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Outcomes of Treatment of Intra-Articular Distal Radius Fractures with Volar Locked Plates in Patients Above 50 Years

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Abstract:-

- ***Objective:***

Outcomes of the treatment of intra-articular distal radius fractures seen in patients above 50 years with volar locked plates were evaluated.

- ***Study design:***

Twenty Eight patients (8 female and 20 male) treated in our clinic with volar locked plates because of intra-articular distal radius fractures were evaluated after a 17-month (range 8-30 months) follow-up. Mean age of the patients was 45.2 (range 50-64) years. Fractures were classified according to Frykman and AO classifications. According to the Frykman classification, 2 patients had type 3 (7%), 1 patient had type 4 (5.5%), 14 patients had type 7 (50%) and 11 patients had type 8 (37.5%) fractures. According to the AO classification, 6 patients had B2 (23.5%), 4 patients had C1 (14%), 11 patients had C2 (37.5%) and 7 patients had C3 (25%) fractures. All patients were evaluated clinically and radiologically. Clinical outcomes of the patients were evaluated using Gartland and Werley's evaluation scores and DASH-T scores. Radiologic outcomes were evaluated according to the radiologic evaluation criteria modified by Steward et al.

- ***Results:***

According to the evaluation scores of Gartland and Werley, 20 patients yielded excellent (72%), 5 patients good (18%) and 3 patients moderate (10%) results. Mean DASH-T score of the patients was 34 (range 31 to 40).

- ***Conclusions:***

Treatment of intra-articular distal radius fractures seen above 50 years of age with volar locked plates is an efficient and safe method. Use of volar locked plates reduces the complication risk of reduction loss and need for grafts in osteoporotic fractures.

Keywords:- *Fractures Of The Radius; Forearm Injuries; Colles Fractures.*

I. INTRODUCTION

Fractures of the distal end of the radius make up one sixth of the patients presenting with fractures at the emergency units.[1] When the distribution of age related fractures are studied, there are two age groups where incidence is increased. While the first group is made of physically active children between 5 and 10 years of age, the second group is made of elderly patients between 50 and 69 years of age leading less active lives.[2] The mechanism of injury is usually falling on open hand, and this mechanism of injury is particularly valid for osteoporotic patients with reduced bone quality.[3,4] Because the young population is open to high energy injuries, there is a high probability of multi-piece and displaced fractures. On the other hand, comminuted intra-articular fractures are more probable in elderly patients due to the reduced bone quality. These fractures can be in the form of open fractures, but can also be associated with tendon ruptures and neurovascular injuries.[5]

These are important fractures because their treatment outcomes affect daily functions of individuals. Fracture type, age, general status, physical and cognitive capacity, additional diseases, compliance to treatment and expectations of the patient should be taken into consideration in planning the treatment,[6]

The aim of treatment is to obtain anatomic reduction as well as maintain the achieved reduction while the fracture heals.[7] Age related reduction in bone quality leads to implant failure and loss of reduction and iatrogenic non-unions. Use of constant angle volar locked plates is an important treatment modality to overcome this complications.[7]

In this study, patients with intra-articular distal radius fractures aged above 50 years and treated with constant angle volar locked plates were evaluated regarding anatomic, radiologic and clinical outcomes, and the influence of treatment outcomes on the daily chores and social lives of the patients were studied.

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II. MATERIALS AND METHODS

Twenty-eight distal radius fractures of 28 patients aged above 50 years presenting with intra-articular distal radius fractures at the emergency service of our clinic between February 2006 and April 2008 were retrospectively evaluated. Eight patients (29%) were female and 20 (71%) were male. Female: male ratio was 1:2.5. Mean age was 54.2 years (range 50 to 64 years). Twenty-two (78%) fractures were on the right extremity and 6 (22%) were on the left extremity. Four (14%) of the fractures were type I open fractures according to the Gustilo-Anderson classification.

In addition to distal radius fractures, there were intertrochanteric femur fractures in 2 patients and an olecranon fracture in 1 patient.

Histories were taken primarily from patients presenting with distal radius fractures at the emergency service. Patients underwent physical examination and antero-posterior and lateral X-rays of the wrists were routinely taken. In patients thought to have additional pathologies, examinations directed at these pathologies were added.

Distal radius fractures of all patients underwent closed reduction and fixation with circular casts and control X-rays were taken. X-rays were evaluated for radial heights, radial inclination, palmar slope and articular discordance before and after reduction. Taking into consideration the stability criteria determined by La fontaine et al.[8], surgical treatment was decided for unstable fractures and the patients were included in the study group.

