

A Comparative Study of Clinical and Radiological Outcomes of Dorsally Angulated, Unstable Distal Radius Fractures in Elderly Patients: Intrafocal Pinning Versus Volar Locking Plating

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Purpose: To compare the clinical and radiological outcomes of intrafocal pinning (IFP) and volar locking plating (VLP) of dorsally angulated, unstable distal radius fractures in elderly patients.

Methods: The subjects were 62 consecutive patients over 60 years of age with dorsally angulated, unstable distal radius fractures treated with IFP or VLP. Bone mineral density (BMD) of the lumbar spine was measured by dual-energy x-ray absorptiometry at first examination. The range of motion and grip strength were measured at follow-up examinations, and ulnar variance (UV) was measured on radiographs at baseline and follow-up postoperative examinations.

Results: There were no notable differences in gender, age, follow-up period, baseline UV, BMD, and AO classification between IFP and VLP groups. There was no difference between the UV in VLP immediately after surgery and at the final follow-up examination; however, IFP showed a significant loss of reduction as measured by UV. In patients with UV more than 5 mm or BMD less than 70% of young adult mean (YAM) at first examination, UV increased again at the final follow-up examination in IFP, while surgically corrected UV was maintained in VLP, independent of the degree of baseline UV and BMD. VLP resulted in earlier recovery of postoperative range of motion and grip strength compared with IFP. The range of flexion and the grip strength value were significantly larger in VLP at final examination.

Conclusions: VLP, but not IFP, can maintain surgically corrected UV in distal radius fractures, independent of the degrees of initial UV and BMD. VLP enhances earlier recovery in range of motion and grip strength than IFP. (J Hand Surg 2007;32A:1385–1392. Copyright © 2007 by the American Society for Surgery of the Hand.)

Type of study/level of evidence: Therapeutic II.

Key words: Radius fracture, intrafocal pinning, volar locking plate, ulnar variance, osteoporosis.

Distal radius fractures are common in the elderly, and at least some benefit from internal fixation. Various surgical techniques are used for the treatment of dorsally displaced, unstable distal radius fractures, such as percutaneous pinning,^{1,2} intramedullary pinning^{3,4} or nail,^{5,6} external fixation,^{7,8} and internal fixation with various plates.^{9,10} There is no standardized protocol,

however, for the management of these fractures.¹¹ Thus, there is a need for objective comparisons of the various treatment alternatives for the surgical treatment of these fractures.

The ideal surgical method should maintain anatomical position and ensure early mobilization. Anatomical reduction with stable fixation is the preferable treatment of unstable distal radius fractures.

Percutaneous pinning techniques with or without external fixation are historically the most popular. Recent studies, however, described the usefulness of volar locking screw/plate implants, which can stabilize cancellous, fragmented bone for the treatment of dorsally displaced, unstable distal radius fractures in elderly patients.^{9,12} The differences in outcomes between percutaneous pinning and volar locking plating are not well reported, so we present postoperative data on serial radiological changes and functional recovery comparing these two methods.

Elderly patients with distal radius fractures frequently have low bone mineral density (BMD). Low BMD in women is a risk factor for low-energy Colles' fractures.¹³ More than half of elderly women with a distal radial fracture have osteoporotic BMD values for the lumbar spine or hip.¹⁴ Osteoporosis is characterized by the presence of both low BMD and disruption of normal bone architecture that leads to bone fragility. In Japan, osteoporosis is diagnosed when BMD falls below 70% of the young adult mean (YAM) (age 20–44 years).¹⁵ This diagnostic criterion is equivalent to that proposed by the World Health Organization, which defines osteoporosis as a BMD value <2.5 SD of YAM (age 20–40 years).¹⁶ The subjects of this study included patients with and without osteoporosis. Our study investigated whether the degree of bone fragility as measured by BMD should be a factor in selecting the surgical procedure for distal radius fractures.

We prospectively and consecutively treated elderly patients with dorsally angulated, unstable distal radius fractures using intrafocal pinning (IFP) (Kapandji's method¹) from 2002 to 2003 and volar locking plating (VLP) in 2004. The plate used in this study was the distal radius volar locking plate system (DRV2, Mizuho Co., Tokyo, Japan) developed by Osada et al.^{17,18} In this study, we compared the clinical and radiological outcomes of the two treatment modalities of IFP and VLP.

Materials and Methods

Subjects

All patients with distal radius fractures were initially managed with closed reduction and splinting, and patients with unstable or unsuccessful reduced fractures underwent surgery. The indications for internal fixation included dorsal angulation $>10^\circ$, radial inclination angle $<15^\circ$, or ulnar variance (UV) >3 mm. Osteoporosis was not a criterion for inclusion into the study. The enrolled subjects were 62 consecutive patients over 60 years of age with 62 dor-

sally angulated, unstable distal radius fractures treated with IFP for 31 patients and VLP for 31 patients from 2002 to 2004 at our institution. We prospectively treated consecutive patients with IFP from 2002 to 2003 and VLP in 2004. All patients consented to the study participation at the first visit, and all aspects of the study were approved by the institutional review board.

We observed that the final UV value in IFP was approximately 2.5 mm and that in VLP was approximately 0.5 mm based on our clinical experience before starting the present study. To determine the number of patients required for meaningful statistical analysis, we performed power analysis before the conduct of the study.¹⁹ We used 2.0 as the minimum difference we wished to detect as significant, assuming $\alpha=0.05$ (two-sided) and $\beta=0.2$ (power=80%). The analysis identified 25 as the minimum number of subjects required for each group.

Subjects of the IFP group were 2 men and 29 women, and the VLP group comprised 5 men and 26 women (Table 1). The mean age of the patients at the time of surgery was 71 years (range, 60–87) for the IFP group, and 70 years (range, 60–94) for the VLP group. All patients were followed up regularly with physical and radiological examinations for at least 6 months after surgery. The mean period of follow-up was 13 months (range, 6–30) for the IFP group and 11 months (range, 6–23) for the VLP group. UV on baseline radiographs after injury was >5 mm in 7 patients and ≤ 5 mm in 24 patients of the IFP group, and 11 and 20 patients of the VLP group, respectively. There were no notable differences in gender, age, follow-up period, or baseline UV between IFP and VLP groups.

BMD of the lumbar spine (L2-L4) was measured by dual-energy x-ray absorptiometry (QDR-4500, Hologic Inc., Bedford, MA) at the first visit. In the IFP group, the BMD/YAM ratio was $\geq 80\%$ in 9 patients, 70–80% in 14 patients, and $<70\%$ in 8 patients. In the VLP group, the corresponding numbers of patients were 8, 16, and 7. According to the AO classification scheme,²⁰ 25 fractures were considered type A (extra-articular fractures involving neither the radiocarpal nor the radioulnar joint) fractures (3 A2 and 22 A3) and 6 type C (complex articular fractures affecting the joint surface and metaphyseal area) fractures (5 C1 and 1 C2) for the IFP group, and 27 type A fractures (7 A2 and 20 A3) and 4 type C fractures (3 C1 and 1 C2) for the VLP group. Articular fractures were identified in 6 patients of the IFP group and 4 patients of the VLP

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