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Early and mid-term efficacy of volar titanium lock plate applications in radial distal intraarticular fractures

Radius alt uç eklem içi kırıklarda volar titanyum kilitli plak uygulamalarının erken ve orta dönem etkinliği

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ABSTRACT

Aim: To determine the efficacy of the functional and radiological results of the patients who underwent titanium volar locking plaque in adult distal radius fractures with early and mid-term analysis.

Patients and methods: 64 patients (67 fractured limbs) who underwent volar locking plate due to distal radius fracture were retrospectively analyzed. The mean age was 53.31 (18-75). They were classified according to the Frkyman classification and AO classification. The modified Gartlant Werley Score, Disability of the Arm, and Hand (DASH) score were evaluated according to Modified Stewart scoring system.

Results: According to Modified Gartland-Werley Score, 35 (52.2%) were evaluated as excellent, 27 (39.7%) as good, 4 (5.9%) as moderate and 1 (1.5%) as poor. The mean value of DASH score was 9.5 ± 8.8 (0-35). Palmar slope preoperatively was -5.58 ± 14.9 [(-50) - (30)], postoperatively 3.65 ± 10.88 [(- 30) - (+ 45)]. Radial height, radial inclination and palmar slope were significantly improved (p = 0.001). When Stewart radiological score was evaluated, 37 (54.4%) were excellent, 26 (38.8%) were as good and 4 (5.9%) as moderate.

Conclusion: It is possible to obtain good results in adult distal radius fractures with good evaluation of the fracture, choosing the appropriate treatment method, using the appropriate surgical technique, good anatomy and robust fixation. Detection of fracture with titanium voler plate is an effective treatment method, allowing early movement to accelerate healing and contribute positively to the result.

Key words: Distal, radius, adult, volar, locked plate, osteosynthesis.

ÖZ

Amaç: Erişkin distal radius kırıklarında titanyum volar kilitli plak uygulanan olgularımıza ait fonksiyonel ve radyolojik sonuçların erken ve orta dönem analizinin yapılarak etkinliğinin ortaya konulmasıdır.

Hastalar ve Yöntemler: Distal Radius kırığı nedeniyle volar kilitli plak uygulanan 64 hasta (67 kırık ekstremite) retrospektif olarak incelendi. 36 kadın, 31 erkek, yaş ortalaması 53.31(18-75) idi. Frkyman sınıflamasına göre ve AO sınıflamasına göre sınıflandırıldı. Modifiye Gartlant Werley Skoru, Disabilities of the Arm, Shoulder and Hand (DASH) scoru, Modifiye Stewart skorlama sistemine göre değerlendirildi.

Bulgular: Modifiye Gartland-Werley Skoruna göre 35(%52.2)'i mükemmel, 27(%39.7)'si iyi, 4(%5.9)'u orta ve 1'i kötü (%1.5) olarak değerlendirildi. DASH skoru ortalama değeri 9,5±8.8(0-35). Palmar eğim ameliyat öncesi -5.58±14.9 [(-50)-(30)], ameliyat sonrası 3.65±10.88[(-30)-(+45)] olarak değerlendirildi. İstatistiksel olarak radial yükseklik, radial inklinasyon ve palmar eğimin anlamlı düzeyde düzeldiği görüldü(p=0.001). Stewart radyolojik skoru değerlendirildiğinde 37(%54.4)'si mükemmel, 26(%38.8)'i iyi, 4(%5.9)'ü orta olarak değerlendirildi.

Sonuç: Erişkin distal radius kırıklarında iyi sonuçların elde edilebilmesi kırığın iyi değerlendirilmesi, uygun tedavi şeklinin seçilmesi, uygun cerrahi tekniğin kullanılması, Anatominin iyi oluşturulması ve sağlam fiksasyon ile mümkün olabilir. Titanyum voler kilitli plak ile kırık tesbiti etkili bir tedavi yöntemi olup erken harekete izin vererek iyileşmeyi hızlandırdığı ve sonuça olumlu katkı sağlamaktadır.

Anahtar Kelimeler: Distal, radius, erişkin, volar, kilitli plak, osteosentez.

