# Radiographic and Clinical Outcomes of Distal Radius Fractures Treated with Volar Locking Plates versus Fragment-Specific Plating Constructs

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INTRODUCTION: Trends toward surgical fixation for distal radius fractures continue to increase. Advancements in orthopedic implants have resulted in a variety of plating options, including plates designed for specific fracture fragments. Indications for these constructs over conventional volar locking plates (VLP) remains largely subjective. The purpose of this study was to compare the outcomes of distal radius fractures treated with VLP alone versus Fragment Specific Fixation (FSF) constructs. We examined the ability of both techniques for restoration and maintenance of radiographic parameters and resulting clinical outcomes.

METHODS: A retrospective review was conducted of all consecutive distal radius fractures treated between 2017 and 2019. Inclusion criteria were skeletally mature patients who were treated with open reduction internal fixation and with minimum 6 month clinical and radiographic follow-up. Primary outcome measures included radiographic evaluations and functional outcomes including active range of the wrist and forearm, grip strength, and composite finger motion. Radiographic evaluations included radial height and inclination, volar tilt, and amount of intra-articular step-off evaluated on pre-operative, immediately post-operative, and at most recent clinical follow-up.

RESULTS: A total of 54 patients were eligible for inclusion and evaluated. Twenty-six patients were treated with VLP and 28 with FSF. There were no statistically significant differences in mean age (56.8 vs 48.6 years, p=0.982), gender (%female: 65% vs 46%, p=0.161) or involvement of dominant limb: 42% vs 46%, p=0.571). However, significant differences (p=0.016) were observed in the distribution of AO fracture patterns: type A fractures were more common in the VLP group (27% vs 4%), type B were more common in the FSF group (12% vs 36%), whereas type C were similar (62% vs 60%). There were no differences observed in any radiographic parameters at pre-operative, immediately post-operative or at final follow-up between the two groups. There was no radiographic subsidence or loss of reduction for either construct. Both constructs adequately maintained reduction. FSF trended towards higher complications with regard to tendinopathy (p=0.062) and significantly higher reoperations than VLP (p=0.027), however this group also contained more complex fractures. No differences between groups were observed in clinical or functional outcome measures.

DISCUSSION AND CONCLUSION: There were no significant differences in clinical outcomes or the ability of either construct to achieve and maintain adequate radiographic outcome parameters. FSF was shown to have higher risks of complication and reoperation, namely removal of instrumentation for persistent pain or tendon dysfunction. However, this finding may be due to more complex fracture patterns seen in the FSF group. As such, further study is warranted.

Table: Radiographic Outcomes by Fracture Pattern

| Fracture type A | | | |
|---|---|---|---|
| | VLP (n=7) | FSF (n=1) | p-value |
| **Radial height (mm)** | | | |
| Pre-op | 8.1 | 11.0 | 0.382 |
| Immediate Post-op | 12.1 | 14.0 | 0.174 |
| Final follow-up | 11.5 | 15.0 | 0.143 |
| **Radial inclination (deg)** | | | |
| Pre-op | 17.0 | 17.9 | 0.912 |
| Immediate Post-op | 19.9 | 29.4 | 0.127 |
| Final follow-up | 22.8 | 29.8 | 0.280 |
| **Volar tilt (deg)** | | | |
| Pre-op | -15.8 | -12.2 | 0.907 |
| Immediate Post-op | 6.6 | 9.9 | 0.513 |
| Final follow-up | 9.9 | 4.6 | 0.501 |
| **Fracture type B** | | | |
| | VLP (n=3) | FSF (n=10) | p-value |
| **Radial height (mm)** | | | |
| Pre-op | 11.7 | 7.5 | 0.185 |
| Immediate Post-op | 12.7 | 13.1 | 0.599 |
| Final follow-up | 12.7 | 12.5 | 0.928 |
| **Radial inclination (deg)** | | | |
| Pre-op | 15.0 | 16.1 | 0.424 |
| Immediate Post-op | 21.9 | 24.2 | 0.237 |
| Final follow-up | 25.4 | 24.3 | 0.722 |
| **Volar tilt (deg)** | | | |
| Pre-op | 25.5 | 17.3 | 0.071 |
| Immediate Post-op | 14.1 | -0.8 | **0.043** |
| Final follow-up | 16.1 | 5.2 | **0.046** |
| **Fracture type C** | | | |
| | VLP (n=16) | FSF (n=17) | p-value |
| **Radial height (mm)** | | | |
| Pre-op | 8.0 | 7.8 | 0.895 |
| Immediate Post-op | 12.0 | 12.4 | 0.986 |
| Final follow-up | 11.2 | 11.9 | 0.291 |
| **Radial inclination (deg)** | | | |
| Pre-op | 16.0 | 14.3 | 0.484 |
| Immediate Post-op | 22.9 | 22.1 | 0.652 |
| Final follow-up | 23.0 | 23.0 | 0.987 |
| **Volar tilt (deg)** | | | |
| Pre-op | -9.6 | -10.5 | 0.912 |
| Immediate Post-op | 4.5 | 4.6 | 0.914 |
| Final follow-up | 6.8 | 5.7 | 0.752 |

