



## The effect of early weight-bearing on comminuted calcaneal fractures treated with locking plates

Erken yüklenmenin kilitli plaklar ile tedavi edilen çok parçalı kalkaneus kırıkları üzerine etkisi

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**Objectives:** This study aims to evaluate the possible effects of early weight-bearing on clinical and radiological outcomes of comminuted calcaneal fractures treated with locking plates.

**Patients and methods:** This retrospective study included 15 patients (12 males, 3 females; mean age 40.1 years; range 18 to 55 years) with comminuted calcaneal fractures between October 2010 and April 2012. Standard lateral extensile approach was carried out for surgical exposure. A corticocancellous allograft was used to fill the defect following the reduction and fixation of posterior facet. Titanium locking plates and screws were used to maintain reduction. The patients were encouraged for a limited weight-bearing at six weeks postoperatively, if tolerated. All patients were able to full weight-bear at 12 weeks postoperatively. Clinical and radiological assessments were performed using the American Orthopaedic Foot and Ankle Society (AOFAS) and Maryland scores.

**Results:** The mean follow-up was 19 months (range, 12 to 27 months). The AOFAS and Maryland scores were 89 and 88.46 points, respectively. The Böhler's angle showed 0.3° loss from early post-surgery to the last visit. Among the workers, all returned to work but one with Sanders type IV fracture and all retired patients returned to their daily activities. The functional status of the patient with Sanders type IV fracture was poor according to the AOFAS and Maryland criteria.

**Conclusion:** Based on radiographic and clinical assessment, there was no unfavorable effect of early weight-bearing after calcaneal fracture surgery. Therefore, these results suggest that sufficient stability can be achieved by locking plates in comminuted calcaneal fractures, when early weight-bearing is recommended, even.

**Key words:** Böhler's angle; calcaneus; early weight-bearing; fracture; locking plate; open reduction.

**Amaç:** Bu çalışmada erken yüklenmenin kilitli plaklar ile tedavi edilen çok parçalı kalkaneus kırıklarının klinik ve radyolojik sonuçları üzerindeki muhtemel etkileri incelendi.

**Hastalar ve yöntemler:** Bu geriye dönük çalışmaya Ekim 2010 ve Nisan 2012 tarihleri arasında çok parçalı kalkaneus kırığı olan 15 hasta (12 erkek, 3 kadın; ort. yaş: 40.1 yıl; dağılım 18-55) dahil edildi. Cerrahi yöntemde standart lateral genişletilmiş yaklaşım uygulandı. Arka faset ekleminin redüksiyonu ve tespitinin ardından, defekt kortikokansellöz allogreft ile dolduruldu. Redüksiyonun devamlılığı titanyum kilitli plak ve vidalarla sağlandı. Hastaların ameliyat sonrasında altıncı haftada tolere edebildikleri kadar kısmi yük yüklenmesi sağlandı. Tüm hastalar ameliyat sonrası 12. haftada tam yük yükleniyorlardı. Klinik ve radyolojik değerlendirmeler Amerikan Ortopedik Ayak ve Ayak Bileği Derneği (AOFAS) ve Maryland skorları ile yapıldı.

**Bulgular:** Ortalama takip süresi 19 ay (dağılım, 12-27 ay) idi. Amerikan Ortopedik Ayak ve Ayak Bileği Derneği ve Maryland değerlendirme puanları sırasıyla 89 ve 88.46 idi. Erken ameliyat sonrasında son kontrole kadar Böhler açısında 0.3° kayıp belirlendi. Sanders tip IV kırığı olan biri dışında tüm hastalardan çalışanlar önceki işlerine, emekli olanlar ise önceki güncel aktivitelerine geri döndü. Sanders tip IV kırığı olan bu hastanın fonksiyonel durumu AOFAS ve Maryland kriterlerine göre kötü idi.

**Sonuç:** Radyografik ve klinik değerlendirmeye göre, erken yüklenmenin kalkaneus cerrahisi sonrası sonucu bozan herhangi bir etkisi saptanmadı. Bu nedenle, bu sonuçlar parçalı kalkaneus kırıklarında, erken yüklenme önerildiği durumlarda dahi, kilitli plaklarla yeterli stabilitenin sağlanabileceğini göstermektedir.

**Anahtar sözcükler:** Böhler açısı; kalkaneus; erken yüklenme; kırık; kilitli plak; açık redüksiyon.

The surgical treatment of displaced calcaneus fractures has been favorable for two decades.<sup>[1-4]</sup> Closed reduction percutaneous fixation, open reduction via extensive or mini incision and internal fixation are the most common procedures.<sup>[3,4]</sup> The literature agrees that weight-bearing should be avoided roughly three months postoperatively due to the possible risk of collapsed talocalcaneal articular surface.<sup>[5,6]</sup>

The introduction of locking plates in orthopedics has changed the biomechanical durability of bone and fracture. Although the advantages of locking plates on calcaneus fractures are controversial, many studies proved the superiority of locking plates over conventional constructions.<sup>[7,8]</sup>

In this study, we aimed to evaluate the possible effects of early weight-bearing on clinical and radiological outcomes of comminuted calcaneal fractures treated with locking plates.

