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Predictives of Poor Outcomes after Volar Plating an Unstable Distal Radius Fracture; A Retrospective Clinical Analysis

Dengesiz Distal Radius Kiriklarinin Volar Plaklama İle Tedavisi Sonrasinda Kötü Sonuçlarin Belirteçleri; Retrospektif Klinik Analiz

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ABSTRACT

Aim: We aimed to evaluate the functional and radiological outcomes and complications after an unstable distal radius fracture that was treated with a volar locked plate in adults and to find out the predictive factors of poor outcomes.

Patients and Method: 91 patients (55 male / 36 female) that were operated for distal radius fractures with a volar locked plate between May 2006 and August 2016 were included in this retrospective study. All fractures were classified by AO classification system. Mayo Wrist score and Quick DASH-T measure were used to quantify the functional and Steawart scores for radiological outcomes. Varying factors were evaluated for predicting the poor radiological and functional outcomes.

Results: Mean age of the patients was 46.9 years (23-72 min-max) and mean follow-up was 29.6 months (12-39 min-max) in this study. Mean union time was 7.3 weeks (6-11 min-max) for all patients. Mean Quick DASH-T score was 7.1 (0-65.9) and mean Mayo Wrist score was 85.8 (55-100) at the follow-up. There were 10 patients with various complications as; 8 patients had wound infections and 2 patients had hypertrophic scars. The strongest predictive factors of poor outcomes were the type of fracture and wound complications.

Conclusion: Volar locked plates are useful for treatment of displaced unstable distal radius fractures with acceptable complication rate and any attempt should be considered to avoid wound complications.

Keywords: distal radius fracture, volar locked plate, complications, functional outcomes

ÖZ

Amaç: Bu çalışmada dengesiz radius distal uç kırıklarının volar kilitli plak ile tedavisi sonrası işlevsel ve radyolojik sonuçları, komplikasyonları değerlendirerek, kötü sonuçların belirteçlerini ortaya çıkarmayı amaçladık.

Hastalar ve Yöntem: Mayıs 2006 ile Ağustos 2016 arasında distal radius kırığı nedeniyle volar kilitli plak uygulanmış 91 hasta (55 erkek / 36 kadın) geriye dönük çalışmamıza dâhil edildi. Tüm kırıklar AO sınıflama sistemiyle sınıflandırıldı. Mayo el bilek ve hızlı DASH-T skorları ile fonksiyonel sonuçlar, Steawart skorları ile de radyolojik sonuçlar değerlendirildi. Kötü radyolojik ve fonksiyonel sonuçların belirtecek çeşitli faktörler değerlendirildi.

Sonuçlar: Hastaların yaş ortalaması 46,9 yıl (23-72 min-maks) ve ortalama takip süresi 29,6 ay (12-39 min-maks) idi. Ortalama kırık kaynama süresi 7,3 hafta (6-11 min-maks) idi. Hastaların son kontrollerinde ortalama hızlı DASH-T skoru 7.1 (0-65.9) ve Mayo el bilek skoru 85.8 (55-100) idi. 10 hastada takipte çeşitli komplikasyonlar görülmüştü; 8 hastada yara yeri enfeksiyonu, 2 hastada hipertrofik skar görüldü. Kötü sonuçların en güçlü belirteçlerinin kırığın tipi ve yara komplikasyonları olduğu tespit edildi.

Sonuç: Volar kilitli plaklar dengesiz distal radius kırıklarının tedavisinde kabul edilebilir komplikasyon oranı ile tedavide tercih edilebilir. Yara yeri komplikasyonlarından kaçınmak için her türlü özen gösterilmelidir.

Anahtar Kelimeler; distal radius kırığı, volar kilitli plak, komplikasyonlar, fonksiyonel sonuçlar

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Introduction

Distal radius fractures are one of the most common orthopedic injuries. Most of these fractures can be treated with closed reduction and casting. Closed reduction and casting cannot provide sufficient fixation for fractures that involve articular surface of distal radius and radiologically unstable ones. Inadequate treatment results as permanent wrist pain, functional loss, deformities and joint degeneration. The goal of the treatment is to achieve and maintain an appropriate reduction and to gain a painless and full functional wrist [1].