Frykman[9] and AO[10] classifications were used in the evaluation of fractures. Patients included in the study had 2 type 3 fractures (7%), 1 type 4 fracture (5.5%), 14 type 7 fractures (50%) and 11 type 8 fractures (37.5%) according to the Frykman classification, and 6 type B2 fractures (23.5%), 4 type C1 fractures (14%), 11 type C2 fractures (37.5%) and 7 type C3 fractures (25%) according to the AO classification.

Among the patients presenting at our clinic with distal radius fractures, 8 were operated on during the first 3 days, 14 between days 3 and 7, and 6 between days 7 and 16. The mean interval between the fracture and surgery was 5.3 days (range 2 to 41 days). Surgical Technique:

- *Surgical Technique*

General anesthesia was applied to 6 patients, supraclavicular block to 8 patients and axillary block to 14 patients. Distal radii of all patients were operated on under a tourniquet. The patients were taken to the operating room and laid in a supine position. Following anesthesia, prophylactic 1 gr Cefazolin sodium was administered intravenously before the tourniquet. Following appropriate cleaning and draping, the fore arm was placed on the hand table with the wrist at a 90 degree flexion. With a volar longitudinal incision, an entrance was made over the flexor carpi radialis tandon. The pronator quadratus muscle was dissected from the radial insertion site. The fracture was exposed. İntra-articular fractures were indirectly reduced and a volar constant angle plate was adapted. First, one unlocked cortical screw was screwed to the proximal fragment by keeping the fracture at the reduced position and the plate was aimed to have a supporting effect on the distal fragment. Then a constant angle locked screw was placed at the part compatible with the subchondral region with the fracture in the reduced position. A fluoroscopic control was carried out and the reduction of the fracture, position of the plate and the relationship of subchondral screws with the joint were assessed. Following this, proximal metaphysis screws were sent as to hold the dorsal pieces for supplemental stability. At least 2 locked cortical screws were added to the proximal fragment and a repeat fluoroscopic control was made. The tourniquet was opened and bleeding control was made. The pronator quadratus muscle was sutured so as to cover the plate. Subcutaneous tissue was sutured with a 4/0 absorbable suture. The skin was closed with a 4/0 nonabsorbable suture and an elastic bandage was applied (Figure 1 and 2).

On the first postoperative day, all patients were started on finger movement aperture exercises and fore arm pronation-supination exercises at tolerable levels. At the end of the first week, the patients started wrist exercises.

Sutures of all patients were taken on day 15. Until the end of the eighth week finger, wrist and fore arm movements were progressively increased with weekly controls.

Patients were followed clinically and radiologically. Patients with adequate follow-up were called for their last controls. Mean follow-up at last controls was 17 months (range 8 months to 30 months). Clinical outcomes were evaluated with the evaluation score of Gartland and Werley[11] (Table 1) and DASH-T score[12] (Table 2). Radiologic outcomes were evaluated according to the radiologic evaluation criteria modified by Steward et al.[13] (Table 3).

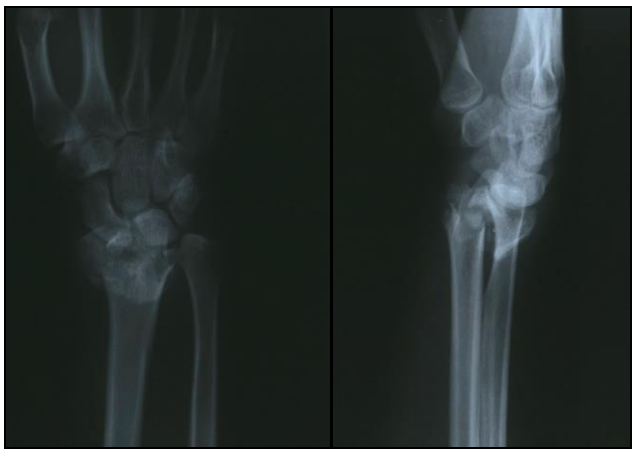

Fig 1: Anteroposterior and Lateral View of 58 Years Old Male Patient's Distal Radial Fracture

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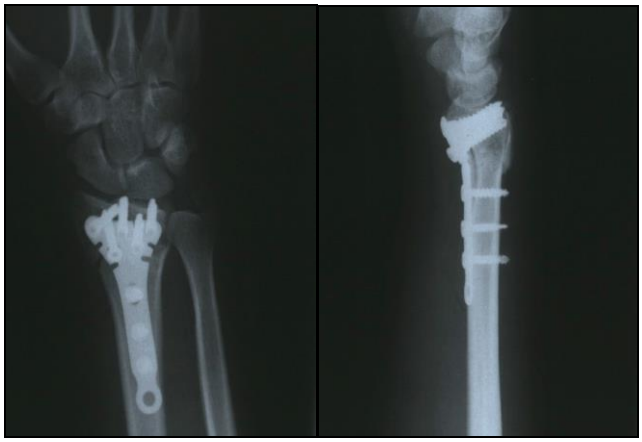

Fig 2: Postoperative Sixth Months Anteroposterior and Lateral View of the Same Patient's Wrist

III. RESULTS

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar: According to the clinical evaluation criteria of Garland and Werley, excellent results were obtained in 20 (72%) of 28 distal radii, good results in 5 (18%) and moderate results in 2 (10%). Mean DASH-T value of the patients evaluated with the DASH-T score was 34 (range 31 to 40).

