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Original Article

Volar locking plate fixation for distal radius fractures: Does age affect outcome?

Ahmed Ezzat^a, Santosh Baliga^{a,b,*}, Carol Carnegie^{a,b}, Alan Johnstone^{a,b}

^a University of Aberdeen, Aberdeen AB24 3FX, United Kingdom

^b Department of Trauma Orthopaedics, Aberdeen Royal Infirmary, NHS Grampian, Aberdeen AB25 2ZN, United Kingdom

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ABSTRACT

Background: The AAOS guidelines are unable to recommend for or against operative treatment of distal radius fractures in older patients.

Aims: This study compares the outcomes of older patients (≥60 years) against a cohort of younger patients treated with volar locking plate (VLP) fixation.

Methods: We assessed 78 patients, comparing range of movement (ROM), grip and pinch strength, subjective Visual Analogue Score (VAS) for pain and function and composite outcome scores.

Results: There was no difference in clinical outcomes between the two groups at six months.

Conclusion: Open reduction and VLP for distal radius fractures gives comparable outcomes in the older population.

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1. Introduction

Distal radius fractures are common injuries that have extensive literature describing treatment options and the respective outcome.^{1–4} One increasingly popular treatment option is open reduction through a volar approach and fixation using a volar locking plate (VLP).

VLP fixation has been shown by numerous studies to have good radiological and clinical outcomes.^{5–8} The advantage of VLPs compared to standard volar fixation is that they offer stable fixation even in comminuted fractures of osteoporotic bone. Therefore, the benefit should be seen particularly in the

older population. In the older patient, that would involve a shorter time to an independent living and return to daily activities.

The principles of 'stable anatomic reduction and early mobilisation' that are well established and universally accepted have been slow to develop for the management of wrist fractures in the older population. This is perhaps partly because of the traditional view that a good result was inevitable regardless of the appearance of the reduction,⁹ and partly that despite the plethora of evidence, there is little consensus. The AAOS guidelines are unable to recommend for or against operative treatment or the use of VLP in the management of distal radius fractures in older patients.¹⁰

* Corresponding author.

E-mail address: santoshbaliga@doctors.org.uk (S. Baliga).

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2. Aim

This study investigates the clinical outcomes of older patients (≥ 60 years) that are treated with VLP fixation for the treatment of unstable distal radius fractures. We aim to compare these to a matched cohort of younger patients (≤ 59 years) undergoing the same procedure.

We aimed to compare the two cohorts for range of movement (ROM), grip and pinch grip strength, Visual Analogue Score (VAS) in pain and function. In addition to this, we compared composite outcome scores at six months post injury.

3. Patients and methods

We prospectively selected and followed 78 consecutive patients who had sustained a displaced unstable distal radius fracture that underwent open reduction and internal fixation with a VLP. All procedures were performed in our trauma unit in a 12-month period by either a consultant orthopaedic surgeon or a trainee under consultant supervision.

Statistical analysis was performed using IBM SPSS Statistics 21 software.

All 78 procedures were done with an above elbow tourniquet. The radius was approached via a volar approach through the bed of flexor carpi radialis. The carpal tunnel was opened if indicated for nerve compression or to improve exposure. The median nerve and flexor tendon were retracted ulnarwards. The pronator quadratus was opened as a flap, being raised from the radial border of the distal radius; this was reflected ulnarward.

The fracture was then reduced and held temporarily with Kirshner wires. Adequate articular surface reduction and restoration of radial height and volar tilt were confirmed using fluoroscopy. Following this, a VLP was applied. Closure was performed in the standard manner.

Post-operatively, the wrist was placed in a bulky wool and crepe bandage or Plaster of Paris for 10–14 days. After this, the patients were allowed to mobilise their wrist, pain permitting, under physiotherapeutic guidance.

We documented standard demographics as well as the fracture type according to the AO/OTA¹¹ classification from the initial radiograph. Patients were reviewed clinically at 6 months in the outpatient department. Objective measurements of ROM, grip and pinch-grip strength were made and measured with a dynamometer (Jamar; Therapeutic Equipment, Clifton, NJ) and when possible compared with the

uninjured contralateral side. Patient Rated Wrist Evaluation (PRWE), modified Gartland and Werley score (mGWS), and the quick Disability of Arm Shoulder and Hand (qDASH) questionnaire were carried out by patient questionnaires on the day of clinic review.^{12–14} Clinical assessment and compilation of data was done by assessor blinded to the study.