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Distal radius fractures account for approximately 20% of fractures in the emergency department and 75% of all forearm fractures. The majority of these fractures can be successfully treated with closed reduction and plaster treatment. However, fracture fractures related to the joint face, dorsal angulation more than 20 degrees at the time of admission, excessive fragmentation of the dorsal cortex of the radius, accompanying ulna fracture, and patients above 60 years of age are considered unstable according to the criteria of La Fountain. Serious complications are encountered when unstable fractures are treated with conservative methods. Therefore, the majority of these fractures are treated surgically[1]. Although there are many different surgical options, plate-screw fixation is an important part of these methods. Distal radius fractures can be detected by external fixator. Type C fractures according to the AO / ASIF classification reported that the results of the fixed volar plate application were better and the palmar inclination and radial inclination angles were better than the external fixator cases. The disadvantage of the locked volar plate is that 28% of the plaque may need to be removed after the bone union is completed and the cost is slightly higher. Informing patients about this issue is very important.

In external fixator application, negative problems such as pin tract infection and radial nerve neuritis have been reported[2-4]. The use of external fixators may be preferred in fractures where the metaphysis is too fragmented[5]. Plastering after percutaneous fixation with closed reduction kirchner wire is a method used in multi-piece distal radius fractures. However, the combination of kirchner wire and external fixator has been suggested. It is also emphasized that this combination alone has better results than using external fixator[6-7]. The distal radius anatomy can be restored with a locked plate. In addition, the joint movement is superior to the opening of the openness[8]. Distal radius fractures may present with complex fracture types including volar and dorsal disintegration. There may be tendon injuries especially after dorsal plate-screw applications. Volar plaque-screw applications with dorsal fracture fragments are possible and due to the tendon irritation is much less volar plate-screw osteosynthesis is popular[9]. The aim of this study is to retrospectively examine adult distal radius fractures treated with anatomically locked volar plate-screw osteosynthesis by the same surgical team in our clinic; To share our experiences and opinions with the comparison of functional and radiological results with the literature.

PATIENTS AND METHODS

After the approval of the local ethics committee, he was admitted to the emergency department of our orthopedics and traumatology clinic and operated for a distal radius fracture. Sixty-eight distal radius fractures of 64 adult patients who underwent open reduction internal fixation with volar plate were retrospectively analyzed. 36 (53.7%) of the cases were female and 31 (46.2%) were male. The mean age was 53.31 (18-75). The demographic characteristics of the cases were given in a table (Table 1). The evaluation of fractures was performed according to Frykmann and AO classification (Graph 1,Graph 2.). The fractures were evaluated according to AO classification. AO Type A-16 (23.8%) patients, AO Type B 26 (38.8%) patients and AO Type C were evaluated as 25 (37.3%) patients (Figure 2).

Figure 1. Osteosynthesis of Radius Intracranial Fracture with Volar Plate Application

The patients received anterior-posterior and lateral radiographs of the wrist. Transient plaster splint was applied to the distal radius fractures of all patients. The control radiographs of the pa-

tients were taken. Distal radius inclination angle, palmar inclination angle, radial length, radial slippage were observed in these radiographs. Joint mismatch was evaluated. Unstable fractures were treated surgically using the di La Fountain Scoring System ".After fluoroscopy control, osteosynthesis was achieved in all cases by using the same brand distal radius volar locking plate-screw system. After fixation, transient K-wires were removed after fluoroscopy control. (Figure 1, 1b). Finger movements within the splint were allowed to facilitate rehabilitation after surgery. Plaster-splint was terminated after 3 weeks. After the removal of the splint, the forearm pronation-supination, wrist flexion-extension-abduction-adduction movements were started. The sutures of all patients were taken on the 15th postoperative day. Patients with a mean follow-up period of 20 (6-30) months were evaluated clinically and radiologically in the outpatient clinic follow-up at the 6th month and they were called back for follow-up every 6 months. In the evaluation of clinical results, Modified Gartlant Werley Scoring System and Turkish modification of the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH-T) were used [10,11]. Radiological results were evaluated ac-cording to Stewart criteria[12].

Figure 2. Application of temporary kirshner wire and locked volar plate in fluoroscopy control

Table 1.Demographic characteristics of the cases

Gender	36(Women),31(Male)
Age	53(18-75)
Fracture type (Accordind to AO classification)	16 type A (%23,8), 26 type B(%38.8), 25 type C(%37.3)
Dominant side	58(Right),9(Left)
Broken side	31(Right),36(Left)
Mechanism of injury	Siple fall 55 (%82.4)
	Occupation
	Additional injury
	Other 2(%2.9)
Occupation	Hause wife 32(%47.7)
	Workers10 (%14.7)
	Tradesment 2 (%2.9)
	Şöför 2(2.9)
	Other21(%31.3)
Additional injury	Clavicle fracture 2
	Distal humeral fractures 1
	Vertebra fracture 2
	Radius fracture (Opposite) 2
	Cot fracture 2
	Pelvic fracture 1
	Metatarsal fracture 1
	Olekranon fracture1
	Nasal bone fracture 1
	Bimalleoler fracture 1

