



## Early results of open mosaicplasty in osteochondral lesions of the talus

### *Talus osteokondral lezyonlarında açık mozaikplasti uygulamalarımızın erken dönem sonuçları*

Ayhan KILIC, Yavuz KABUKCUOGLU, Murat GUL, Ufuk OZKAYA, Sami SOKUCU

*Taksim Education and Training Hospital Orthopaedics and Traumatology Department*

**Amaç:** Bu çalışmada, kronik seyirli yakınmalara neden olan talus osteokondral lezyonlarının tedavisinde açık mozaikplastinin erken dönem sonuçları değerlendirildi.

**Çalışma planı:** Çalışmaya talus çatısında osteokondral lezyon saptanan sekiz hasta (1 erkek, 7 kadın; ort. yaş 35; dağılım 18-74) alındı. Tanı öncesi geçen süre ortalama 11 aydı. Ortalama büyüklüğü 17x9 mm olan lezyonlar, beş hastada medial, üç hastada lateral yerleşimliydi. Bristol sınıflamasına göre, lezyon evreleri iki hastada evre IIa, bir hastada IIb, iki hastada III, bir hastada IV, iki hastada ise V idi. Hastaların tümünde mozaikplasti, osteotomili mini artrotomi yöntemi ile uygulandı. Hastalar, ameliyat öncesi ve sonrası dönemde Amerikan Ortopedik Ayak ve Ayak Bileği Derneği'nin (AOFAS) skorlama sistemiyle değerlendirildi. Ağrı değerlendirmesinde görsel analog skala kullanıldı. Lezyon bölgesindeki yeni kıkırdak gelişimi manyetik rezonans görüntüleme ile incelendi. Ortalama takip süresi 17 ay (dağılım 8-34 ay) idi.

**Sonuçlar:** Osteotomi sahası tüm hastalarda ortalama altı haftada kaynadı. Ameliyat öncesi 58 (dağılım 40-68) olan AOFAS puanı son kontrolde 89'a (dağılım 80-97) yükseldi ( $p<0.005$ ). Ameliyat öncesi ortalama 8 (dağılım 5-10) olan ağrı puanı ise son kontrolde 2'ye (dağılım 1-4) düştü ( $p<0.005$ ). Mozaikplasti girişimi sonrasında sadece bir hastada komplikasyon görüldü. Hastaların tümü ameliyat öncesindeki iş ve uğraşlarına döndü. Manyetik rezonans incelemede, tüm hastalarda osteokondral greft alanında bütünlüşme görüldü.

**Çıkarımlar:** Açık mozaikplasti, talus çatısının özellikle kistik yapılı ve 10 mm'den büyük çaplı kıkırdak kayıplarının tedavisinde basit, güvenilir ve etkili bir tedavi seçeneğidir.

**Anahtar sözcükler:** Kemik transplantasyonu; kıkırdak/transplantasyon; osteokondrit/cerrahi; talus/yaralanma/cerrahi.

**Objectives:** The aim of this study was to evaluate early results of open mosaicplasty for the treatment of talus osteochondral lesions associated with chronic complaints.

**Methods:** The study included eight patients (1 male, 7 females; mean age 35 years; range 18 to 74 years) with osteochondral lesions of the talar dome. The mean duration of symptoms was 11 months and the mean lesion size was 17x9 mm. The lesions were of medial localization in five patients, and lateral localization in three patients. According to the Bristol classification, the stages of the lesions were as follows: stage IIa (n=2), IIb (n=1), III (n=2), IV (n=1), and V (n=2). Mosaicplasty was performed via a mini arthrotomy with osteotomy. Functional assessments were made using the AOFAS (American Orthopaedic Foot & Ankle Society) scoring system pre- and postoperatively. Pain was assessed using a visual analog scale. Regeneration of new cartilage tissue at the lesion site was monitored by magnetic resonance imaging. The mean follow-up was 17 months (range 8 to 34 months).

**Results:** The osteotomy site healed in a mean of six weeks in all the patients. The mean pre- and postoperative AOFAS scores were 58 (range 40-68) and 89 (range 80-97), respectively ( $p<0.005$ ). Pain scores decreased from a mean of 8 (range 5 to 10) to 2 (range 1 to 4;  $p<0.005$ ). Surgery-related complication was seen in one patient. All the patients returned to preoperative levels of activity and occupation. Magnetic resonance imaging showed graft incorporation in all the patients.