#### PATIENTS AND METHODS

This retrospective study included 15 patients (3 females, 12 males; mean age 40.1 years; range 18-55 years) with Sanders type III (n=11) and IV (n=4) fractures between October 2010 and April 2012 (Figure 1). The etiology was identical for all cases including falling from a height. The Sanders type I and II fractures, open fractures, extra-articular fractures, non-displaced fractures, those with multiple injury, bilateral calcaneal fractures, patients younger than 18, and pathologic fractures were excluded. All cases underwent computed tomography (CT) for the evaluation of fracture pattern at emergency



**Figure 1.** Preoperative lateral X-ray.

department including axial, coronal, and sagittal views (Figure 2a-c). Following referral to our clinic, short leg splint was applied with elevation, ice, and resting recommendations. The patients with a positive wrinkle test underwent surgery. An informed consent was taken from each patient. The mean time from admission to surgery was 5.7 days (range 3-10 days).

Under pneumatic tourniquet, an extensive L shape incision was performed, as described by Benirschke and Sangeorzan.<sup>[9]</sup> The full thickness flap was retracted by using Kirschner wires (K-wires) which were put into the talus and bent. The bulge lateral cortical wall retracted, depressed posterior calcaneal facet was elevated, and then talocalcaneal joint was restored. One or two screws were used to fix the facet joint to sustentaculum tali. The bony defect was filled by using a cortico-cancellous bone allograft. The fixation was achieved with low profile locking plates and 3.5 mm screws (Figure 3).

Active and passive ankle rehabilitation was instructed after removal of drains. The patients were followed at six-week intervals in our outpatient clinic after discharge. The patients were also encouraged for a limited weight-bearing at six weeks postoperatively as follows: toe touch for a couple of days,  $\frac{1}{4}$  of body mass for two weeks,  $\frac{1}{2}$  of body mass for the next two weeks, and  $\frac{3}{4}$  of body mass for the last two weeks by using scale. All patients were able to full weight-bear at 12 weeks postoperatively.

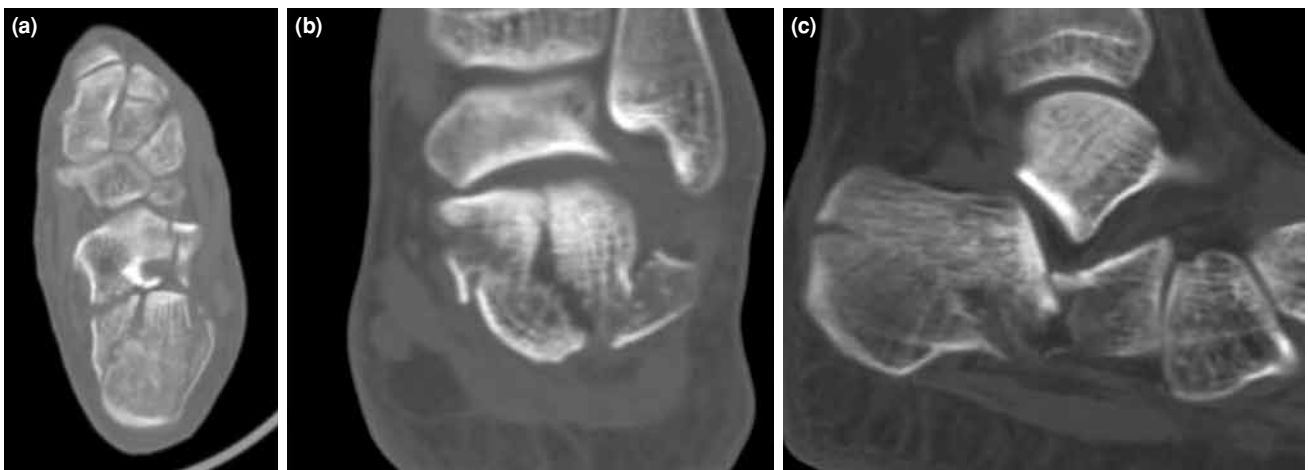
Clinical evaluation was done by using the American Orthopaedic Foot and Ankle Society (AOFAS) and Maryland scores at the last visit.<sup>[10,11]</sup> Preoperative, early postoperative, and the last visit Böhler's angles and amount of depression at the posterior facet were measured by a single surgeon. Non-parametric paired two-sample tests were used for statistical analysis. A *p* value of <0.05 was considered statistically significant.

