Volar locking plate fixations for displaced distal radius fractures: An evaluation of functional and radiographic outcomes

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ABSTRACT

Objectives: In this study, our aim was to evaluate the functional, radiological and clinical results of the patients which treated with a volar anatomical locking plate due to distal radius fractures retrospectively.

Methods: Patients operated with distal radius fracture between 2014-2016 were screened retrospectively. Fractures were classified according to the AO classification. Radiological values for radial height, radial inclination, radial volar tilt and ulnar variance were measured according to the radiological key points described by Medoff. The Stewart scoring form was used to evaluate the radiological results. Flexion-extension, pronation-supination was measured using with a goniometer. Grip strength was measured using a hand dynamometer. Clinical results were evaluated according to the Mayo wrist system.

Results: The average age of 60 patients included in this study was 45 and average follow-up period was 13 month. Mean grip strength value was 18.33, the contralateral side was 25.33. The distribution of the Stewart radiological assessment score were 16 (27%) patients excellent, 36 (60%) good, and 8 (13%) moderate results. When evaluated clinically with the Mayo wrist score, the results were excellent in 20 (33%) patients, good in 35 (58%) patients, and moderate in 5 (9%) patients. Statistically significant differences were found in all radiological parameters. (p < 0.05)

Conclusion: Surgery using a volar anatomical locking plate is an effective treatment method for distal radius fractures. Joint range of motion can be achieved early with correct fixation of the plate and by beginning joint movement as soon as possible.

Key words: Complications, distal radius fracture, volar plating

Introduction

Distal radius fractures are the most common fractures that present to emergency services. They account for 4% of all fractures in adults; this rate rises to 12% in the elderly [1]. The mechanism of injury in elderly patients is usually low-energy trauma, while in young patients, distal radius fractures are more often caused by traffic accidents, falling from heights and sports injuries [2]. The goal of treatment is to restore and maintain normal anatomy [3]. A conservative approach is suit-
able for stable extra-articular fractures, which account for 75–80% of all distal radius fractures. These are minimally displaced or impacted fractures that can be treated with closed reduction and plaster fixation [4,5]. In unstable, multi-part or intra-articular fractures, it may not be possible to achieve joint face continuity with closed methods. Understanding the necessity of restoring wrist anatomy and function, as well as patients’ increasing expectations, has led to a shift towards surgical management for more indications [3]. At present, open reduction with a volar locking plate is the standard method used for surgical treatment of intra-articular distal radius fractures [3,4].

The aim of this retrospective study was to evaluate the functional, radiological and clinical results of patients treated in our clinic with volar anatomical locking plates for distal radius fractures.

Materials and Methods

Patients who were admitted to the emergency service with a diagnosis of distal radius fracture between January 2014 and March 2016 were screened retrospectively. Following closed reduction and long arm splint application under sedoanalgesia, control radiographs were taken. Patients with an unsatisfactory reduction (more than 10% dorsal angulation, more than 20% volar angulation, more than 5 mm radial shortening or with more than 2 mm dissociation on the joint face continuity) who accepted surgical treatment were selected. Patients who had at least a six-month follow-up period and whose final radiographs could be performed were included in this study. Patients with additional injuries in the same extremity, patients whose follow-up period was less than six months and patients younger than 18 years of age were not included. Sixty patients who met the criteria and had undergone surgery with volar locking plates were evaluated. Fractures were classified according to the AO classification.

Open reduction was performed using a tourniquet under regional/general anaesthesia. The fracture was reduced using the volar Henry approach, and proper restoration of the articular surface and bony fragments was established by scopy. After obtaining the correct position, the broken radial styloid was fixed using Kirschner wires, and a 2.4 mm volar anatomical locking plate was fixated (Hippocrates, Izmir, Turkey). A short arm splint was used until the sutures were removed two weeks after surgery. After the sutures were removed and splinted out, wrist and finger exercises were started immediately. Wrist strengthening exercises were started in 4–6 weeks.

Clinical, radiological and functional evaluations were conducted during the last follow-up appointment. Radiological values for radial height, radial inclination, radial volar tilt and ulnar variance were measured by a single surgeon according to the radiological key points described by Medoff [6]. The Stewart scoring form was used to evaluate the radiological results. Flexion-extension, pronation-supination was measured using with a goniometer. Grip strength was measured using a Jamar dynamometer (model SH 5001, Saehan Corporation, Masan, South Korea). Clinical results were evaluated according to the Mayo wrist system.

