



ORIGINAL RESEARCH PAPER

Orthopaedics

ANALYSIS OF FUNCTIONAL OUTCOME OF VOLAR LOCKING PLATE IN THE MANAGEMENT OF INTRA - ARTICULAR DISTAL END RADIUS FRACTURES

KEY WORDS:

Dr. Manish Thangaraj

Orthopaedic Resident, RNT Medical College, Udaipur

Dr. Mahendra Prakash Jain

Associate Professor, RNT Medical College Udaipur

INTRODUCTION

Fractures of the distal end of the radius continue to pose a therapeutic challenge¹. Intra-articular and extra-articular malalignment can lead to various complications like post-traumatic osteoarthritis, decreased grip strength and endurance, as well as limited motion and carpal instability².

Open reduction and internal fixation is indicated to address unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation³. Palmar plating is preferred, as the screws directly buttress against collapse and loss of palmar tilt⁴.

- **Locking Compression Plates:** With fixed-angle locking plates, the locking screws support subchondral bone and resist axial forces⁵. Compression of the locking compression plate to bone is unnecessary and preserves periosteal blood supply⁶.
- **Biomechanics:** Under 100N axial load, the palmar locking compression T-plate restores stability comparable to that of an intact radius and is superior to conventional palmar or dorsal T-plates⁷.

Aims and Objectives

1. To study the functional outcome of operative management of intra-articular distal end radius fracture with locking compression plates⁸.
2. To study the effectiveness and complications of distal end radius fractures treated with locking compression plates⁹.
3. To study the efficacy and reliability of the plate¹⁰.

Review of Literature

Historically, distal radius fractures were mistaken as wrist dislocations until Colles' statement in 1814¹¹.

- **1847:** Smith first explained the "Garden spade deformity" due to volar displacement¹².
- **1965:** Ellis introduced the concept of internal fixation using a buttress plate through a volar approach^{13,14, 15}.
- **Recent Studies:**¹⁶
- **Jupiter JB (2010):** Concluded that internal fixation with locking screws results in good-to-excellent outcomes with limited complications^{17,18}.
- **Anakwe RE (2010):** Found that locked volar plating for complex distal radius fractures produces good results¹⁹.
- **Ritesh S. Pathak et al. (2018):** Showed 85% excellent results using the Green and O'Brien system²⁰.

MATERIALS AND METHODS

- **Study Design:** A prospective study of forty patients with intra-articular distal end radial fractures²¹.
- **Location:** Department of Orthopaedics, R.N.T. Medical College, Maharana Bhupal Hospital, Udaipur, Rajasthan²².
- **Duration:** July 2024 to May 2025²³.
- **Follow-up:** Up to 9 months²⁴.
- **Inclusion Criteria:** Adults (20-60 years), intra-articular fractures, willing to give informed written consent²⁵.
- **Surgical Procedure:** Open reduction and internal fixation using a Volar Locking Compression Plate via the Modified Henry's (AO) approach²⁶.

- **Post-operative Care:** Wrist mobilization started 1-week post-op; strengthening exercises started 6 weeks post-op²⁷.
- **Assessment:** Functional outcome was assessed using the Modified Mayo Wrist Scoring System²⁸.

OBSERVATIONS AND RESULTS

Table No. 1: Age and Gender wise Distribution of Patients²⁹

Age group (yrs)	Female (No.)	Female (%)	Male (No.)	Male (%)	Total (No.)	Total (%)
<21	0	0.00%	2	7.41%	2	5.00%
21-30	7	53.85%	14	51.85%	21	52.50%
31-40	4	30.77%	6	22.22%	10	25.00%
41-50	2	15.38%	5	18.52%	7	17.50%
Total	13	100.00%	27	100.00%	40	100.00%

Table No. 2: Occupation and Gender wise Distribution of Patients³⁰

Occupation	Female (No.)	Female (%)	Male (No.)	Male (%)	Total (No.)	Total (%)
Farmer	1	7.69%	7	25.93%	8	20.00%
Housewife	10	76.92%	0	0.00%	10	25.00%
Postman	0	0.00%	1	3.70%	1	2.50%
Salesman	0	0.00%	2	7.41%	2	5.00%
Student	2	15.38%	7	25.93%	9	22.50%
Worker	0	0.00%	10	37.04%	10	25.00%
Total	13	100%	27	100%	40	100%