#### RESULTS

The mean follow-up was 19 months (range, 12 to 27 months). All fractures healed (Figure 4a, b). The Maryland and AOFAS evaluation scores at the last visit were 89 points (72-99) and 88.46 (63-100), respectively.

The preoperative Böhler's angle was improved from 10.46° (8°-14°) to 23° (20°-28°) postoperatively. It was 22.7° (18°-28°) at the last visit. We did find no statistical difference between postoperative and last visit values (*p*=0.5).

The mean preoperative amount of depression at the posterior facet joint line was 5 mm (4-7).



**Figure 2.** (a) Preoperative axial, (b) coronal and (c) sagittal computed tomography scans of foot revealing Sanders type IIIAB fracture.

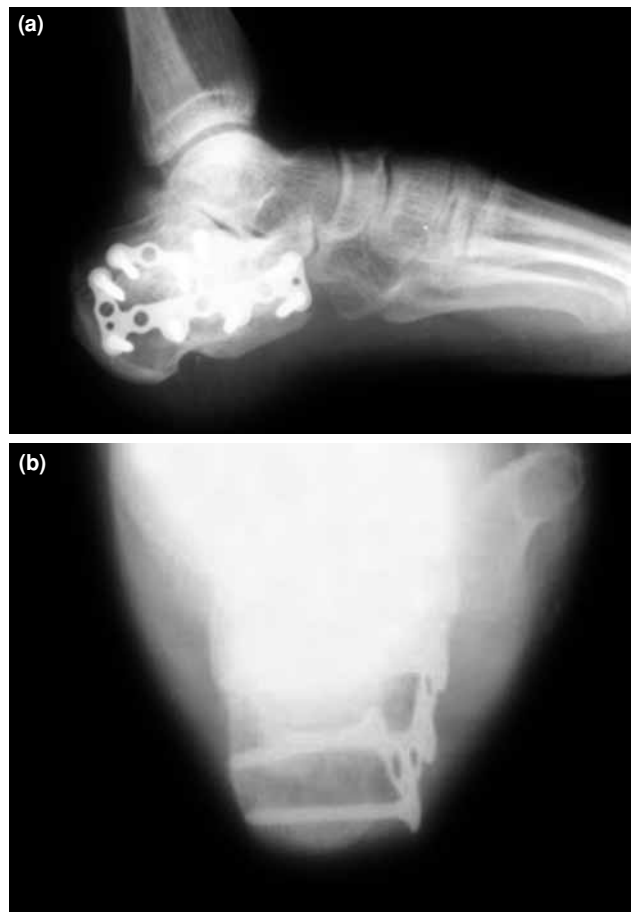
It was measured as 0.4 mm (0-2) and 0.66 mm (0-2) postoperatively and at the last visit, respectively.

Complications were categorized as minor and major. There was no deep infection. Superficial infection was defined as minor complication and occurred in three patients (20%). All were treated by local wound care and oral antibiotics. Another three cases had wound edge necrosis. However, two of them healed by wound care seamlessly, but one did not. The hardware was exposed at the second month postoperatively. The patient was then referred to a plastic surgeon and facio-cutaneous flap was performed. The patient was seen at the outpatient clinic at four months postoperatively. The wound was closed and he was pain-free and function result was

good according to the Maryland scores and AOFAS criteria. Talocalcaneal joint arthritis was identified at the last visit by using hind foot CT (Figure 5).<sup>[12]</sup> We observed seven type I, six type II, and two type III talocalcaneal arthritis. No sural nerve-related



**Figure 3.** Postoperative lateral X-ray.



**Figure 4.** Thirteen months follow up; (a) lateral, (b) Harris X-ray.

**TABLE I**  
The demographic, clinical, and radiological data of patients

No	Age/sex	Type (sanders)	Follow-up (months)	Maryland	AOFAS	Böhler preoperative	Böhler early postoperative	Böhler late postoperative	P.F.D. preoperative (mm)	P.F.D. early postoperative (mm)	P.F.D. late postoperative (mm)	Complication	Arthritis
1	26/F	III	17	88	85	13°	26°	26°	4	1	1	-	II
2	50/M	III	18	97	100	12°	28°	28°	4	0	0	-	I
3	34/M	III	13	87	88	14°	25°	25°	5	0	1	Wound edge necrosis	II
4	41/M	III	12	99	100	10°	20°	20°	4	0	0	-	I
5	52/M	III	25	98	100	12°	23°	23°	5	0	0	Superficial infection	II
6	33/M	III	20	89	88	11°	25°	25°	4	0	0	-	I
7	18/M	III	22	80	84	9°	22°	21°	4	0	0	-	I
8	51/F	III	12	99	93	10°	25°	25°	6	0	0	-	I
9	55/M	IV	12	86	82	11°	27°	26°	7	2	2	Wound edge necrosis	III
10	52/M	III	21	94	99	8°	22°	22°	6	0	1	Superficial infection	I
11	52/M	III	27	83	87	8°	20°	20°	5	1	1	-	II
12	43/M	IV	24	97	100	10°	21°	21°	4	0	1	Superficial infection	II
13	45/M	IV	26	72	63	12°	20°	18°	6	1	2	Persistent pain	III
14	24/M	III	14	91	80	9°	21°	21°	7	0	0	Wound edge necrosis	I
15	26/F	IV	22	75	78	8°	20°	20°	5	1	1	-	II

AOFAS: American Orthopaedic Foot and Ankle Society; P.F.D.: Posterior facet depression.



