International Journal of Research in Orthopaedics
Hanumanthappa PT et al. Int J Res Orthop. 2021 Jul;7(4):768-772
http://www.ijoro.org

Original Research Article

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20212419

Radiological outcomes of AO type B and C distal radius fractures managed with 2.7 mm volar locking plate fixation in geriatric population: a retrospective analysis

Prakashappa Thamalehally Hanumanthappa, Bharath Raja B. S., Muthu Kishore Marichamy*

Department of Orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Bangalore, Karnataka, India

Received: 03 April 2021
Accepted: 05 May 2021

***Correspondence:**
Dr. Muthu Kishore Marichamy,
E-mail: kismuth007@gmail.com

ABSTRACT

Background: Distal end radius fractures are one of the most common fractures. Compared to younger patients, elderly with distal radius fractures with osteoporosis and higher comminution compromise the treatment outcomes. Anatomic reduction with stable fixation is usually the choice of treatment for displaced intra-articular fractures. While osteoporosis and poor bone quality hamper fracture stabilization, locking compression plates (LCPs) provide enhanced stability and axial loading force as compared to conventional plates. The current study retrospectively analysed the postoperative radiological outcomes in a 2.7 mm volar LCP system used for internal stabilisation of intra articular distal radius fractures.

Methods: A retrospective study was conducted in the Sanjay Gandhi institute of trauma and orthopaedics, Bangalore from June 2018 to July 2020. All Arbeitsgemeinschaft für Osteosynthesefragen (AO) type B and C distal radius fractures of patients aged 60 and above who underwent 2.7 mm volar locking plate fixation during that time period were analysed with X-rays at immediate post-operative, six weeks and three months. The radiological outcome was scored based on Sarmiento's modification of Lindstorm criteria.

Results: The mean immediate post-operative radial shortening, decrease in radial deviation and loss of palmar tilt were 3.80±1.03, 4.38±1.05 and 3.97±1.02, respectively. The corresponding values at last follow up were 4.31±1.12, 6.19±1.02 and 4.76±0.99, respectively. No statistically significant difference (p=0.949; p=1.0; p=0.996) in radial shortening, loss of radial deviation and decrease in palmar angulation was seen till the final follow up. Sarmiento's modification of Lindstorm criteria showed a good radiological outcome in 80% and excellent in 20%.

Conclusions: Use of 2.7 mm volar LCP showed good to excellent post-operative radiological outcomes in geriatric population. The fracture reduction achieved in the immediate post-operative period is maintained throughout the follow up duration without any significant change.

Keywords: Distal end radius fractures, AO type B and C, Geriatric population, 2.7 mm LCP, Radiological outcome,

INTRODUCTION

Distal end radius fractures are one of the most common fractures encountered by the orthopaedic surgeon with a bimodal age distribution. Compared to younger patients, elderly with distal radius fractures have usually poorer bone quality and higher comminution which may compromise the treatment outcome. Management for distal radius fractures has evolved significantly over the years. Closed manipulative reduction and below elbow cast application has been the main treatment especially for the elderly people.[1] However, the outcomes are often less than satisfactory with loss of reduction, limitation of function and disabilities. Several studies have shown that

after a distal radius fracture, patients function more effectively when the anatomy is restored.[2] So, anatomic reduction with stable fixation is usually the choice treatment for displaced intra-articular fractures. While osteoporosis and poor bone quality hamper fracture stabilization, locking compression plates (LCPs) provide enhanced stability and axial loading force as compared to conventional plates.[3-5] The current study retrospectively analysed the post-operative radiological outcomes in a 2.7 mm volar LCP system used for internal stabilisation of distal radius fractures based on the Sarmiento's modification of Lindstorm criteria.[6]