Table No. 3: Side of Injured Hand and Gender wise Distribution of Patients³¹

Side of Injured Hand	Female (No.)	Female (%)	Male (No.)	Male (%)	Total (No.)	Total (%)
Left	6	46.15%	9	33.33%	15	37.50%
Right	7	53.85%	18	66.67%	25	62.50%
Total	13	100%	27	100%	40	100%

Table No. 4: Mode of Injury and Gender wise Distribution of Patients³²

Mode of Injury	Female (No.)	Female (%)	Male (No.)	Male (%)	Total (No.)	Total (%)
RTA	4	30.77%	21	77.78%	25	62.50%
SELF FALL	9	69.23%	6	22.22%	15	37.50%
Total	13	100%	27	100%	40	100%

Table No. 5: AO Classification and Gender wise Distribution of Patients³³

AO Classification	Female (No.)	Female (%)	Male (No.)	Male (%)	Total (No.)	Total (%)
B1	1	7.69%	5	18.52%	6	15.00%
B2	1	7.69%	12	44.44%	13	32.50%
B3	3	23.08%	6	22.22%	9	22.50%
C1	4	30.77%	1	3.70%	5	12.50%
C2	4	30.77%	3	11.11%	7	17.50%
Total	13	100%	27	100%	40	100%

Table No. 6: Duration of Operation From Date of Injury³⁴

Duration	No. of Cases	Percentage
1-5 days	36	90%
6-10 days	4	10%

Table No. 7: Complications and Gender wise Distribution of Patients³⁵

Complications	Female (No.)	Female (%)	Male (No.)	Male (%)	Total (No.)	Total (%)
Delayed Union	0	0.00%	1	3.70%	1	2.50%
Infection	0	0.00%	1	3.70%	1	2.50%
Stiffness	3	23.08%	0	0.00%	3	7.50%
Nil	10	76.92%	25	92.59%	35	87.50%
Total	13	100%	27	100%	40	100%

Table No. 8: Duration of Fracture Union³⁶

Time of Union	No. of Cases	Percentage
2-3 months	32	80%
3-4 months	6	15%
>4 months	2	5%

Table No. 9: PAIN (Functional Outcome at 9 Months)³⁷

CHARACTER	No. of Cases	Percentage
NO PAIN	37	92.5%
MILD	03	7.5%
MODERATE	NIL	NIL
SEVERE	NIL	NIL
TOTAL	40	100%

Table No. 10: RANGE OF MOVEMENTS (Functional Outcome at 9 Months)³⁸

% OF ROM COMPARED TO OPPOSITE SIDE	No. of Cases	Percentage
100%	05	12.5%
75-99%	25	62.5%
50-74%	10	25%
0-49%	00	00%
TOTAL	40	100%

Table No. 11: RETURN TO WORK (Functional Outcome at 9 Months)³⁹

Status	No. of Cases	Percentage
REGULAR WORK	24	60%
RESTRICTED WORK	15	37.5%
ABLE TO WORK UNEMPLOYED	01	2.5%
UNABLE TO WORK DUE TO PAIN	00	00%
TOTAL	40	100%

Table No. 12: GRIP STRENGTH (Functional Outcome at 9 Months)⁴⁰

% OF OPPOSITE SIDE GRIP STRENGTH	No. of Cases	Percentage
100%	15	37.5%
75-99%	25	62.5%
50-74%	00	0%
0-49%	00	0%
TOTAL	40	100%

Table No. 13: Modified Mayo Wrist Scoring System and AO Classification at Three Months Follow-up⁴¹

AO Class	Excellent	Good	Fair	Poor (No. / %)
B1 (6)	-	-	2 (15.38%)	4 (14.81%)
B2 (13)	-	-	4 (30.77%)	9 (33.33%)
B3 (8)	-	-	3 (23.08%)	5 (18.52%)
C1 (5)	-	-	1 (7.69%)	4 (14.81%)
C2 (7)	-	-	3 (23.08%)	4 (14.81%)
C3 (1)	-	-	0 (0.00%)	1 (3.70%)
Total (40)	-	-	13 (32.50%)	27 (67.50%)

Table No. 14: Modified Mayo Wrist Scoring System and AO Classification at Six Months Follow-up⁴²