Plate and screws were first used in 1960s for fixation of distal radius fractures and various methods were used up to today. Irregular dorsal anatomy with insufficient soft tissue cover of distal radius and related extensor tendon problems let the surgeons' decision tend to volar locked plate rather than a dorsal plate [2-4]. Flat and concave shape of volar surface with the cover of soft tissue by pronator muscle minimizes the plate tendon contact and enables an easier fixation.

In this study, we aimed to evaluate the mid and long term outcomes and complications of volar locked plates and describe the predictive factors of poor functional and radiological outcomes in unstable distal radius fractures.

Patients and Methods

We included a total of 91 patients with unstable intra-articular fractures of distal radius that underwent open reduction and volar locking plate fixation at our clinic between May 2006 and August 2016. Patients with open fractures, open physis, associated upper extremity fractures and patients who were treated with another modality were excluded from the study. Radiological instability criteria for surgical treatment in this study were; >2mm articular incongruity, >15o radial inclination, >5mm radial shortening and >20 dorsal angulations. Permission was obtained from our institutional ethics committee for the use of patient data for publication purposes and the study was conducted in full accordance with local Good Clinical Practice (GCP) guidelines.

Patient demographics, type of trauma, fracture type, associated injuries and time to fracture union was obtained from hospital records. Associated fractures, metaphyseal communution, need for bone grafting during surgery and the complications during follow-up were collected from patient records. We contacted to patients and called them for a final physical and radiological examination. All patients were evaluated for functional outcomes with DASH score (Disabilities of the Arm, Shoulder and Hand), Mayo Wrist score. All range of motion was measured with a goniometer for the affected and non-affected side of all patients. Radiographs were taken on final follow up and assessed for radial inclination, volar tilt, radial height and radio-ulnar variance. The radiological outcomes were evaluated with Stewart score system and patients were classified with 3 scales; final dorsal angle, loss of radial angle and loss of radial length. The results were reported in 4 categories as; excellent, good, fair and poor. Patients that were unable to come for a final examination were excluded from the study.

Operative Technique

All surgeries were performed with general anesthesia and a pneumatic tourniquet and through volar Henry approach. Two types of volar locking plates were used; LCP distal radius plate (Synthes Inc, Paoli, PA, USA) and Acu-Loc plate (Acumed, Beaverton, OR, USA). All patients' iliac crests were prepared before surgery in case of the need for grafting. Postoperative treatment consisted of a short arm cast for first week and finger motion was started immediately after the operation. 1 week after surgery, the cast was removed. Control radiographs were taken two weeks after surgery.

Statistical Analysis

All data were assessed with SPSS ver. 20.0 for Windows (IBM SPSS, Inc., NY, USA). We calculated the sensitivity and positive predictive value for fracture type (type B and C), associated ulnar styloid fracture, wound complications during treatment and need for bone grafting by using %95 confidence interval. The Mayo Wrist score groups (excellent and good are grouped as good; fair and poor are grouped as poor) were used as reference standard for functional outcomes and Stewart score groups (excellent and good are grouped as good; fair and poor are grouped as poor) were used as reference standard for radiological outcomes. Descriptive variables were presented as means, standard deviation and minimum/maximum values.

Results

There were 91 patients (55 male / 36 female) with mean age; 46.9 (min-max; 23-72) in this study. Mean follow up of patients was 29.6 (min-max; 12-49) months. The trauma etiologies were; fall on outstretched hand in 62 patients, motor vehicle accident in 11 patients, fall from height in 11 patients and sports trauma in 7 patients. Patients were operated mean 1.3 days (min-max; 1-11) after initial trauma.