METHODS

This is a retrospective study conducted at Sanjay Gandhi institute of trauma and orthopaedics, Bangalore. The sample comprised of 25 patients. All patients aged 60 years and over with closed, intraarticular distal radius fractures (AO type B and C) treated with 2.7 mm volar locking plate fixation between June 2018 to July 2020 were included in study.[7] The exclusion criteria were distal radius AO classification type A, bilateral distal radius fractures, poly-trauma patients with an injury severity score of more than 16, concomitant distal ulna fractures with metaphyseal involvement, same-side upper limb injury that affected the overall functional outcome or an open fracture, patients in whom bone grafting or bone substitute was used were excluded from the study to eliminate surgical-related bias.[8] A proforma was used to collect data pertaining to patient demographics, procedure details, mode of injury, type of fracture, duration and type of immobilisations and complications once they have provided their written informed consent.

Figure 1: Pre-operative X-ray in anteroposterior and true lateral views showing distal radius fracture.

The radiographic assessment was the prime outcome. So, X-ray of the wrist in the anteroposterior and true lateral views taken pre-operatively, immediate post-operative, six weeks and three months were assessed (Figure 1-4). Radiographic measurements were performed by two independent observers on digital radiographs with the help of a computer software according to the methods of Medoff and mean values were obtained.[9] The radiological outcome was scored based on the Sarmiento's modification of Lindstorm criteria which comprised of recording and grading palmar tilt, radial angulation, articular congruency and radial length.[6] Analysis was done using descriptive statistics. Difference between data of follow up intervals was estimated by student's paired t test. A statistical package SPSS version 17.0 and MS excel was used to do the analysis. A p value <0.05 was considered as significant with a 95% confidence interval.

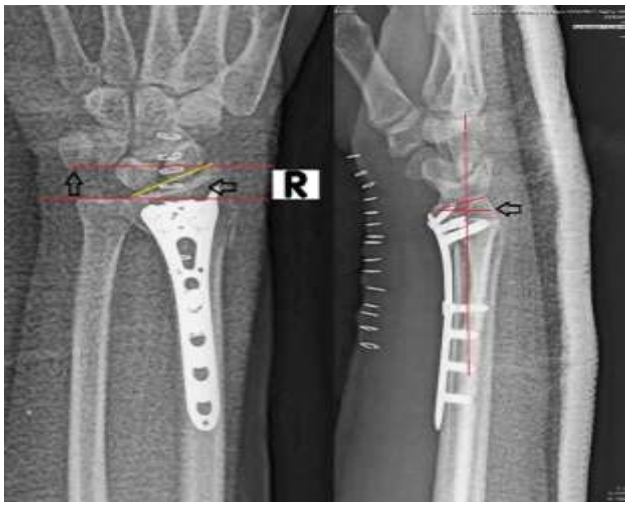

Figure 2: Immediate post-operative X-ray in posterior-anterior and true lateral views after open reduction and internal fixation with 2.7 mm volar LCP with measurements of radial length (red), radial deviation (yellow) and palmar angulation (red).

Figure 3: Six weeks follow up X-ray in true lateral and antero-posterior views after open reduction and internal fixation with 2.7 mm volar LCP with measurements of radial length (red), radial deviation (yellow) and palmar angulation (red).

Figure 4: Three months follow up X-ray in antero-posterior view after open reduction and internal fixation with 2.7 mm volar LCP with measurements of radial length (red), radial deviation (yellow).

RESULTS

All 25 patients underwent the surgical procedure under regional anaesthesia and within a week after the injury. The modified Henry's approach was used. The limb was immobilised in a below elbow plaster splint until suture removal on the eleventh or the twelfth post-operative day. Active finger movements were initiated early followed by wrist mobilisation after three to four weeks, check X-rays of the wrist in the anteroposterior and true lateral views were taken in the immediate post-operative, six weeks and three months. The study comprised of sixteen (64%) females and nine males (36%). The mean age was 70.28±6.39 with range being 60 to 84 years. Slip and fall on an out stretchered hand from standing height (72%) was the most common mode of injury. With AO type B3 (60%) being the most common type of fracture pattern.

