applied the fracture fragments were reduced back into a more normal alignment (severe hyper-flexion or hyperextension is avoided) under the fluroscopy guidance. The wrist was maintained in mild flexion and ulnar deviation. The fore-arm and hand were scrubbed thoroughly with betadiene 7.5% and 10% solution, painted with betadiene 10% solution and draped under aseptic precaution.

A stab incision was made approximately 10 cm proximal to the radial styloid over the lateral aspect of the radius. Through the stab incision, the periosteum was displaced and the drill sleeve was fixed centrally. Care was taken to avoid injury to the tendons, nerves and muscle in the process of drilling. The radius was drilled with 2.5mm drill bit, and 3.5mm Schanz pin was fixed. A stab incision was made over the lateral aspect of the base of the 2nd metacarpal. It was drilled with 1.5mm drill bit, and then fixed with 2.5mm Schanz pin. Then the 4mm connecting rod was fixed to the Schanz pins with the clamps. The other 2 Schanz pins, one in the shaft of radius and the other in second metacarpal were fixed in similar fashion .Now the external fixation device is tightened and the fracture was reduced carefully assessed clinically and under fluoroscopy; (K-wire was used for augmentation for certain cases), sterile dressings were done to the pins, the fingers were left free to go through a full range of motion. Fingers were checked for capillary refilling. No splint was given.

Fig 5- Patient position draping of the limb

Fig 6- Intra-operative, Schanz pins placement

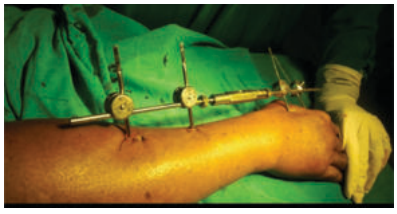


Fig 7- Intra-operative image showing External Fixator frame

Post-Operative Care and Rehabilitation:
Check X -rays were taken in both Antero-posterior and lateral views on post-operative day one. Reduction of the fracture was confirmed and any displacement of fracture was studied. Tension generated by the external fixation device across the wrist joint should provide enough ligamentotaxis, so that on an Antero-posterior radiograph the radiocarpal articulation was seen to be 1 mm wider than the midcarpal joint.

From post-operative day one of surgery active exercises of fingers and thumb were started, patients were put on inj cefoperazone with sulbactum, IV for 5 days. On post-operative day two the dressing was opened, the pins were cleaned with spirit on every alternate day; later the patient was educated regarding pin site care. Throughout the period of the healing the patients were encouraged to perform shoulder, elbow and finger range of motion.

VOLAR PLATING
Position and tourniquet
Under the action of brachial block, the patient was placed supine on the operating table with the injured limb on side arm board. The limb was elevated for 2-3 minutes and exsanguinated and a mid-arm pneumatic tourniquet was applied. The fore-arm and hand were scrubbed thoroughly with betadiene 7.5% and 10% solution, painted with betadiene 10% solution and draped under aseptic precaution.

Technique
The incision for volar plating of the distal radius was performed through the modified Henry approach. An incision is made over the flexor carpi radialis (FCR) tendon. The subcutaneous tissue was dissected and the anterior tendon sheath was incised, the FCR tendon was retracted ulnarly. An inter-nervous plane was created between FCR (supplied by median nerve) and the brachioradialis muscle (supplied by radial nerve). This interval is developed, revealing the flexor pollicis longus (FPL) muscle at the proximal extent of the wound and the pronator quadratus more distally. The radial artery is carefully retracted radially and FPL are retracted ulnarly.

The pronator quadratus is divided at its most radial aspect, leaving a small cuff of muscle for later reattachment. After the pronator quadratus was divided and elevated, the fracture site was exposed and visualized. After exposure and debridement of the fracture site, the fracture is reduced and provisionally fixed under fluoroscopy with K-wires, reduction forceps.

The appropriate plate was selected following fracture reduction. First, a standard cortical screw was applied in the oval hole of the vertical limb of the plate in order to temporarily secure the plate to the proximal fragment. This allowed the plate adjustment either proximal or distal subsequently. After fixing the distal fragment with subchondral locking screws, radial length was gained, when necessary, by pushing the plate distally. The first standard screw was left in situ, the oval hole designed for standard cortical screw placement at the proximal end of the hole and locking head screw placement at the distal end. The screws were inserted at the radial styloid, beneath the lunate facet, and near the sigmoid notch. More volar tilt was achieved using distal screw placement with wrist flexed volarly as much as possible by an assistant. The radial length was further improved by pushing the whole plating system distally while using the oval plate hole and screw as a glide.