AO Class	Excellent	Good	Fair	Poor
B1 (6)	1	-	5	-
B2 (13)	-	1	12	-
B3 (8)	2	-	6	-
C1 (5)	-	1	4	-
C2 (7)	-	-	7	-
C3 (1)	-	-	-	1
Total (40)	3 (7.50%)	2 (5%)	34 (85%)	1 (2.50%)

Table No. 15: Modified Mayo Wrist Scoring System and AO Classification at Nine Months Follow-up⁴³

AO Class	Excellent	Good	Fair	Poor
B1 (6)	4	2	-	-
B2 (13)	3	7	3	-
B3 (8)	3	4	1	-
C1 (5)	1	4	-	-
C2 (7)	-	1	6	-
C3 (1)	-	-	-	1
Total (40)	11 (27.50%)	18 (45%)	10 (25%)	1 (2.50%)

Table No. 16: Outcome According to Modified Mayo Wrist Scoring System in Follow-up⁴⁴

Outcome	After 3 months	After 6 months	After 9 months
Excellent	-	3 (7.50%)	11 (27.50%)
Good	-	2 (5.00%)	19 (47.50%)
Fair	12 (30.00%)	34 (85.00%)	9 (22.50%)
Poor	28 (70.00%)	1 (2.50%)	1 (2.50%)

Table No. 17: Outcome According to Modified Mayo Wrist Scoring System and Gender wise Distribution⁴⁵

Outcome	Female (No.)	Female (%)	Male (No.)	Male (%)	Total (No.)	Total (%)
Excellent	1	7.69%	10	37.04%	11	27.50%
Good	9	69.23%	10	37.04%	19	47.50%
Fair	3	23.08%	6	22.22%	9	22.50%
Poor	0	0.00%	1	3.70%	1	2.50%
Total	13	100%	27	100%	40	100%

DISCUSSION

- **Age Distribution:** In our study, distal radial fracture was more common in the 3rd to 5th decade with an average of 42.5 years⁴⁶. This is comparable to studies by Ayhan Kilic et al. (45 years), Kevin C. Chung et al. (48.9 years), and Anakwe et al. (48 years)⁴⁷.
- **Complications:** We encountered a complication rate of 12.5%⁴⁸. Stiffness was developed in 3 (7.5%) patients, and 1 (2.5%) had delayed union and infection⁴⁹. This is comparable to Ayhan Kilic et al. (11.1%) and Kevin C. Chung et al. (9.1%)⁵⁰.
- **Functional Outcome:**
- **3 Months:** 70% of patients had poor grading⁵¹.
- **6 Months:** Results improved significantly, with 85% having fair results⁵².
- **9 Months:** 72% had good to excellent grades, and 22.50% had fair grades⁵³.
- In our series, we had 27.5% excellent, 47.5% good, 22.5% fair, and 2.5% poor results⁵⁴. This is comparable to Ayhan Kilic et al., who reported 44.4% excellent and 44.4% good results⁵⁵.

CONCLUSION

The present study has shown excellent results with minor complications in various fractures of the younger group of patients with good bone stock⁵⁶. However, longer follow-up is required to see the long-term effects of these plates⁵⁷.

We conclude that the assessment of functional outcome by the Modified Mayo Wrist Score in intra-articular distal end radius fracture managed by plate osteosynthesis gives an excellent scoring system to assess the outcome of comminuted intra-articular distal radius fractures with reference to the function of the hand and wrist of the individual⁵⁸.

REFERENCES

1. Fitoussi F and Chow S.P. Treatment of displaced Intra articular fractures of the distal end of Radius with Plates⁵⁹.
2. Gerostathopoulos Nicolaos et al. Trimed Fixation system for Displaced fractures of the Distal Radius⁶⁰.
3. Ruch David S. Fractures of the distal Radius and Ulna⁶¹.
4. Crenshaw Andrew H. Jr. Fractures of shoulder, arm, and forearm⁶².
5. Gartland JJ, Werley CW: Evaluation of healed Colles' fractures⁶³.
6. Jupiter JB et al. Operative management of distal radial fractures with 2.4-millimeter locking plates⁶⁴.
7. Anakwe RE et al. Locked volar plating for complex distal radius fractures: Patient reported outcomes and satisfaction⁶⁵.
8. Gupta V Ritesh et al. A prospective study on clinical and functional outcome of fracture distal end radius managed by volar plate⁶⁶.