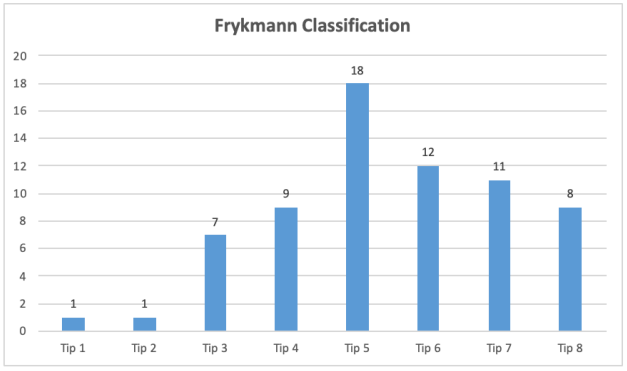
Ethical approval: This study was approved by local Ethics Committee.

Statistic Analysis: It was used for statistical analysis of data (IBM SPSS Statistic 22 program).

RESULTS

According to Frkyman classification, 1 case type1 (1.5%), 1 case type 2 (1.5%), 7 cases type3 (10.3%), 9 cases type 4 (13.2%), 18 cases type 5 (12 patients were evaluated as type 6 (17,6), 11 patients as type 7 (16,2%), 8 patients as type 8 (13,2). When the cases were classified according to the AO classification, 16 fracture type A (23.8%), 26 fracture type B (38.8%) and 25 fracture type C (37.3%) were found. When the patients were evaluated according to Modified Gartland-Werley Scoring System, 35 (52.2%) of 67 distal radius fractures were excellent; 1.5%) (Graph 3). When the patients were evaluated according to DASH-T questionnaire results, our mean score was 9.5 ± 8.8 (0-35). When the patients were evaluated radiologically, radial height

values were evaluated as mean 5.62 ± 5.2 [(- 10) - (+ 16)] and 9.53 ± 3 [(- 5) - (+ 16)] postoperatively. The distal radial angle of inclination was 9.06±8.4[(-17)-(+24)] preoperatively and 20.06±6.5(4-35) postoperatively.The preoperative Radial Palmar slope was-5.58 ± 14.9 [(-50) - (30)] and postoperatively 3.65 ± 10.88 [(-30)-(+45)]. When the results were compared statistically, radial height, distal radius inclination angle and palmar angle of inclination were found to be significantly improved (p=0.001) (Table 2). When the cases were evaluated radiologically according to the Modified Stewart Radiological Scoring System 38, 37 (55.2%) were excellent, 26 (38.8%) were in good and 4 (5.9%) were in the middle (Graph 4). No complications were encountered during the operation. No wound infection was detected in any patient in the early postoperative period. A total of 6 cases (8.8%) with complications were observed. False union-2 cases, nonunion-1 case, 1 year after surgery on the detection of carpal tunnel syndrome implants and transverse carpal ligament relaxation 1 case applied. One case with implant removal at the 1st year upon implant fixation. One case with hypoesthesia was detected in the radial nerve sensory area and the patient had improvement. The follow-up period of the patients was short, but none of the patients had osteoarthritic changes.