The fractures were classified with AO/ASIF classification system and 17 patients had B3, 38 patients had C1, 28 patients had C2 and 8 patients had C3 fractures (Figure 1). In 13 patients there were associated fracture of ulnar styloid and 12 patients had associated lower extremity fractures (Table 1). Autografts were used in 11 patients and 8 of them were the referred patients that were operated in a late manner and the other patient had serious metaphyseal comminution. Mean fracture union time was 7.3 (min-max; 6-11) weeks (Figure 1).

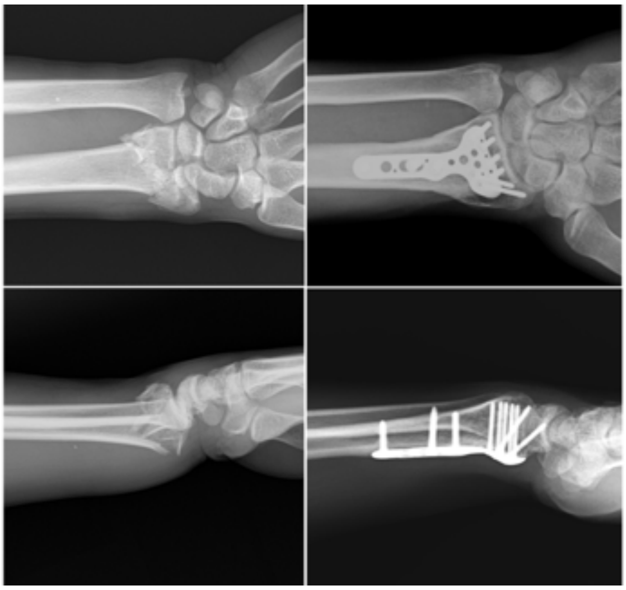

Figure 1. Pre-op and 15 months follow-up x-rays of a patient

On final examination; 39 patients had excellent (%43), 45 patients had good (%49), 7 patients had mild (%8) results with Steward radiological evaluation and 40 patients had excellent (%44), 41 patients had good (%45), 7 patients had mild (%8) and 3 patient had poor (%3) results with Mayo Wrist scores. Mean quick DASH-T score was 7.1 (min-max 0-65.9) for all patients (Table 2).

Table 1. Main Findings of Patients

Patients	91
Male / Female	55/36
Mean Age (years)	46,9 (23-72 min-max)
Mean Follow-up (months)	29,6 (12-49 min-max)
Etiology of Trauma	
Fall on Otstretched Hand	62
Motor Vehicle Accident	11
Fall from hight	11
Sports Trauma	7
Fracture Classification (AO)	
Type B3	17
Type C1	38
Type C2	28
Type C3	8
Time to surgery (days)	1,3 (1-11 min-max)
Ulnar styloid fracture	13
Mean Union Time (weeks)	7,3 (min-max)

Table 2. Outcomes at final follow-up

Radiological Outcomes	
Excellent	39 (%43)
Good	45 (%49)
Mild	7 (%8)
Poor	0 (%0)
Functional Outcomes	
Excellent	40 (%44)
Good	41 (%45)
Mild	7 (%8)
Poor	3 (%3)
q DASH-T score	7,1 (0-65,9 min-max

All patients were evaluated for the complications at the final follow up. 8 patients had superficial wound infection that was treated with oral antibiotics after surgery. 2 patients had hypertrophic scar with pain. This patient's complaint was resolved without any intervention. The positive predictive values for poor radiological outcomes were 0,83 (0,45-0,97 CI) for Type C3 fractures, 0,30 (0,115-0,52 CI) for associated ulnar styloid fractures, 0,60 (0,35-0,8 CI) for fractures with wound complications and 0,45 (0,25-0,67 CI) for fractures that needed bone grafting. The positive predictive values for poor functional outcomes were 0,87 (0,48-0,98 CI) for type C3 fractures, 0,08 (0,06-0,12 CI) for associated ulnar styloid fractures, 0,70 (0,41-0,88

CI) for fractures with wound complications and 0,54 (0,3-0,78 CI) for fractures that treated with bone grafting (Table 3).