**Conclusion:** Open mosaicplasty is a simple, safe, and effective alternative in the treatment of cartilage losses of the talar dome, in particular those of cystic type and exceeding 10 mm in size.

**Key words:** Bone transplantation; cartilage/transplantation; osteochondritis/surgery; talus/injuries/surgery.

*Presented as an oral presentation in 5. EFOST 2008 congress (26-29 November, Antalya).*

**Correspondence / Yazışma adresi:** Dr. Ayhan Kılıç, Taksim Education and Training Hospital Orthopaedics and Traumatology Department, 34433 Beyoğlu, İstanbul. Phone: +90212 - 252 43 00 / 1403 e-mail: kilicayhan@yahoo.com

**Submitted / Başvuru tarihi:** 28.09.2008 **Accepted / Kabul tarihi:** 25.03.2009

© 2009 Türk Ortopedi ve Travmatoloji Derneği / © 2009 Turkish Association of Orthopaedics and Traumatology

Osteochondral lesions (OCL) of talus are associated with pain, edema and movement dysfunctionality that lead to limitations in daily life. Though the most significant factor is known to be trauma, the etiology of OCL is still unknown at all.<sup>[1]</sup> OCL, as the most common definition of this pathology, may occur as a result of direct impact of the trauma on the site of lesion. Also, subchondral circulation disorders related to ankle sprains may trigger OCL.<sup>[1, 2]</sup> Other etiological factors may be suggested as malalignments, endocrine disorders, exposure to hyperbaric conditions and osteonecrosis.<sup>[3]</sup> A carefully acquired patient history and physical examination followed by plain radiography (standard and special positions) can be helpful for diagnosis. Moreover, magnetic resonance imaging as well as T<sup>99</sup> bone scintigraphy and arthroscopy have exceptional importance in diagnosis.<sup>[4]</sup>

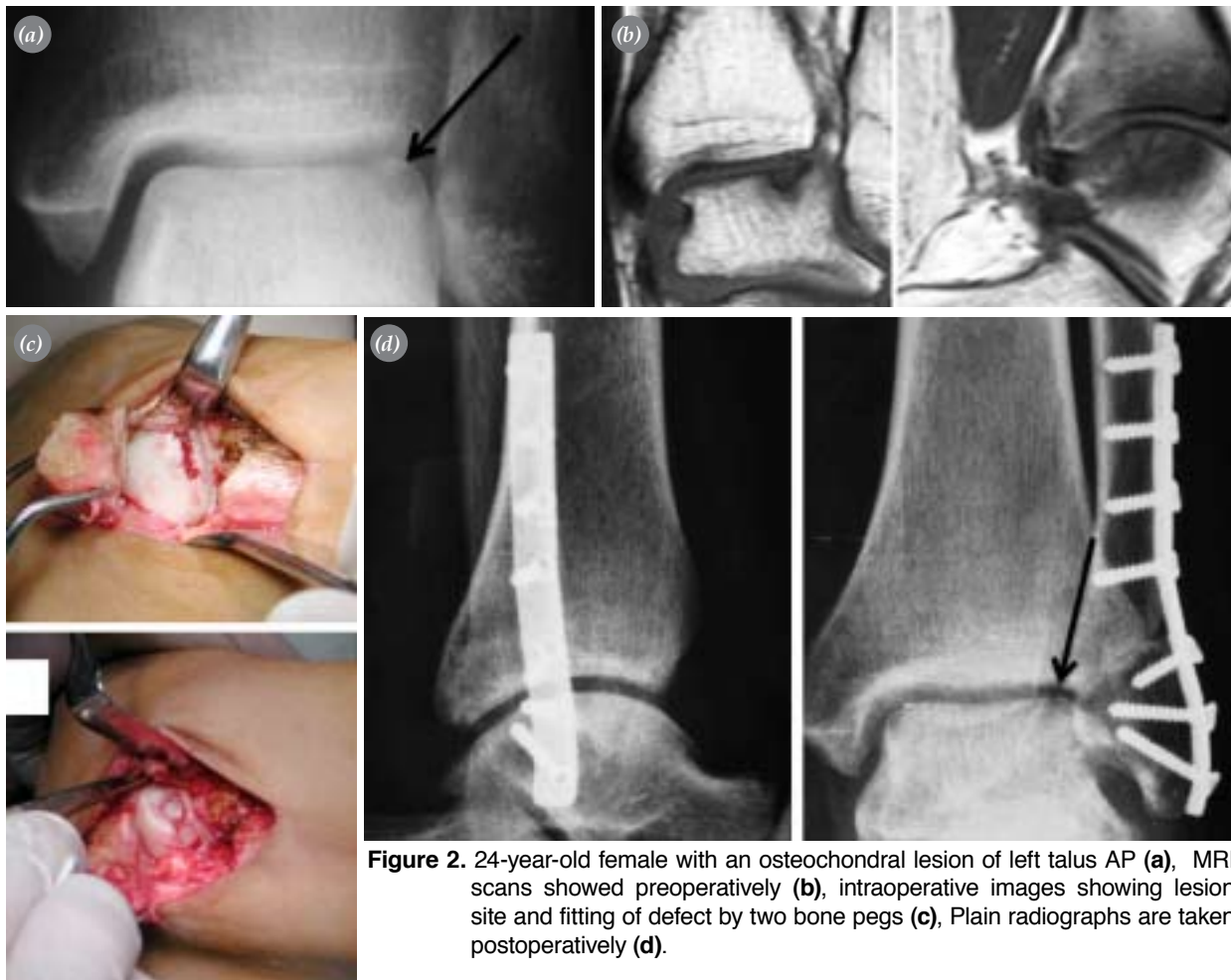
The classification suggested by Berndt and Harty<sup>[1]</sup> is still in current use for the definition and treatment algorithm of acute OCL. However, in particular of chronic OCL, this classification and related treatment schemes appear to be insufficient. An MRI based

