A comparative study of volar locking plate versus external fixation for displaced intra-articular distal end radius fractures: A prospective study

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Abstract

Background: Distal radius fracture is more common accounting for 1/6th of all the fractures. With this background, this study was carried out to compare the functional outcome of volar locking plate and external fixator to the displaced intra-articular distal end radius fractures using Modified Mayo Wrist Score (MMWS).

Materials and methods: This study included those patients with distal radius fracture attending the Orthopaedic clinic at SIMS, during July 2018 till December 2018. Patients were randomised based on even and odd day of the week. This included two set of group with twenty patients in each group - one with volar locking plating and other with external fixation. Patients were followed up at 6 months and 1 year. At each follow up, the pain and range of movements were assessed by MMWS score which was entered in Microsoft excel and analysed in SPSS 20.

Results: At the end of one year after surgery, we observed that external fixation technique was superior for treating displaced intra-articular comminuted distal end radius fractures than volar locking plate.

Conclusion: External fixator showed more advantageous than volar locking plates after 1 year of follow up.

Keywords: Distal end radius fracture, volar locking plate, external fixator, MMWS score

Introduction

The most common fracture in daily orthopaedic practice is distal radius fracture which accounts for 1/6th of all the fractures. There were days, where fractures were treated by closed reduction and immobilization with casts, surprisingly the same is being practiced in rural set up [1-3]. Though union of these fractures progresses, there occurs many sequelae. Most common are high incidence of mal-union and wrist joint instability which is more likely among comminution & intra articular extension cases. There is change in trend, where, youth are being the prey of Road Traffic Accident and trauma, leading to more complicated fractures with intra-articular extension and comminution. Hence the management of distal radius fractures changed from cast immobilisation to operative interventions [4-7]. With this background, this study was conducted to compare the effect of volar plating and external fixation for distal end radius fractures with intra-articular extension.

In the meta-analysis done by Zvi Margaliot and colleagues in the year 2005, which included 46 papers, with 916 patients treated by external fixation and 603 by internal fixation, the authors could find no evidence to support one treatment method superior over the other [8]. Walenkamp MM in 2013 along with his colleagues conducted a meta-analysis which observed that better functional outcome was among those patients with unstable distal radius fractures treated with a volar locking plate compared to external fixation at 3, 6 and 12 months follow-ups [9].

Objective

To compare the functional outcome of volar locking plate and external fixator to the displaced intra-articular distal end radius fractures using MMWS score.
Materials and Methods
A prospective study was planned and the protocol was presented for Institutional Ethical Committee. After ethical committee clearance, the study was carried out between July 2018 and Dec 2018, among those patients who attended the orthopaedic clinic with distal radius fractures at SIMS, Bengaluru. The study was explained to the patient and respective attenders, in the language understood by them, after obtaining the written consent, the procedure was carried out. The patient criteria for inclusion in this study were age >18 years without any other skeletal injury and with Frykman’s type III, IV, VII, VIII. Patients with any other associated injury/fracture, bilateral distal radius fractures, open fractures of distal radius and associated head injury were excluded from the study.

Classification of fracture distal end of radius
Frykman’s classification [10,11],
1. Type I: Extra articular radial fracture
2. Type II: Extra articular radial fracture + Ulnar styloid fracture
3. Type III: Intra articular fracture of the radio carpal joint.
4. Type IV: Intra articular fracture of the radio carpal joint + Ulnar styloid fracture.
5. Type V: Fracture of the radio-ulnar joint
6. Type VI: Fracture of the radio-ulnar joint + Ulnar styloid fracture.
7. Type VII: Intra articular fracture involving both radiocarpal and radioulnar joints.
8. Type VIII: Intra articular fracture involving both radiocarpal and radioulnar joints with an ulnar styloid fracture.