Table 3. Main Predictive Factors of Poor Outcomes

	Radiological Outcomes	Functional Outcomes
Type C3 fracture	0,83 (0,45-0,97 CI)	0,87 (0,48-0,98 CI)
Associated Ulnar Styloid Fracture	0,30 (0,115-0,52 CI)	0,08 (0,06-0,12 CI)
Wound Complications	0,60 (0,35-0,8 CI)	0,70 (0,41-0,88 CI)
Bone grafting	0,45 (0,25-0,67 CI)	0,54 (0,3-0,78 CI)

Discussion

The main goal of the treatment of distal radius fractures is to achieve a painless and full functional wrist. There are several treatment options for these fractures and surgical intervention became more frequent by the development of new implants. Although most of these fractures can be treated with closed reduction and cast immobilization, it is not always possible to achieve a permanent fixation particularly in comminuted and unstable fractures. It is reported that 4 objectives must be corrected to achieve good functional outcomes as; radial shortening, radial inclination, dorsal slope and distal radio-ulnar joint [5]. The most important factor is to achieve an anatomic reduction of articular surface of distal radius.

Our study indicated that a type C3 fracture and wound complications during treatment were the strongest predictive factors of poor outcomes in patients with unstable distal radius fractures that were treated with volar locking plates. Although the fracture type cannot be manipulated by surgeons; it is crucial to be attentive to avoid wound complications as surgical site infections. An intensive care must be performed during surgery and post operative care particularly for patients who are under risk of surgical site infections. This finding was compatible with the study of Lee et al. in which they demonstrated the strongest predictive factors of poor functional outcomes of volar plating as diabetes and age [6]. Hence the increasing age and diabetes both weaken immune system and they are the main risk factors for surgical site infections.

The fixation method must be sufficient to maintain the reduction until the fracture union. Loss of reduction may lead disruption of the distal radio-ulnar joint and limitation of forehand supination and pronation [7]. Each treatment method has its own advantages and disadvantages. External fixators are useful to control radial length while they can cause neurapraxia of median nerve and loss of wrist motion due to the over distraction and sometimes reflex symphatic atrophy [8,9]. Nowadays they are mostly used for open fractures. Dorsal approach and plates are also having typical disadvantages as the tough anatomy of dorsal bone surface and insufficient soft tissue cover. Many complications of extensor tendon disorders after dorsal plating of distal radius were reported before [3,4,10].

Volar plating has gained popularity by minimizing these potential complications and it is reported to provide sufficient fixation even in dorsally displaced fractures [2]. When compared to dorsal approach, it is easier to place the plate to smooth surface of volar radius. The muscle belly of pronator quadratus restricts the plate-tendon contact and tendon disorder are less frequent in volar fixation [11]. Volar plates also allow for subchondral screw placement and it is shown to enhance the fixation strength [12]. Volar plates have typical complications as extensor and flexor tendon disorders, radial artery injury, carpal tunnel syndrome, injury to the superficial branch of radial nerve, compartment syndrome and loss of reduction [13-15].

Tendon penetration during drilling or irritation of tendons by over-lengthed screw is the cause of extensor tendon disorders after volar plating of distal radius [11]. Flexor tendon problems also occur but seems less frequent. In a study with 141 patients, 2 extensor pollicis longus total rupture, 4 extensor tenosynovitis and 9 flexor tenosynovitis were reported [16] although we did not observe any flexor or extensor tendon problems in our study. Carpal tunnel syndrome is another complication of volar plating and it may occur in an acute, subacute or late manner [14,16-20]. Its reported to be around 2-14% [14,17,18] after volar plating of distal radius. On the contrary there was no carpal tunnel complication in this study.

The main limitation of our study was the retrospective manner and small sample size. Future prospective studies with larger sample and including many other parameters are needed to improve our understanding of the factors that affect outcomes of volar locking plates.

In conclusion; volar plating of unstable distal radius fractures is a safe treatment choice with acceptable complications and main predictive factors of poor outcomes of volar plating are the fracture type and wound complications. Surgeons should pay attention to avoid wound complications to improve outcomes in patients with unstable distal radius fractures.

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