At the last follow-up, wrist and fore arm movement aperture values were as follows: 70º (range 50º to 90º) dorsiflexion, 60º (range 40º to 90º) palmar flexion, 28º (range 20º to 45º) unlar deviation, 20º (range 10º to 35º) radial deviation, 75º (range 60º to 90º) pronation and 80º (range 75º to 90º) supination.

With the Steward's scoring system carried out for radiologic evaluation, excellent results were obtained in 19 fractures (68%), good results in 7 (25%) and moderate results in 2 fractures (7%).

In the radiologic evaluation of the fractures, mean preoperative radial height was 0 mm [range (-16) to 6], mean postoperative radial height was 14 mm [range 6 to 25], mean preoperative radial inclination was 4º [range (-8º) to 10º], mean postoperative radial inclination was 22º [range 10º to 28º], mean preoperative palmar slope was -10º [range (-20º) to 5º] and mean postoperative palmar slope was 4º [range (-5º) to 10º]. İntra-articular stepping and gapings were anatomically restored with the exception of 1 patient. There was a 3-mm intra-articular stepping only in 1 patient.

Mean time needed for the patients to perform their normal daily functions was found to be 65 days (range 42 to 105 days).

During surgery no radial artery injury, median nerve injury or complications related with the tendinous structures dissected during exploration were encountered in any patient. There was a wound site infection in one patient during the early postoperative period and was treated with wound debridement on day 12 and use of oral antibiotics. In one patient operated on day 41 following fracture and healing with shortening, there were findings of pressure on the median nerve during follow-up and the implant was removed at the end of the 8th month. The symptoms improved following removal of the implant. Reflex sympathetic dystrophy developed in 5 patients. Significant improvement was obtained with physical therapy together with opposite bath applications and use of Calcitonin 200 IU as a nasal spray for 2 months. No complications like tendon ruptures and tenosynovitis were seen in any patient. Postoperative arthritis was not encountered clinically or radiologically, but the follow-up was short.

IV. DISCUSSION

The incidence of distal radius fractures has increased due to the widespread use of motor vehicles, regular sports activities and increased life expectancy. The aims in the treatment of intra-articular distal radius fractures are achievement of maximal function, maintenance of movement aperture, limitation of posttraumatic arthritis and prevention of complications.[12] In order to achieve these therapeutic aims, an appropriate reduction should be obtained and preserved until the fracture heals and a good rehabilitation program should be carried out for the restoration of movement and strength.

In addition to the necessary criteria for an acceptable reduction in intra-articular distal radius fractures, there is still controversy about the optimal techniques to be applied in order to obtain this reduction and maintain its continuity. Gartland and Werley have shown that four components of distal radius fractures should be corrected in order to obtain good functional results; 1) radial shortening, 2) radial inclination, 3) dorsal slope and 4) discordance of distal radioulnar joint.[14] The generally accepted opinion is that good functional results can be obtained by restoring the neutral length of the radius, and by achieving a radial inclination of more than 0 degree, a volar slope between 0 and 5 degrees, an articular stepping of less than 2 mm, stable relationships between carpal joints and decreased distal radioulnar joint instability. Although basic extraarticular criteria (radial height, radial inclination, volar slope) are important, the most important criterion required for successful results has been accepted to be intra-articular reconstruction, that is correct restoration of the joint surface.[4,14,15]

Currently, the treatment of fractures of the distal end of the radius is planned regarding the stability of the fracture. La Fontaine et al. have identified criteria for determining the stability the fracture. According to the criteria of La Fontaine et al., stable fractures are non-displaced or mildly displaced fractures without dorsal fragmentation and seen in young patients.[8] In these patients treatment with a cast is usually sufficient. On the other hand, different treatment modalities should be tried in unstable fractures of the distal end of the radius. An unstable fracture should have at least three of the following criteria: a dorsal inclination of more than 20 degrees during

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fracture formation, fragmentation of dorsal metaphysis, radiocarpal intra-articular spreading, presence of an unlar styloid fracture and patient age above 60 years.[8]