**Table 2:** Selected Functional Outcomes

| Functional Outcomes | VLP (n=23) | | FSF (n=21) | | p-value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| **Return to full activity** | 20 | 87.0 | 18 | 85.7 | 0.711 |
| **Full grip strength** | 18 | 78.3 | 17 | 81.0 | 0.500 |
| **Full composite finger flexion (Missing information for 2 VLP patients)** | 19 | 82.6 | 19 | 90.4 | 0.697 |
| **Sub-Analysis by Limb Dominance** | | | | | |
| **Dominant hand** | | | | | |
| Return to full activity | 7 | 87.5 | 7 | 77.8 | 0.624 |
| Full grip strength | 8 | 100 | 8 | 88.9 | 1.000 |
| Full composite finger flexion | 8 | 100 | 9 | 100 | 1.000 |
| **Non-Dominant hand** | | | | | |
| Return to full activity | 13 | 86.7 | 11 | 91.7 | 0.238 |
| Full grip strength | 10 | 66.7 | 9 | 75.0 | 0.419 |
| Full composite finger flexion | 11 | 73.3 | 10 | 83.3 | 0.420 |
| **Sub-Analysis by Baseline Functioning Status** | | | | | |
| **Active** | | | | | |
| Return to full activity | 11 | 78.6 | 9 | 81.8 | 0.916 |
| Full grip strength | 10 | 71.4 | 9 | 81.8 | 0.424 |
| Full composite finger flexion | 11 | 78.6 | 10 | 90.9 | 0.425 |
| **Laborer** | | | | | |
| Return to full activity | – | – | 3 | 100 | – |
| Full grip strength | – | – | 2 | 66.7 | – |
| Full composite finger flexion | – | – | 2 | 66.7 | – |
| **Low demand** | | | | | |
| Return to full activity | 9 | 100 | 6 | 85.7 | 0.438 |
| Full grip strength | 8 | 88.9 | 6 | 85.7 | 1.000 |
| Full composite finger flexion | 8 | 88.9 | 7 | 100 | 1.000 |

**Table 3:** Complications and Reoperations

| | VLP (n=26) | FSF (n=28) | p-value |
|---|---|---|---|
| **Total complications, n*** | 10 | 17 | |
| **Tendinopathy** | 1 (4%) | 6 (21%) | 0.062 |
| **Persistent pain** | 3 (12%) | 3 (11%) | 0.629 |
| **Paresthesia** | 5 (19%) | 6 (21%) | 0.555 |
| **Screw perforation** | 1 (4%) | 0 (0%) | 0.481 |
| **Malunion** | 0 (0%) | 2 (4%) | 0.264 |
| **Total reoperations, n** | 2 (8%) | 9 (32%) | 0.027 |
| **Removal of hardware** | 1 (4%) | 7 (25%) | 0.033 |
| **Carpal Tunnel Release** | 1 (4%) | 3 (11%) | 0.334 |
| **Tenolysis** | 0 (0%) | 5 (18%) | 0.031 |
| **Neurolysis** | 0 (0%) | 1 (3.6%) | 0.519 |
| **Sub-Analysis by Radiographic >12 months** | | | |
| **Posttraumatic OA** | VLP (n=16) | FSF (n=10) | 0.138 |
| **No** | 16 (100%) | 8 (80%) | |
| **Yes** | 0 (0%) | 2 (20% | |
| **Follow-up (months)** | 39.7 ± 25.8 | 35.8 ± 20.3 | 0.692 |

*Percentages not calculated for total complications as some patients experienced more than one