Statistical analyses were performed as follows:

Outcome measures were statistically analysed at 6 months post-VLP using the Student's t-test and Mann–Whitney U test. Results were grouped in age groups as the ≤ 59 group and the ≥ 60 group. Data which followed a normal distribution was considered as parametric and analysed using a Student's t-test at 95% confidence interval (95% CI). Data with a positive skew meaning they did not have a normal 95% distribution curve was considered non-parametric and a Mann–Whitney U test generated.¹⁵

For analyses of all outcome measures including ROM, grip strength and composite scores, the Mann–Whitney U test (for independent samples and related samples, respectively) hypothesised that *the distribution of the outcome measures is the same across categories of age where the ≤ 59 group was compared to the ≥ 60 group. Pinch grip strength was analysed using Student's t test.*

When comparison of treated limb against normal (untreated) contralateral limbs was made, the Mann–Whitney U test hypothesised that *the median of differences between each treated limb movement and normal limb movement is equal.*

4. Results

There were 43 patients in the ≤ 59 years group and 35 in the ≥ 60 years group. In total, there were 62 females and 16 males, the ages ranging from 17 to 83. According to the AO/OTA classification, there were 22 type A fractures, 14 type B and 42 type C (Table 1).

4.1. Objective ROM

Grip strength was significantly better for the < 59 group (mean 57 N) compared to the ≥ 60 group (mean 40 N), p value = 0.001. Pinch movements were also significantly better in the ≤ 59 group (mean 9.1 N) compared to the over ≥ 60 (mean 7.2 N) (95% CI 0.63, 3.2; p = 0.004). In contrast, ulnar flexion was better in the ≥ 60 group (mean 28.1°) compared to a mean = 23.6° in the younger group (p = 0.022) (Table 2). The remaining measures of movement were statistically insignificant between the two groups

Table 1 – Demographics of the study.

Age group	Number of patients	Age range (years)	Mean age	Male:Female (M:F)	AO/OTA classification		
					A	B	C
≤ 59	43	17–59	45.5	11:32	11	8	24
≥ 60	35	60–83	70	5:30	11	6	18
Total	78	17–83	56.6	16:62	22	14	42

Table 2 – Comparing objective Grip, Pinch and ROM in ≤59 against ≥60.

Objective outcomes	Mean		p-Value (significance ≤0.05)
	≤59	≥60	
Grip (N)	57	40	0.001
Pinch (N)	9	7	0.004 (95% CI 0.632, 3.20) Md = 1.92
Wrist Flexion (degrees)	50	48	0.590 (95% CI –4.04, 7.06) Md = 1.51
Wrist Extension (degrees)	46	40	0.061 (95% CI –0.301, 13.2) Md = 6.45
Ulnar Flexion (degrees)	24	28	0.022
Radial Flexion (degrees)	26	27	0.607 (95% CI –4.50, 2.65) Md = –0.927
Pronation (degrees)	90	89	0.227
Supination (degrees)	89	89	0.731

Md = mean difference, 95% CI (confidence interval), T-test shows a 2-tailed significance.

Table 3 – Comparison of the two groups in terms of subjective and composite outcome scores at 6 months.

Subjective and composite outcomes	Mean		p-Value (significance ≤0.05)
	≤59	≥60	
Pain/10	2.5	2.2	0.70
Function/10	8.0	8.3	0.25
Modified Garland and Werley (mGWS)/45	7	7	0.91
Patient Rated Wrist Evaluation (PRWE) total/150	17	17	0.51
Quick DASH total/55 (qDash)	17	19	0.24
Green and O'Brien Wrist Score 1978 (G&B) total/80	57	55	0.29 (95% CI –1.86, 6.04) Md = 2.09

Md = mean difference, 95% CI (confidence interval), T-test shows a 2-tailed significance.

4.2. Subjective measures and composite outcomes

At six months, the mean VAS for pain was 2.5 in ≤59 group and 2.2 in the ≥60 group. The VAS function scores were 8.0 and 8.3 respectively. Both variables showed no significance. Comparing mGWS and PRWE scores between the two age groups was insignificant ($p = 0.912$ and $p = 0.514$, respectively). Data from the Quick DASH questionnaire revealed a mean Dash total score of 17 in ≤59 group and 19 in the ≥60 group, $p = 0.240$ (Table 3).

When comparing the difference between treated versus uninjured limb at 6 months between the two groups, no significant findings were evident (Table 4). Adverse events included carpal tunnel syndrome, paraesthesia and soft tissue

irritation. A total of four patients needed removal of metal. Table 5 summarises these events and shows no significant difference between the two cohorts.

5. Discussion

As the population continues to age, the incidence of distal radial fractures increases, a phenomenon linked with osteoporosis with a peak incidence at 65 years.^{16,17} Osteoporosis weakens the metaphysis of the bone due to a reduction in trabecular bone volume resulting in large metaphyseal voids which propagates fracture instability.^{18,19}

Table 4 – A comparison of the ROM difference in ≤59 group against the ROM difference in the ≥60.