Post-operative check X-ray were analysed at immediate post-operative, six weeks and three months. The mean immediate post-operative radial shortening, loss of radial deviation and decrease in palmar tilt were 3.80±1.03, 4.38±1.05and 3.97±1.02, respectively. The corresponding values at last follow up were 4.31±1.12, 6.19±1.02 and 4.76±0.99, respectively (Table 1). No statistically significant difference (p=0.949; p=1.0; p=0.996) in radial shortening, decrease in palmar angulation and loss of radial deviation was seen at the final follow up. These parameters were then graded and scored using the Sarmiento's modification of Lindstorm criteria to assess the radiological outcome which showed that majority had a good outcome (80%, N=20) and excellent in 20% (N=5) (Table 2).

Table 1: The average immediate post-operative, 6 weeks and final follow up radiographic parameters.

Time interval	Radial shortening (in mm)	Loss of radial deviation (in degrees)	Loss of palmar tilt (in degrees)
Average immediate post-operative value	3.80±1.03	4.38±1.05	3.97±1.02
Average value at 6 weeks follow up	4.02±1.06	5.32±1.23	4.21±1.14
Average value at 3 months follow up	4.31±1.12	6.19±1.02	4.76±0.99
P value (immediate versus 3 month follow up)	0.949	1.0	0.996

Table 2: The radiological outcome based on Sarmiento's modification of Lindstorm criteria (N=25).

Radiological outcomes	Frequency (percentage)
Excellent	5 (20)
Good	20 (80)
Fair	0
Poor	0

DISCUSSION

We all know that fracture of the distal radius especially intra articular ones requires accurate restoration of the anatomy and articular congruity. Failure to restore radiographic parameters can have a negative effect on the functional outcome. This is assessed by radiographic parameters. The late post-operative complications such as post traumatic arthritis, reduced grip strength, loss of range of motion, instability has been noted due to misalignment and failure to restore the articular congruity.[6,10]

The main impact parameters reported are volar tilt of less than 5°, radial inclination less than 20°, radial height loss greater than 6 mm and positive ulnar variance greater than 5 mm.[11-16] Moreover, maintaining these in geriatric osteoporotic fractures is a challenging task. Internal stabilisation with locking plates provides a better restoration of the radial length as well as the volar tilt in comparison to external fixation in osteoporotic bones.[17] This study has proved clearly that there is an insignificant difference in the radial height, radial inclination and the palmar tilt in the immediate post-operative and the last

follow up. This highlights the fact that the fracture reduction that was achieved in the immediate post-operative period is maintained throughout the follow up duration.

The results are in concordance with other studies conducted using a volar LCP fixation although not the 2.7 mm volar LCP or in geriatric population. Rozental et al and Konstantinidis et al found good post-operative radiological outcomes with use of LCP for distal radius fracture.[18,19] A few studies in the Indian subcontinent such as Pradhan et al in their study concluded that treatment with open reduction and internal fixation for intra articular fractures of distal end of radius provides good radiological results and Khan MS et al found that the use of volar LCPs for intra-articular distal radius fracture shows good results especially in comminuted distal radius fractures.[20,21]

The limitations of the current study were that it was retrospective, selection bias due to lack of randomization, the number of patients were low and the follow up time was short.