During the study period, 42 such patients were enrolled. Among whom two were lost to follow up inspite of telephonic contact after surgery. Hence 40 were in this study who were randomised based on the even and odd day of the week and Sunday was considered based on the odd and even Sunday of the month. All even day patients underwent volar plating technique and odd day patients underwent external fixator. By this technique, equal distribution of patients was found over a period of time among both the groups. All surgical procedures were performed by a single surgeon in our institute using standard protocols under general or regional anaesthesia. The patients of both the groups were under appropriate antibiotic coverage and were regularly checked the dressing and advised for active finger movements. They were discharged after two days of surgery. The patients were followed up for check dressing for every 4th day and suture removal was done on 14th post-operative day and reduction was confirmed radiologically after 10 days. Acceptable criteria for fracture reduction were:
Radial inclination of >15°.
Radial shortening of <5 mm compared to the contralateral side.
Sagittal tilt between 15° dorsal and 20° volar tilt.
Intra-articular step-off of <2 mm.

After discharge, all these enrolled patients were followed up at 6 weeks, 3 months, 6 months and 1 year after surgery. During these visit, the pain, grip strength, wrist range of motion (ROM) and satisfaction was assessed by MMWS scoring system.
Clinical assessment was done by Modified Mayo Wrist Score [12] scoring system
MMWS is a modification of Green and O Brien score. It is a clinician completed scoring system used to evaluate the level of disability in the wrist by assessing pain, functional status [able to work], range of motion and grip strength. There is total of 100 points which are divided among evaluaters assessment of pain [25points], active flexion/extension arc as a percentage of opposite side [25 points], grip strength as percentage of opposite side [25 points] and ability to return to regular employment or activities [25 points]. Total points are added and graded as 90-100 excellent, 80-90 good, 60-80 fair, below 60 poor.

Statistical analysis
These data were entered in Microsoft Excel and analysed in SPSS 20. Appropriate statistical tests were applied.

Results
The mean age of our study sample was 45.95± 9.23 years. We expected male to be predominant in the study but surprisingly 62.5% were females and only 37.5% were males. Majority were right-sided fracture accounting for 65%.
Among Frykman’s classification 3, 4, 7 and 8 type, type 3 and 4 were 60% of the fracture, were both shared equal contribution (30% of each type of fractures). They underwent volar locking compression plate and external fixation procedure as per the randomization method. Later these patients were followed up monthly initially and biannually data was documented. This biannual assessment was made using Mayo Modified Wrist Score (MMWS) at 6 months and 1 year follow up visits. These rating was entered in Microsoft excel and analysed in SPSS20. The overall data was categorized as excellent, good, fair and poor.

Table 1: MMWS score and percentage at 6months and 1 year.

| Sl. No. | Categorization | Aggregate score at 6 months | Aggregate score at 1 year |
|--------|----------------|-----------------------------|----------------------------|
|        | Score | Percentage | Score | Percentage |
| 1.     | Excellent | 2 | 5.0 | 3 | 7.5 |
| 2.     | Good | 3 | 7.5 | 16 | 40.0 |
| 3.     | Fair | 16 | 40.0 | 15 | 37.5 |
| 4.     | Poor | 19 | 47.5 | 6 | 15.0 |
|        | Total | 40 | 100 | 40 | 100 |

Table 2: Shows MMWS score by Frykmans classification at 6months and 1year.

| Sl. No. | Fracture type (according to Frykmans' classification) | Score of MMWS at 6 months | Score of MMWS at 1 year |
|---------|------------------------------------------------------|---------------------------|-------------------------|
| 1.      | III                                                  | Excellent 0 | Good 1 | Fair 8 | Poor 3 | 0.097 | Excellent 1 | Good 6 | Fair 4 | Poor 2 |
| 2.      | IV                                                   | 0 | 2 | 0 | 4 | 6 | 0.816 | 2 | 4 | 4 | 2 |
| 3.      | VII                                                  | 0 | 2 | 0 | 2 | 1 | 5 | 0 | 4 | 2 | 2 |
Two patient in the volar locking plate group developed complex regional pain syndrome type 1 that improved within 4 to 6 months by physiotherapy and analgesics.

One year after surgery, 60% of patients treated with external fixation and 35% of patients with volar plating had an excellent or good result according to the MMWS score. And 40% of volar locking plate had fair results and 35% of external fixator had fair results.