Bristol Classification System was described by Hepple et al <sup>[5]</sup>, is useful in the definition and classification of this pathological process. Bristol Classification System classifies sole chondral lesions as (grade I), chondral lesions associated with subchondral fractures and edema in the surrounding bone structure as (grade II a), chondral lesions associated with subchondral fractures but without edema in the surrounding bone structure as (grade II b), elevated but non-displaced chondral fragment as (grade III), elevated and displaced chondral fragment as (grade IV) and development of subchondral cyst as (grade V).<sup>[6]</sup>

Studies reveal that conservative treatment methods yielded less success compared to surgical interventions.<sup>[2, 7]</sup> Hence, surgical treatment methods are used more commonly in adults with OCL of talus.<sup>[8-10]</sup> The size, grade and location of lesion as well as the age and expectations of the patient appear to be determinant in the selection of treatment method.<sup>[11-12]</sup> Classical and arthroscopic surgery methods can include debridement and drilling/microfracture, mosaicplasty and autologous chondrocyte transplantati-



**Figure 1.** 74-year-old female with an osteochondral lesion of the talus. AP and lateral plain radiographs at an initial examination shows a medial Grade-V lesion (a, b), MRI scans showed preoperatively (c).



**Figure 2.** 24-year-old female with an osteochondral lesion of left talus AP (a), MRI scans showed preoperatively (b), intraoperative images showing lesion site and fitting of defect by two bone pegs (c), Plain radiographs are taken postoperatively (d).

on.<sup>[8-12]</sup> Especially for those lesions with a diameter exceeding 10 mm, implantation of autologous chondrocyte or mosaicplasty is recommended for renewal of chondral surface and functional recovery.<sup>[13-16]</sup> However, the relationship between the characteristics of the lesion and selection of surgical method has to be discussed furthermore. In our study, the results of the treatment of talus osteochondral lesions based on mosaicplasty were aimed to be discussed in reference to the current literature.<sup>[9, 16, 17]</sup>

## Patients and Methods

As a prospective case series set up, our study covers 8 (1 male, 7 females) cases, who were diagnosed to have osteochondral lesion in talus dome, between 2005-2008. All patients have been complaining for a variety of ankle problems for at least 3 months. The mean age of the patients was 35 (range 18-74). The average duration of pre-diagnosis was 11 months (range 6-24). For the diagnosis of OCL, both clinical and radiological

methods were used. Ankle radiography, MRI and T99 scintigraphy were used as auxiliary diagnostic methods for all patients. For two patients, additionally, diagnostic ankle arthroscopy was implemented. The common etiological factor for 3 patients was trauma (2 had a fall and 1 had on-board car accident history), while the causes for the rest of the cases were unknown. Among those traumatic cases who were then diagnosed to have OCL and treated with 6 weeks plaster casting and medical treatment. 5 patients had medially located lesions (1 central and 4 posteromedial) whereas the rest had posterolateral OCL. In reference to MRI based Bristol classification system patients were grouped n=2 grade II a, n=1 grade II b, n=2 grade III, n=1 grade IV and n=2 grade V). A lesion diameter more than 10 mm, extension of lesion to subchondral zone and existence of a lesion site that is difficult to reach arthroscopically, which requires advanced technical skills were the predefined indications for us to prefer mosaicplasty conducted with osteotomy aided mini arthrotomy.