Intra-articular distal radius fractures which usually occur following high energy trauma in young adults occur as a result of low energy trauma due to decreased bone quality in patients above 50 years of age. Distal radius fractures occurring as a result of a simple fall on open hand can be treated with closed reduction and cast immobilization most of the time. Although numerous fixation methods have been described for patients that cannot undergo closed reduction or are decided to be unstable following closed reduction, there is still no consensus about the appropriate treatment. Many treatment and fixation methods have been described in the literature ranging from percutaneous pinning together with closed reduction to arthroscopically supported open reduction and internal fixation technique with multiple plates (fragment specific fixation). Successful results can be obtained with the defined techniques in many distal radius fractures. Nevertheless, treatment of patients with reduced bone quality is important. Particularly, the treatment method to be chosen in intra-articular distal radius fractures in patients above 50 years should allow a more rigid fixation.

There are reports recommending avoidance of open reduction internal fixation in the presence of intra-articular fractures with severe osteoporosis in the elderly. This was concluded due to the frequent complications like implant failure, iatrogenic non-union and reflex sympathetic dystrophy in these patients.[16,17,18]

Lauber and Pfeiffer have published the results of 117 cases with distal radius fractures they treated in 1984, and have reported loss of reduction in 12% of cases, permanent intra-articular stepping or gaping in 50% of cases and failure to restore extra-articular anatomy in approximately 2/3 of cases and permanent joint pain in 60% of cases.[19] Again in 1984, Letsch et al. have evaluated 124 cases treated with a 3.5-mm T plate through dorsal and volar interventions, and have concluded that these implants are not suitable fixation devices in osteoporotic fractures and in fractures with large defects due to induction of secondary reduction losses.[20]

Successful results have been reported with the use of constant angle volar locked plates in the last decade.[21,22,23] It was aimed to reduce radial shortness and prevent secondary reduction losses, maintain palmar tilt by restoration and reduce the need for grafting by supporting the subchondral region with distal locked screws and pegs located in the design of volar constant angle plates and by placing a locked screw in the proximal of the fracture. With the exception of our patient with a residual 3-mm stepping in the joint, anatomic joint restoration was realized in all patients by relieving radial shortening and correcting palmar tilt, and none of our patients developed secondary reduction loss. Also, none our patients required grafting. Another important point is that this plate system allows earlier movement. We monitored our patients without additional casts in the postoperative period and started active movement aperture exercises of the wrist and elbow on the seventh postoperative day.

Another important point is that constant angle volar locked plates provide indirect reduction. In our technique, it is possible to provide reduction between the proximal and distal fragments by using the buttress effect of the plate after the adaptation of the anatomically compatible constant angle volar locked plate to the proximal fragment with one unlocked cortical screw following indirect reduction of intaarticular fragments with the aid of carpal bones and carpal ligaments and consequently stabilization of the fracture by placing locked screws to the screw holes matching the subchondral region of the distal fragment with the use of these plates.

Because previous plates did not have these qualifications, the use of plate screw was not recommended in osteoporotic elderly patients.[24] According to our current knowledge, osteoporosis of the fracture is among the indications for the use of plate screws. The study by Orbay and Fernandez confirming this observation of ours has also reported success with the treatment performed by the volar constant angle locked plate system in radius fractures occurring in the setting of osteoporosis in patients aged 75 years or above.[24]

Clinical evaluation of our patients at the end of the study has revealed excellent results in 20 of 28 distal radii (72%), good results in 5 (18%) and moderate results in 3 (10%), according to the clinical evaluation criteria of Gartland and Werley. Mean DASH-T value of the patients evaluated with the DASH-T scoring system was 34 (range 31 to 40). These results are similar to those in the literature. Radiologic evaluation of the patients according to Steward's radiologic scoring system has revealed excellent results in 19 fractures (68%), good results in 7 (25%) and moderate results in 2 (7%). Thus, clinical and radiologic scores were found to show compatibility.

V. CONCLUSIONS

The aims in the treatment of distal radius fractures are providing anatomic restoration, maintenance of the restoration until the fracture heals and allowing movement aperture and function by starting early rehabilitation. Rigid fixation is required particularly in patients with intaarticular distal radius fractures aged 50 years and above because of reduced bone quality. Constant angle volar locked plates are suitable materials for the fixation of these fractures. The use of constant angle volar locked plates is associated with low complication rates.

As a result of our study, the use of constant angle volar locked plates in the treatment of intra-articular distal radius fractures with low bone quality was shown to be an effective treatment method. Reliability of this method was supported by the absence of secondary reduction losses and favorable joint movements and good clinical and radiologic outcomes. We think that this method can be used as a

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reliable method in patients with low bone quality planned for surgery.

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