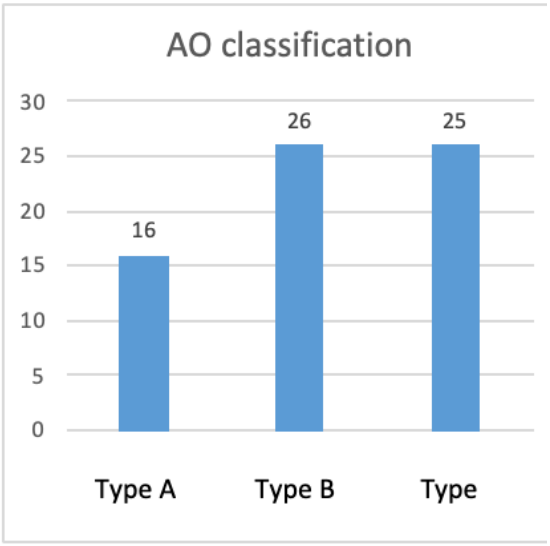


Graphic 1

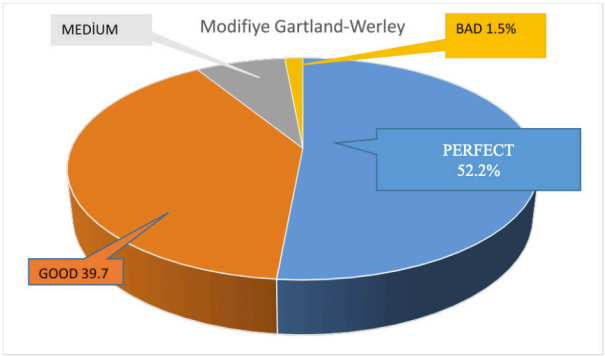
Graphic 1. Distribution of forty types according to Frykmann classification

DISCUSSION

The incidence of distal radius fractures has increased due to the increasing life span, modernized traffic accidents and increase in sports activities. Similarly, modern medical developments have increased the expectation of success in the treatment of distal radius fractures. Intact fracture fixation with new technological implants led to early mobilization, which enabled early return to daily life after treatment. Treatment goals are to achieve full mobility, to limit the development of arthritis after fracture and to prevent complications[11]. In order to achieve these goals, volar plate applications are a suitable treatment method. When the literature is examined, female male ratio for distal radius fractures is found in Tarallo et al.[12] as reported. This situation is attributed to the more frequent occurrence of osteoporosis. Fractures in young men are caused by severe trauma[14].



Graphic 2. Distribution of fracture types according to AO Classification



Graphic 3

Graphic 3. Modified Gartland-Werley Scoring results

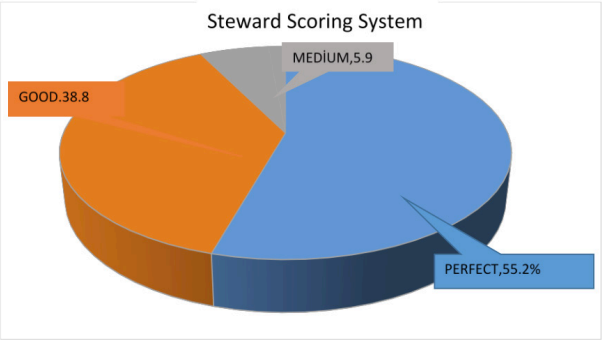
In our study, female male ratio was reported as 36 (F) / 31 (E). Mignemi et al.[15] in his 185 patients in the study of 49 patients and Williksen et al.[16] done in the study of 104 patients with a mean age of 54 was found in our study, the average age was 53.31 (18-75) and is similar.The mean age of our patients is below 65 years. When the literature is examined, there is no consensus that even the patients aged 65 and over are right to be treated conservatively in the distal radius fracture. Although most authors believe that long-term results after surgical treatment are the same as conservative treatment, it has been proven that treatment with voler lock plate accelerates recovery even in elderly patients[17]. Yin SQ et al.[18] reported that palmar slope, radioulnar changes, radial elevation were the radiological parameters that should be evaluated and the most important radial height was emphasized. In our study, these criteria were the most important criteria in volar plate application. Radial length was tried to be provided with intraoperative scopy control closest to the original length. In the study by Knirk et al.[19], Cooney et al.[20](83%) had distal radius fractures in 58% and dominant extremities in 83% of the cases. In our study, 86% of the cases had fractures in the dominant extremity. The reason for the excessive fracture in the dominant extremity may be the use of dominant extremity as a reflex reflex during fall. When the literature is examined, it is reported that the most common radial lower extremity fractures are occurred[21-23]. Sugün et al.[24] Bacorn and Krutzke.[23] In 2047 cases, 91% of the distal radius fracture was seen as a simple fall. In our study, 82.4% simple fall, 10.3% traffic accident, 4.4% was due to work accidents. These data are consistent with the literature.