We observed there was improvement in pain, ROM and grip strength in volar locking plate and external fixator from 6 months and the final score at 1 year follow up.

We observed a significant reduction in pain, increased ROM, grip strength, activity and final score after 1 year follow-up compared to that at 6 month follow-up in the external fixation group.

Although there was no significant difference in pain, ROM, grip strength, activity and final outcome in patients at 6 months after surgery using either of these two techniques, we observed low ROM in patients treated with volar locking plates compared to those treated by external fixation.

However, at 1 year, we observed a significant increase in ROM, grip strength and final outcome in patients treated with external fixation compared to patients treated with volar locking plates.

Five patients presented with reduced ROM at 6 months post operative which gradually improve with physiotherapy. In them 4 were treated by volar locking plate and 1 was treated by external fixator.

One patient with external fixation which was removed at 10th week which landed in collapse of the fragment at 12th week which underwent volar locking plating, mostly because of early weight lifting and early return to work.

In conclusion, acceptable radiological reduction was achieved in all patients with minimal surgical time and surgical exposure with external fixation. Volar locking has superiority in case of stability and early mobilisation but had poor results in total articular comminution whereas external fixation was better for comminuted intra articular displaced distal end radius fracture. So we recommend External fixation technique for treating displaced intra-articular totally comminuted distal end radius fractures and volar plating for minimal intra articular comminution.

References
1. Jupiter JB. Fractures of the distal end of the radius. J Bone Jt Surg Am. 1991; 73:461-469. [PubMed] [Google Scholar]
2. Lichtman DM, Bindra RR, Boyer MI, Putnam MD, Ring D. Distal radius work group: the treatment of distal radius fractures. J Am Acad Orthop Surg. 2010; 18:180–189. [PubMed] [Google Scholar]
3. Handoll HH, Huntley JS, Madhok R. External fixation versus conservative treatment for distal radial fractures in adults. Cochrane Database Syst Rev. 2007; 18(3):CD006194. [PubMed] [Google Scholar]
4. Slutsky DJ. External fixation of distal radius fractures. J Hand Surg Am. 2007; 32:1624–1637. Doi: 10.1016/j.jhsa.2007.09.009. [PubMed] [CrossRef] [Google Scholar]
5. Chung KC, Watt AJ, Kotsis SV, Margaliot Z, Haase SC, Kim HC. Treatment of unstable distal radial fractures with the volar locking plating system. J Bone Jt Surg Am. 2006; 88:2687-2694. Doi: 10.2106/JBJS.E.01298. [PubMed] [CrossRef] [Google Scholar]
6. Schnall SB, Kim BJ, Abramo A, Kopylov P. Fixation of distal radius fractures using a fragment-specific system. Clin Orthop. 2006; 445:51–57. [PubMed] [Google Scholar]
7. Konstantinos CX, Dionysios AV, Konstantinos JK. Classifying fractures of the distal radius: impossible or unnecessary? Review of the literature and proposal of a grouping system. Med Sci Monit. 2009; 15(3):RA67–RA74. [PubMed] [Google Scholar]

8. Margaliot Z, Haase SC, Kotisis SV, Kim HM, Chung KC. A meta-analysis of outcomes of external fixation versus plate osteosynthesis for unstable distal radius fractures. J Hand Surg Am. 2005; 30:1185–1199. doi: 10.1016/j.jhsa.2005.08.009. [PubMed] [CrossRef] [Google Scholar]

9. Walenkamp MM, Benthoami A, Beerkamp MS, Peters RW, van der Heiden R, Goslings JC, Schep NW. Functional outcome in patients with unstable distal radius fractures, volar locking plate versus external fixation: a meta-analysis. Strategies Trauma Limb Reconstr. 2013; 8(2):67–75. doi: 10.1007/s11751-013-0169-4. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

10. Rikli DA, Kupfer K, Regazzoni P. The role of External fixation in management of wrist Fractures. Techniques in Orthopaedics, Lippincott Williams & wilkins 2002; 17(2):262-270.