**Figure 5.** Talocalcaneal joint arthritis classification.

complication was observed. All patients were satisfied with the treatment except one. He was 45-year-old male with Sanders type IV fracture. His functional scores were as follows: Maryland 72 and AOFAS 63. He was unable to return to work due to persistent pain (Table I).

**DISCUSSION**

The tendency towards surgical treatment for intra-articular calcaneus fractures has been increasing thanks to superior clinical and radiological results on conservative methods.<sup>[13,14]</sup> On the other hand, locking plates have been widely adopted for almost two decades. Although some reported no beneficial effects of locking plates over conventional ones, most recent reports used locking plates.<sup>[15,16]</sup> In addition, some studies reported the advantages of early weight-bearing by using locking plates. However, the traditional concept on early weight-bearing after calcaneal fractures has not been changed in textbooks yet.

Kienast et al.<sup>[17]</sup> reported the results of early weight-bearing treated via locking plates in 136 patients with Sanders type II, III, and IV fractures. Initially, the patients were allowed for 10 kg weight-bearing at 12 weeks postoperatively. However, the authors identified local osteoporosis and changed the protocol as 20 kg weight-bearing at six weeks, 40 kg at eight weeks, and full bearing at 10 weeks.

Hyer et al.<sup>[15]</sup> reported different scope after stabilization with locking plates and early weight-bearing. The authors compared the Böhler's angle postoperatively, at first weight-bearing day and at the last visit. After eight months follow-up period, they measured 1.65° loss of Böhler's angle. They reported promising radiographic results with locking plates and early weight-bearing without sacrificing fixation or correction.

Furthermore, we found similar results in terms of the mean preoperative Böhler's angle which improved from 10.46° to 23° immediate postoperatively. It was measured as 22.7° at 19 months during follow-up,

indicating no significant difference statistically. We believe intervention via locking plates and early weight-bearing does not lead to loss of correction and stabilization as others, even if minimal invasive techniques are performed.<sup>[4,18]</sup> Similarly, the amount of depression on posterior facet showed a slight loss from early postoperative X-ray to the last visit.

Tomesen et al.<sup>[19]</sup> reported their results after closed reduction and percutaneous screw fixation. They encouraged the patients for early weight-bearing at six weeks postoperatively. After a mean follow-up time of 65 months, they found AOFAS and Maryland scores as 84 and 86 points, respectively.

On contrary, Basile treated 42 Sanders type II and III fractures using extensile approach and allowed the patients for weight-bearing at 12 week, postoperatively. The mean AOFAS scores of Sanders type II fractures were 81.15 and of Sanders type III fractures were 80.56 points after a mean follow-up of 4.8 years.<sup>[20]</sup>

Another study including 35 patients who were older than 65 years was reported by Herscovici et al.<sup>[21]</sup> They treated their patients with lateral extensile approach. The mean AOFAS score was 82.4 points after a mean follow-up of 43.9 months.

In consistent with the previous study findings, the AOFAS and Maryland scores were 89 and 88.46 points, respectively in our study after a mean follow-up of 19 months. It seems that early weight-bearing following an improved stability of locking plates has no deleterious effect on clinical and radiological outcomes, as shown by Hyer et al.<sup>[15]</sup> before. In our series, there was only 0.3° loss in Böhler's angle from early postoperative view to the last visit, indicating no statistically significant difference. Moreover, early weight-bearing may have an effect on preventing local disuse osteoporosis, as described by Kienast et al.<sup>[17]</sup> They also noticed that early weight-bearing group had better AOFAS results compared to the others.

However, our study has some limitations. First, it had a small sample size. Second, the follow-up period was short and a 19-month follow-up was inadequate to evaluate the definite talocalcaneal arthritis. Another limitation was the lack of control group which was managed according to the point of long-term weight-bearing restriction protocol. Therefore, further comparative large-scale studies with longer follow-ups are required to evaluate the outcomes of early weight-bearing after surgical treatment of calcaneal fractures.

In conclusion, our study revealed that early weight-bearing at six weeks after surgery has no deleterious effect on clinical and radiological outcomes of comminuted calcaneal fractures.

#### Declaration of conflicting interests

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