The final position of the plate and screws were confirmed using fluoroscopy. Thorough wash was given with normal saline, hemostasis was achieved. Pronator quadratus was sutured back to secure the plate applied to the anterior surface of the radius. The wound was closed in layers and sterile compression dressing was applied. The tourniquet was removed fingers were checked for capillary refill time. Volar below elbow PoP slab was applied with the wrist in neutral position.

Fig 8- Intra-operative image (skin incision)

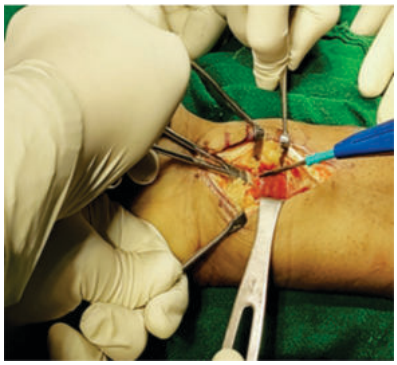


Fig 9- Pronator Quadratus muscle

Fig 10- Intra-operative image (fracture site)

Fig 11-Volar plate in-situ

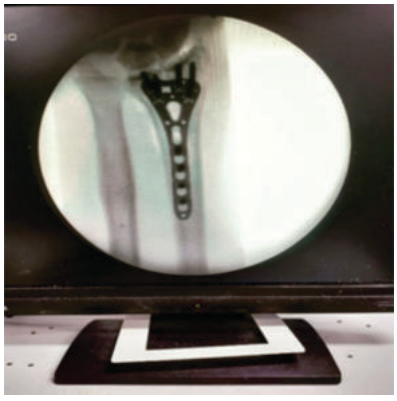


Fig 12- Fluoroscopic image (AP view)

Fig 13- Fluoroscopic image (lateral view)

Post-Operative Care and Rehabilitation

Check X -rays were taken in both Antero-posterior and lateral views on post-operative day one. Reduction of the fracture was confirmed and any displacement of fracture was studied. The position of the plate and subchondral screws were confirmed.

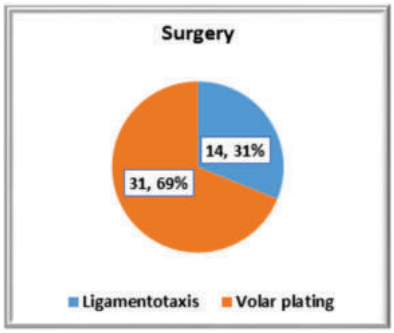
From post-operative day one of surgery active exercises of fingers and thumb were started, patients were put on inj cefoperazone with sulbactum, IV for 5 days. On post-operative day two the dressing was opened and wound was inspected. Throughout the period of the healing the patients were encouraged to perform shoulder, elbow and finger range of motion. Suture removal was done on post-operative day 15.

Statistical Analysis

Data were entered into Microsoft Excel and statistical analysis was carried out in SPSS software version 17.0. Type of surgical procedure was expressed as numbers and percentages. Correlation between genders, side involved, mode of injury, Frykman classification and complications between the ligamentotaxis and volar plating was performed using ac hi squared test. Comparison of age and duration between the time of injury and surgery was done with independent t test. Bar diagrams and pie charts were used for graphical representation of data. A p value of <0.05 was considered as statistically significant.

Table no 2: Distribution of cases based on surgery performed.

Surgery	Number	Percentage
Ligamentotaxis	14	31.1
Volar plating	31	68.9
Total	45	100.0



Graph 1- Distribution of cases based on surgery performed

Table no 3- Comparison of age distribution between the groups

	Number	Mean	SD	P value
Ligamentotaxis	14	45.2	11.8	0.90
Volar plating	31	45.7	10.5	
Independent t-test, p value-not significant				

Table no 4: Comparison of gender distribution between the groups

Gender	Ligamentotaxis		Volar plating	
	n	%	n	%
Female	5	35.7	12	38.7
Male	9	64.3	19	61.3
Total	14	100.0	31	100.0
Chi square p value=0.84 (Not significant)				

Table no 5: Comparison of side involvement between the groups

Side	Ligamentotaxis		Volar plating	
	n	%	n	%
Left	5	35.7	14	45.2
Right	9	64.3	17	54.8
Total	14	100.0	31	100.0
Chi square p value=0.55 (Not significant)				

Table no 6: Comparison of mode of injury between the groups

Mode of injury	Ligamentotaxis		Volar plating	
	n	%	n	%
Fall	5	35.7	11	35.5
RTA	9	64.3	20	64.5
Total	14	100.0	31	100.0
Chi square p value=0.98 (Not significant)				

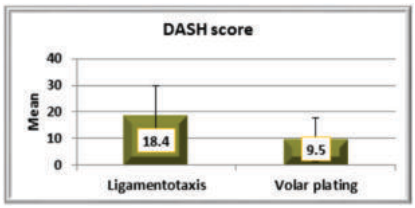
Table no 7: Distribution according to Frykman classification