The Kolmogorov-Smirnov and Shapiro-Wilk tests were used for the distribution of the data. Age, Stewart score, Mayo wrist score, grip strength, range of motion measurement and radiological measurement values were evaluated using the Mann-Whitney U and Kruskal-Wallis tests. In all tests, p < 0.05 was considered statistically significant. (IBM SPSS Statistics 19, SPSS inc., an IBM Co., Somers, NY).

Results

The demographic findings of the patients and the classification of the fractures according to the AO system are shown in Table 1. When we compared the functionally operated wrist with the contralateral wrist, there was no significant difference in the pronation-supination value. Although there were decreases in the flexion-extension arc, ulnar deviation and radial deviation, the differences were not statistically significant. The grip strength value of the intact wrist was higher.
than the surgically repaired wrist to a statistically significant degree; this is presented in Table 2.

Preoperative first admission x-rays were compared radiologically with final follow-up x-rays. Statistically significant differences were found in all radiological parameters, and the radiological mean evaluations are presented in Table 3.

According to the Stewart score, the results of 16 (27%) patients were excellent, 36 (60%) were good and eight (13%) were moderate. The distribution of the Stewart radiological assessment according to AO fracture types is shown in Table 4.

When evaluated clinically with the Mayo wrist score, the results were excellent in 20 (33%) patients, good in 35 (58%) patients and moderate in five (9%) patients. Complex regional sympathetic dystrophy (Sudeck atrophy) was diagnosed in 10 (17%) cases, and median nerve neuropathy was detected in three cases (5%). In one case (1.6%), the length of one of the screws was changed in the first postoperative month due to findings of irritation because of the inappropriate length of the screw directed to the radial styloid.

### Discussion

In our study, when the patients were evaluated radiologically, 52 had good or excellent results. Six of the eight patients with moderate results had AO type C fractures. We suggest that the moderate results in these patients occurred because there was no support in the metaphyseal region from the volar or dorsal cortex, which occurs after high energy injuries. When we considered radial height, radial inclination and volar tilt angles, statistically significant differences were obtained between the preoperative and postoperative values, which is consistent with the literature [7,8]. In their study, Chan et al. compared the wrist that was treated with a volar locking plate with the contralateral.
wrist. While they did not find a significant difference in range of motion, they reported a meaningful difference in grip strength [9]. We attribute the difference in grip strength in our study to be due to the patients’ weakness in terms of hand rehabilitation. According to the Mayo wrist scoring classification, Jose et al. and Ballal et al. reported good or excellent results in 82% and 83% of their patients, respectively [10,11]. We found the rate of good or excellent results in our patients to be 83%, which is similar to the literature.

According to the literature, the complication rate for locking plates ranges from 3% to 34% [12-14]. In our study, the complication rate was 23%. The majority of these patients were diagnosed with complex regional sympathetic dystrophy. They were treated with multimodal pain control methods, contrast water baths and physical therapy methods, and their complaints resolved completely by the sixth postoperative month. Carpal tunnel syndrome is a well-known but overlooked complication after distal radius fractures [11]. In a study by Lutz et al., they compared volar locking plates with conservative treatment and reported that the most common complication was median neuropathy, which had an incidence of 8.5% [15]. We diagnosed three (5%) patients with carpal tunnel syndrome, which is similar to the literature. In one secondary emergency service case, acute median neuropathy was present into the fracture, and the patient was treated with early median nerve decompression. One patient’s symptoms improved six months after surgery, and the other patient’s symptoms resolved with conservative treatment. Aldemir et al. proposed placing the distal part of the plate at the proximal side of the watershed line in the distal radius to prevent tenosynovitis and plate irritation [12]. We placed our plates according to their recommendation, and as a result, only one patient required screw removal due to screw irritation.

The most obvious limitations of our study are the short duration of follow-up and the absence of a control group. Since we only have short-and intermediate-term results, complications affecting the wrist beyond our follow-up period, such as arthrosis, cannot be evaluated. Surgery using a volar anatomical locking plate is an effective treatment method for distal radius fractures. The complication rates are low, and they can be prevented by proper reduction and placement of the plate. Joint range of motion can be achieved early with correct fixation of the plate and by beginning joint movement as soon as possible.

**Conflict of interest statement**

The authors have no conflicts of interest to declare.

**References**

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