11. Frykmann Bassett RL. Displaced intra articular fractures of distal radius. Clin Ortho. 1985; 214:148-52.

12. Cooney WP, Busrey R, Dohyns JH, Linscheid RL. Difficult wrist fractures perulate fracture-dislocations of the wrist. Clin Orthop Relat Res. 1987; 214:136-147

13. Gradl G, Gradl G, Wендt M, Mittlmeier T, Kundt G, Jupiter JB. Non-bridging external fixation employing multplanar K-wires versus volar locked plating for dorsally displaced fractures of the distal radius. Arch Orthop Trauma Surg. 2013; 133(5):595–602. doi: 10.1007/s00402-013-1698-5. [PubMed] [CrossRef] [Google Scholar]

14. Kapoor H, Agarwal A, Dhaon BK. Displaced intra-articular fractures of distal radius: a comparative evaluation of results following closed reduction, external fixation and open reduction with internal fixation. Injury. 2000; 31:75-79. doi: 10.1016/S0020-1383(99)00207-7. [PubMed] [Cross Ref] [Google Scholar]

15. Westphal T, Platek S, Schubert S, Winckler S. Outcome after surgery of distal radius fractures: no differences between external fixation and ORIF. Arch Orthop Trauma Surg. 2005; 125:507-514. doi: 10.1007/s00402-005-0023-3. [PubMed] [Cross Ref] [Google Scholar]

16. Wolfe SW. Patterns and treatment of distal radius fractures. In: Proceedings of the AAOS/ASH update on the painful and injured wrist. May 29–30, Rosemont, IL, 2009, 66.

17. Grewal R, Mac Dermid JC, King JC, Faber KJ. Open reduction internal fixation versus percutaneous pinning with external fixation of distal of distal radius fractures: a prospective, randomized clinical trial. J Hand Surg. 2011; 36:1899-1906. doi: 10.1016/j.jhsa.2011.09.015. [PubMed] [CrossRef] [Google Scholar]

18. Kamano M, Honda Y, Kazuki K, Yasuda M. Palmar plating for dorsally displaced fractures of the distal radius. Clin Orthop Relat Res. 2002; 397:403-408. doi: 10.1097/00003086-20020400-00047. [PubMed] [Cross Ref] [Google Scholar]

19. Landgren M, Jerrhag D, Tägil M, Kopylov P, Geijer M,Abramo A. External or internal fixation in the treatment of non-reducible distal radial fractures? A 5-year follow-up of a randomized study involving 50 patients. Acta Orthop. 2011; 82:610-613. doi: 10.3109/17531934.2010.552781. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

20. Wilcke MK, Abbaszadegan H, Adolphson PY. Wrist function recovers more rapidly after volar locked plating than after external fixation but the outcomes are similar after 1 year. Acta Orthop. 2011; 82:76-81. doi: 10.3109/17531934.2010.552781. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

21. Kumbaraci M, Kucuk L, Karapinar L, Kurt C, Coskunol E. Retrospective comparison of external fixation versus volar locking plate in the plate in the treatment of unstable intra-articular distal radius fractures. Eur J Orthop Surg Traumatol. 2013; 24(2):173-178. doi: 10.1007/s00590-012-1155-0. [PubMed] [CrossRef] [Google Scholar]

22. Marcheix PS, Dotzis A, Benkő PE, Siegler J, Arnaud JP, Charissoux JL. Extension fractures of the distal radius in patients older than 50: a prospective and randomized study comparing fixation using mixed pins or a palmar fixed-angle plate. J Hand Surg (Eur) 2010; 35(8):646-651. doi: 10.1177/1753193410364179. [PubMed] [CrossRef] [Google Scholar]

23. Wei DH, Raizman NM, Bottino CJ, Jobin CM, Strauch RJ, Rosenwasser MP. Unstable distal radial fractures treated with external fixation, a radial column plate, or a volar plate. J Bone Jt Surg. 2009; 91-A:1568–1577. Doi: 10.2106/JBJS.H.00722. [PubMed] [CrossRef] [Google Scholar]