CONCLUSION

In conclusion, this study found that volar locking plate fixation for displaced intra-articular distal radius fractures in elderly patients was an effective procedure to maintain the radiographic parameter and in turn to obtain successful functional outcomes. Although reduction loss in volar tilt and radial height occurred within four first months, volar plate was able to maintain fracture stabilization with radiographic parameters within functional range over the time in most patients of these elderly patients.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Charnley J. The closed treatment of common fractures. 4th ed. Cambridge: Cambridge University Press; 2003.
2. Obert L, Rey P, Uhring J, Gasse N, Rochet S, Lepage D, et al. Fixation of distal radius fractures in adults: a review. Orthop Traumatol Surg Res. 2013;99(2):216-34.
3. Downing ND, Karantana A. A revolution in the management of fractures of the distal radius? J Bone Joint Surg Br. 2008;90(10):1271-5.
4. Cordey J, Borgeaud M, Perren SM. Force transfer between the plate and the bone: relative importance of the bending stiffness of the screws friction between plate and bone. Injury. 2000;31(3):21-8.
5. Voigt C, Lill H. What advantages does volar plate fixation have over K-wire fixation for distal radius extension fractures in the elderly? Unfallchirurg. 2006;109(10):845-54.
6. Sarmiento A, Pratt GAW, Berry NC, Sinclair WF. Colles' fractures. Functional bracing in supination. J Bone Joint Surg Am. 1975;57(3):311-7.
7. Müller ME, Nazarian S, Koch P, Schatzker J. The comprehensive classification of fractures of long bones. 1st ed. Berlin: Springer-Verlag; 1990.
8. Baker SP, O'Neill B, Haddon W, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma. 1974;14(3):187-96.
9. Medoff RJ. Essential radiographic evaluation for distal radius fractures. Hand Clin. 2005;21(3):279-88.
10. Gartland JJ, Werley CW. Evaluation of healed Colles' fractures. J Bone Joint Surg Am. 1951;33(4):895-907.
11. Mann FA, Wilson AJ, Gilula LA. Radiographic evaluation of the wrist: what does the hand surgeon want to know? Radiology. 1992;184(1):15-24.
12. Chen NC, Jupiter JB. Management of distal radial fractures. J Bone Joint Surg Am. 2007;89(9):2051-62.
13. Rubinovich RM, Rennie WR. Colles' fracture: end results in relation to radiologic parameters. Can J Surg. 1983;26(4):361-3.
14. Trumble TE, Schmitt SR, Vedder NB. Factors affecting functional outcome of displaced intra-articular distal radius fractures. J Hand Surg Am. 1994;19(2):325-40.
15. Batra S, Gupta A. The effect of fracture-related factors on the functional outcome at 1 year in distal radius fractures. Injury. 2002;33(6):499-502.
16. Lee SJ, Park JW, Kang BJ, Lee JI. Clinical and radiologic factors affecting functional outcomes after volar locking plate fixation of dorsal angulated distal radius fractures. J Orthop Sci. 2016;21(5):619–-24.
17. Leung F, Tu YK, Chew WY, Chow SP. Comparison of external and percutaneous pin fixation with plate fixation for intra articular distal radial fractures. A randomised study. J Bone Joint Surg Am. 2008;90(1):16-22.
18. Rozental TD, Blazar PE. Functional outcome and complications after volar plating for dorsally displaced, unstable fractures of the distal radius. J Hand Surg Am. 2006;31(3):359-65.
19. Konstantinidis L, Helwig P, Strohm PC, Hirschmuller A, Kron P, Sudkamp NP. Clinical and radiological outcomes after stabilisation of complex intra-articular fractures of the distal radius with the volar 2.4 mm LCP. Arch Orthop Trauma Surg. 2010;130(6):751-7.
20. Pradhan U, Agrawal A, Prasad P, Chauhan V, Maheshwari R, Juyal A. Clinico-radiological and functional outcome after surgical fixation of intraarticular fractures of distal end of radius by external fixator versus locked volar plate: a

prospective randomised study. IOSR J Dent Med Sci. 2013;6(3):20-6.
21. Khan MS, Noordin S, Hashmi PM. Intra-articular distal radius fractures: postoperative roentgenographic and functional outcomes. JPMA. 2016;66(3):275.

Cite this article as: Hanumanthappa PT, Bharath Raja BS, Marichamy MK. Radiological outcomes of AO type B and C distal radius fractures managed with 2.7 mm volar locking plate fixation in geriatric population: a retrospective analysis. Int J Res Orthop 2021;7:768-72.