Table 2. Comparison before and after surgery

	preoperative	Postoperative	P value
Radial height	5.62±5.2	9.53± 3	0.001
Radial İnclination	9.06±8.4	20.06±6.5	0.001
Palmar İnclination	-5.58±14.9	3.65±10.88	0.001

Partial wrist fractures can be seen in patients with multiple trauma. Especially, dislocation of the shoulder, elbow fracture and dislocation, carpal and metacarpal bone fractures may occur in the formation of nerve nerve lesions[25]

Complications are rare in distal radius fractures. Tarallo et al.[12] investigated the complications of treatment in a 315-case study that was treated with volar plate fixation. According to this study, 1.6% extensor tenosynovitis, 1% extensor tendon rupture, 0.7% flexor tendon rupture, 0.7% flexor tendon tenosynovitis, 0.7% loss of screw fixation, 0.3% lunate facet loss loss, 0.3% distal radioulnar joint injury with screws 0.3% median nerve damage, 0.3% infection complications. One study reported that although intramedullary fixation of the distal radius fractures was less invasive, the patient could not avoid common complications such as trigger finger and carpal tunnel syndrome[26]. Similarly, in another study, it was reported that the results of volar locking plate and intramedullary fixation were similar and both techniques did not reduce postoperative complications[27]. In our study, one patient had loss of screw fixation, 1 patient had median nerve damage and 1 patient had loss of sensation in the radial nerve sensation area. Hershman et al.[28] studied the repair and functional effects of pronator quadratus in patients who underwent volar plate in a 606 case study. There was no significant difference between pronation and pronation range of motion between groups with and without pronator quadratus repair. Goorens CK et al.[29] reported that proximal positioning of the volar plating and good Pronotor quadratus muscle repair in the distal radius fractures reduced the flexor pollicis longus tendon damage.



Graphic 4

Graphic 4. Evaluation of Modified Stewart Radiological Scoring System

In our study, care was given to the placement position of the volar plate to prevent tendon irritation, and pronator quadratus muscle repair was performed routinely. In addition, plate fixation has been a major contributor to the prevention of flexor pollicis longus tendon rupture and to a bet-

ter understanding of tendon kinematics[30]. In a study by Gyurizca et al.[31] implants due to various complications such as wrist voler region pain, extensor pollicis longus rupture, flexor tenosynovitis, intraarticular screw penetration, radial pain, and volar plate-screw fixation due to distal radius fracture were performed after 63 weeks. In 28 patients, there was a significant improvement in the complaints after surgery. Since our follow-up period was short, only 4 patients were operated because of the implants. One of these patients was operated due to screw fixation loosening and the other 3 was operated because of wrist volar region pain. There was a significant improvement in the complaints of the patients after surgery. A study by Keizer et al.[32] Modified Gartland Werley Score of 26 patients over 50 years old, 14 patients were excellent, 11 patients were good, 1 patient was moderate[10]. Kamano et al.[33] performed 33 patients in a study of the Modified Gartland Werley Score in 12 patients excellent, 20 patients good, 1 patient had a moderate result[10]. In our study, clinical results were evaluated with Modified Gartland Werley Scoring System. Similarly, 35 of the 67 distal radius fractures were excellent (52.2%), 27 were good (40.2%), 4 were moderate (7.4%), and 1 was bad (1.5%). According to a multicentre study by Margaret and Fok.34, DASH-T score after treatment was 8 on average. In a study conducted by Sügün et al.[24], the average value was calculated as 15.9. In our study, the mean of DASH-T score was 9.5 ± 8.8 (0-35). Stewart Radiological Scoring System was used for radiological evaluation[12]. 37 of the cases were excellent (55.2%), 26 were good (38.8%), and 4 were moderate (5.9%). New studies showing that the biomechanics of the distal radio-ulnar joint are affected in Dista radius fractures especially in the fracture extending joints and new studies showing that the lower extremity radio-ulnar joint may be affected in the distal radius maluniondemonstrates the importance of correct evaluation of surgical fractures and correct evaluation of fractures[35]. In addition to this new information, the anatomical detection of the fracture and the better provision of the radio-ulnar joint relationship increased the value of the locked plate applications. It has been reported that the surgical treatment of distal radius fractures in the finish with volar locking plate almost replaced the external fixator and wig-fixation[36]. There were no serious complications during and after surgery. Due to the careful surgical approach, careful selection of the implant suitable for the fracture type, careful control of the bleeding, and early joint rehabilitation, our complication rates have decreased. We think that internal fixation is important in joint restoration, especially as the fracture type becomes complex. We also think that early recovery and early rehabilitation started to contribute positively.

As a conclusion; We believe that the results of distal radius fractures operated by the same surgical team in our clinic are satisfactory and it is a valuable study with a follow-up period of 20 months. Achieving good results; We think that it is possible to evaluate the fracture, to choose the appropriate treatment method, to use the appropriate surgical technique, to ensure anatomical joint integrity and to fix the fracture. Titanium voler lock plate application is an effective treatment for fracture detection. We believe that by allowing early movement, it accelerates recovery and makes a positive contribution to the outcome.

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