Frykman classification	Ligamentotaxis		Volar plating	
	n	%	n	%

3	0	-	7	22.6
4	1	7.1	7	22.6
5	2	14.3	3	9.7
6	3	21.4	6	19.4
7	3	21.4	2	6.5
8	5	35.7	6	19.4
Total	14	100.0	31	100.0
Chi square p value=0.17 (Not significant)				

Table no 8: Comparison of Quick DASH score between the study groups

	Number	Mean	SD	P value
Ligamentotaxis	14	18.4	11.4	0.02
Volar plating	31	9.5	8.2	
Independent t-test, p value- significant				



Graph 2- Mean Quick DASH score

Table no 9: Comparison of complications between the study groups

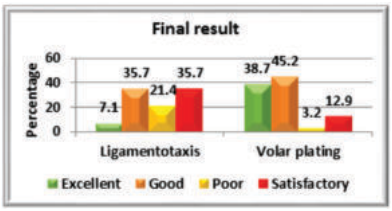
Complications	Ligamentotaxis		Volar plating	
	n	%	n	%
No	7	50.0	26	83.9
Yes	7	50.0	5	16.1
Total	14	100.0	31	100.0
Chi square p value=0.02 (Significant)				

Table no 10: Individual complications across the groups

Complications	Number	Percentage
Volar plating (N=31)		
Infection	1	3.2
Mal-union	1	3.2
Complex regional pain syndrome	2	6.5
Arthritis	1	3.2
Ligamentotaxis (N=14)		
Pin tract infection	3	21.4
Mal union	1	7.1
Complex regional pain syndrome	1	7.1
Arthritis	2	14.3

Table no 11: Comparison of final result between the study groups based on Quick DASH score

Result	Ligamentotaxis		Volar plating	
	n	%	n	%
Excellent	1	7.1	12	38.7
Good	5	35.7	14	45.2
Poor	3	21.4	1	3.2
Satisfactory	5	35.7	4	12.9
Total	14	100.0	31	100.0
Chi square p value=0.02 (Significant)				



Graph 3- Final outcome

DISCUSSION

Intra-articular distal radius fractures are complex, unstable fractures that are encountered by an orthopaedic surgeon in the practice. Distal radius fractures are most frequently encountered fractures of upper limb. More than 200 years have passed since the fractures of distal end radius were described by Abraham Colles[9], yet they are one of the most challenging fractures to treat owing to its complexity and instability. He described the non-operative management of distal radius fractures which were considered to be satisfactory then. More recently, the unsatisfactory results with conservative management of distal radius fractures are attributed to loss of reduction.[10]

The restoration of articular congruity, radial inclination and radial height remains the main objectives of distal radius fracture management to provide better clinical, functional outcomes in terms of mobility of wrist which is pain free. Mal-union of distal radius fracture can lead to a poor functional outcome with residual pain, loss of motion, reduced grip strength, midcarpal instability, and post-traumatic arthritis. Recent studies have shown that there is a strong relationship between the anatomical alignment of fracture fragments and functional outcome on a long term basis.[11]

Various surgical modalities are available for management of distal radius fractures like percutaneous pinning, ligamentotaxis and open reduction & internal fixation with volar or dorsal plating each with their own advantages and disadvantages. The principles of external fixation involve longitudinal traction (ligamentotaxis) and most importantly, palmar translation. Longitudinal traction alone has not been shown to restore palmar tilt.[12] But it has a disadvantage of inability to reduce the fracture under vision. The advantage of open reduction and internal fixation is that, it provides direct visualization of fracture fragments and its reduction.

In this study, 45 patients with intra-articular distal radius fractures were treated surgically with ligamentotaxis and volar plating which provided favourable results.

Kerim Öner et al in their studies observed that the mean age in years for bridging external fixation was 49.92 (19–70) and in the volar locking plate group was 46.81 (19–70).[13] Xiaofei Yu et al in their study observed that the mean age was 52.0 years.[14] In our study, the mean age was 45.2 for ligamentotaxis and 45.7 for volar plating.

Chilakamary V K et al in their study observed that the average number of male patients were 15 (57.69%) and female were 11 (42.31%).[15] In our study the average number of male patients were 28 (61.3%) and female patients were 17 (38.7%).

Kerim Oner et al in their study observed that 58 (35.8%) patients had simple fall, 41 (25.3%) patients had fall from height, 27 (16.7%) patients had occupational accident, 22 (13.6%) patients had in-vehicle traffic accident, and 14 (8.6%) patients had non-vehicle traffic accident.[13] Chilakamary V K et al observed that the number of cases due to road traffic accidents was 61.53% and 34.61% were due to falls.[15] In our study we observed that 5 (35.7%) patients in ligamentotaxis group and 11 (35.5%) patients in volar plating group had simple fall whereas 9 (64.3%) patients and 20 (64.5%) patients had road traffic accidents.