ROM difference Outcomes:	Mean		p-Value (significance ≤0.05)
	≤59	≥60	
Grip difference (N)	–11.3	–9.86	0.16
Pinch difference (N)	–1.19	–1.20	0.98 (95% CI –0.98, 1.01) Md = 0.14
Wrist Flexion difference (degrees)	–10.5	–11.4	0.61
Wrist Extension difference (degrees)	–10.3	–11.4	0.41
Ulnar Flexion difference (degrees)	–8.37	–5.86	0.25
Radial Flexion difference (degrees)	–5.70	–6.14	0.73 (95% CI –2.14, 3.04) Md = 0.45
Pronation difference (degrees)	–0.35	–0.71	0.45
Supination difference (degrees)	–0.930	–0.714	0.59

Table 5 – Adverse events at ≤6 months reported after open reduction VLP fixation for the treatment of distal radial fractures in the ≤59 and ≥60 cohorts.

Complication at ≤6 months	≤59	≥60	Total
Plate removed	3	1	4
Paraesthesia	1	1	2
Carpal tunnel syndrome	1	1	2
Soft tissue irritation	2	1	3
Total	7	4	11

Changes in social demography have resulted in a later retirement age but have importantly changed society's perceptions of the ageing process and raised public expectation of both clinical management and outcomes. Consequently, the elderly need not accept suboptimal functional outcomes and anatomical deformity based on misperceptions of frailty and low functional demands.^{20–22}

Traditionally, stable distal radial fractures have been unanimously treated with satisfactory clinical outcomes adopting closed reduction with cast immobilisation.²³ For unstable distal radial fractures, closed reduction has been reported to compromise functional return and result in malunion in up to 50%.^{24,21,25} Treatment options include percutaneous wiring, reported as ineffective in osteoporotic bone,^{26,27} dorsal plate fixation, which can lead to attrition ruptures of extensor tendons,²⁸ and external fixation, which carries the risk of pin tract infection and wrist stiffness.²⁹

One option for treating these complex fractures is by open reduction and internal fixation. Compared with standard plates and screws, angle stable VLPs are excellent for maintaining fracture reduction following distal radius fractures since they offer increased fracture stability⁵ and understandably have become increasingly popular for treating comminuted fractures.

In this study, we found a number of significant differences between the two age groups (≤59 and ≥60 years). Pinch and grip strength was significantly better in the younger age group ($p = 0.004$ and $p = 0.001$, respectively). Ulnar flexion was better in the older age group. However, when these parameters were compared to the uninjured respective limb, Pinch and Grip Strength difference and ROM difference were statistically insignificant (Table 4).

Comparison across the two age groups in terms of the regain of function in relation to the uninjured limb revealed no significant findings in any movement, suggesting the older group to regain function in relation to their respective uninjured limb just as well as the younger group.

Subjectively, VAS pain and function were similar and statistically insignificant across age. Composite scores such as qDASH, mGWS, PRWE and G&B revealed no difference across age groups. Subjective and composite scores in this study agree with previous studies.²⁷

Some of the differences between the groups could be attributed to the higher ratio of AO/OTA type C fractures in the younger age group. However, the results of this study can be supported by biomechanical research, which demonstrated that the VLP device was efficient in the restoration of the normal axial force alignment without the reliance on screw engagement into the bone due to the nature of the screws,

which mediate better locking mechanism into osteoporotic bone.³¹ Additionally, the data proves coherent with Jupiter et al. who studied ≥60 years patients and concluded that open reduction VLPs could be used to treat displaced distal radial fractures in older patients when conservative managements have failed, although our data considers the technique as primary management.³² We cannot fully explain why older patients had better ulna deviation, but we hypothesise that it may be due to ulna shortening after fracture, which more commonly occurs in osteoporotic bone. This may lead to some carpal translation and consequent ulna deviation.

Despite the positive findings, some complications were reported in both cohorts (Table 5). Our findings are coherent with existing literature, which report similar adverse events and have sometimes led to second surgeries.³⁰ Of note, we had to perform two acute carpal tunnel decompressions; these were both performed on the day after initial ORIF. Both patients complained of median nerve distribution paraesthesia in the hand and underwent decompression and evacuation of haematoma. Both patients had normal median nerve function at six-month review.

During this study, a number of limitations were faced. The sample size was only 78 patients and so may have accounted for the large CIs in some of the results. Furthermore, patients were only assessed at 6 months postoperatively and so it would be important to arrange more follow-ups for better assessment over time.

6. Conclusion

Open reduction and VLP fixation is a good option for the management of unstable distal radius fractures. The older population (≥60 years) can benefit from a number of reasons, including ROM, Pinch and Grip Strength. Clinically, this would translate into an earlier return to usual activities such as an occupation, hobbies and self-care. Statistical analysis revealed no significance in the extent of functional recovery as compared to the uninjured side across the two age groups. It is therefore concluded that VLP is just as good for ≥60 years as in the ≤59-year-old patients.

Conflicts of interest

The authors have none to declare. The data has been presented at the European Surgical Orthopaedics and Traumatology Conference (EFORT), British Orthopaedic Association (BOA) Congress and the International Society of Orthopaedic Surgery and Traumatology (SICOT) congress. Abstract has been published in the J Bone Joint Surg Br 2012 vol. 94-B no. SUPP XXXVII 346 as conference proceedings.

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