John H. Williksen et al in their study observed that the average Quick DASH score was 11 in external fixator and was 9 in volar plating group.[16] Xiaofei Yu et al in their study observed that the Quick DASH score was 16 ± 12 in the external fixation group and 12 ± 15 points in the volar locking group (p = 0.162).[14] Kerim Öner et al in their study observed that the Quick DASH score was 5.41 (3.802) in bridging external fixator group and 4.94 (3.12) in volar plating group.[13] In our study it was observed that the mean Quick DASH score in ligamentotaxis group was 18.4 and in that of volar plating group was 9.5 which was significant (p <0.05)

The primary objective of this study was to assess the

functional outcome of intra-articular distal radius fractures treated surgically using ligamentotaxis or volar plating and to assess their post-operative complications which was well fulfilled in our study.

CONCLUSION

- The treatment of intra-articular distal radius fractures with open reduction and internal fixation with volar plating provided excellent to good results in terms of functional outcome assessed on the basis of Quick DASH score at 6 months follow up.
- The treatment of intra-articular distal radius fractures with ligamentotaxis provided good to satisfactory results in terms of functional outcome assessed on the basis of Quick DASH score at 6 months follow up.
- There were minor complications observed in each group assessed at 6 months follow up which were addressed appropriately. The number of patients with such complications were comparatively more in ligamentotaxis group.
- Hence to conclude, the treatment of intra-articular distal radius fracture with open reduction and internal fixation with volar plating provides better functional outcome than with ligamentotaxis.

SUMMARY

- Among 45 patients, 31 (69%) patients were treated with ORIF with volar plating and 14 (31%) patients were treated with ligamentotaxis.
- Number of female patients were higher than male patients with a mean age of 45.2 for ligamentotaxis group and 45.7 for volar plating group.
- Right wrist was the most affected wrist.
- Mode of injury was a fall on an outstretched hand in 5 (35.7%) patients and road traffic accident in 9 (64.3%) patients in ligamentotaxis group and in volar plating group, mode of injury was a fall on an outstretched hand in 11 (35.5%) patients and road traffic accident in 20 (64.5%) patients.
- Among 14 patients in ligamentotaxis group 1 (7.1%) patient had Frykman type 4 fracture, 2 (14.3%) patients had Frykman type 5 fracture, 3 (21.4%) patients had Frykman type 6 fracture, 3 (21.4%) patients had Frykman type 7 fracture and 5 (35.7%) patients had Frykman type 8 fracture.
- Among 31 patients in volar plating group 7 (22.6%) patients had Frykman type 3 fracture, 7 (22.6%) patients had Frykman type 4 fracture, 3 (9.7%) patients had Frykman type 5 fracture, 6 (19.4%) patients had Frykman type 6 fracture, 2 (6.5%) patients had Frykman type 7 fracture, and 6 (19.4%) patients had Frykman type 8 fracture.
- The mean duration between time of injury and surgery was 2.64 days in ligamentotaxis group and in that of volar plating group was 2.71 days.
- The average Quick DASH score for ligamentotaxis group was 18.4 and in volar plating group was 9.5 with a p value of 0.02 ($p < 0.05$) which is statistically significant.
- Among 14 patients in ligamentotaxis group, 7 (50%) patients had complications, 3 (21.43%) patients had pin tract infections, 1(7.1%) patient had mal-union, 1(7.1%) patient had complex regional pain syndrome and 2 (14.3%) patients had arthritis.
- Among 31 patients in volar plating group, 1 (3.2%) patient had infection, 1 (3.2%) patient had mal-union, 2 (6.5%) patients had complex regional syndrome, 1 (3.2%) patient had arthritis.

Case 1: 45 year male patient with right intra-articular distal radius fracture treated with ligamentotaxis.

Fig 14- Pre-operative X-Ray

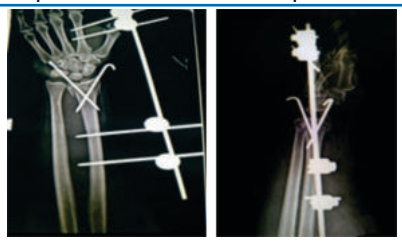


Fig 15- Post-operative X-Ray

Case 2- 39 year male with intra-articular distal radius fracture treated with ORIF with volar plating.

Fig 16- Pre-operative X- Ray

Fig 17- Check X-Ray

Fig 18- Follow up at 6 months

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