In order to reach the lesion located medially on the talus dome, an oblique medial malleol osteotomy at the edge of tibial plafond was performed.<sup>[13, 18]</sup> The OCL were then sized. The average length of lesions was calculated as 17 mm (range, 13-22) and width of the lesions was calculated as 9.2 mm (range, 5-12). A mosaicplasty kit for single use used to harvest the osteochondral graft and to relocate at the defect area (Small Joint OATS Set, Arthrex Inc,

Naples, FL, ABD). For the fixation of medial malleol osteotomies, headless compression screws made of titanium (Acutrak, Acumed, Hillsboro, OR, ABD) were used while utilizing plate screwing systems for lateral malleol osteotomies (LC-DCP, Synthes, Paoli, PA, ABD) (Figures 1-2). In cases with lateral OCL, the surgery site was accessed by oblique osteotomy carried out under the level syndesmosis without disintegrating lateral ligaments and then mosaicplasty was performed. The lateral condyle of femur of the same side was used as donor site. As a standard procedure, an average 3 pieces (range, 2-4) of graft blocks, each of 15 mm in length and usually 6 mm in thickness were administered at the site of lesion and the donor site was not plugged. At the end of a post-surgical slab assisted union period of two weeks, loading was allowed (Figure 3). 8 months after mosaicplasty, regeneration of chondral tissue was investigated with MRI. Sportive activities were allowed only for those patients who experienced no problem in the union of graft. The mean period of follow up was 17(range, 8-34) months. Association of Orthopedic Food and Ankle Surgery (AOFAS) rating scale was used for the functional assessment of cases. Pain level was assessed using the visual analogue scale (VAS; 0 to 10)

For statistical analyses SPSS version 11.5 was used to run Wilcoxon Signed Rank test. Analyses results that meet  $p < 0.05$  criteria are regarded as statistically significant.

## Results

The average pre-surgery and post-surgery scores of cases for AOFAS rating scale were 58 (range, 40-68) and 89 (range, 80-97), respectively. In similar order, VAS scores for pain assessment were 8 (range, 5-10) and 2 (range, 1-4) ( $p < 0.005$ ). All patients were satisfied with the achieved results and returned to their daily business they have done before they had their ankle problems.

In all patients, a union at the osteotomy site was achieved without problem in 6 weeks. In patients with lateral OCL, implants were removed before the MRI controls in month 8. During the MRI, subchondral edema in talus was existing in 5 patients. However, no problem was detected in the integration of osteochondral grafts at the osteotomy site.

A graft plug was shown significantly (1mm) higher than intact cartilage in one case. One patient has developed medial malleol fracture 6 months after surgery. Retrospective evaluation of the case revealed that the screws used for fixation were not seated completely into the bone structure. In conjunction with that, the development of the fracture was considered to occur due to in situ accumulation of stress. During the fixture of medial malleol fracture by using a tension band, regeneration of chondral tissue at the lesion site was observed [Figure 4].

**Table 1.** Surgical technique and data of functional evaluation

Patient no /age	Osteotomy side	Classification	Host area (mm)	Number of graft	Ostesynthes material	Other surgery/ complication	AOFAS score prepost	Fallow (month)
1/18	Medial malleol	V	22x10	3 (6 mm)	Acutrak	-	61/97	34
2/36	Medial malleol	III	14x12	3 (2x4 mm, 1x8 mm)	Acutrak	-	57/97	29
3/28	Lateral malleol	IIa	15x10	3 (6 mm)	Plate screw	Plate extraction	68/92	19
4/30	Medial malleol	IV	15x8	2 (6 mm)	Acutrak	Reoperation	40/80	14
5/32	Medial malleol	IIa	20x9	4 (6 mm)	Acutrak	-	68/85	8
6/36	Lateral malleol	IIb	13x10	2 (6 mm)	Plate screw	Plate extraction	58/81	10
7/74	Medial malleol	V	18x5	3 (1x4 mm, 2x6 mm)	Acutrak	-	60/86	12
8/24	Lateral malleol	III	20x10	2 (10 mm)	Plate screw	Plate extraction	49/93	8

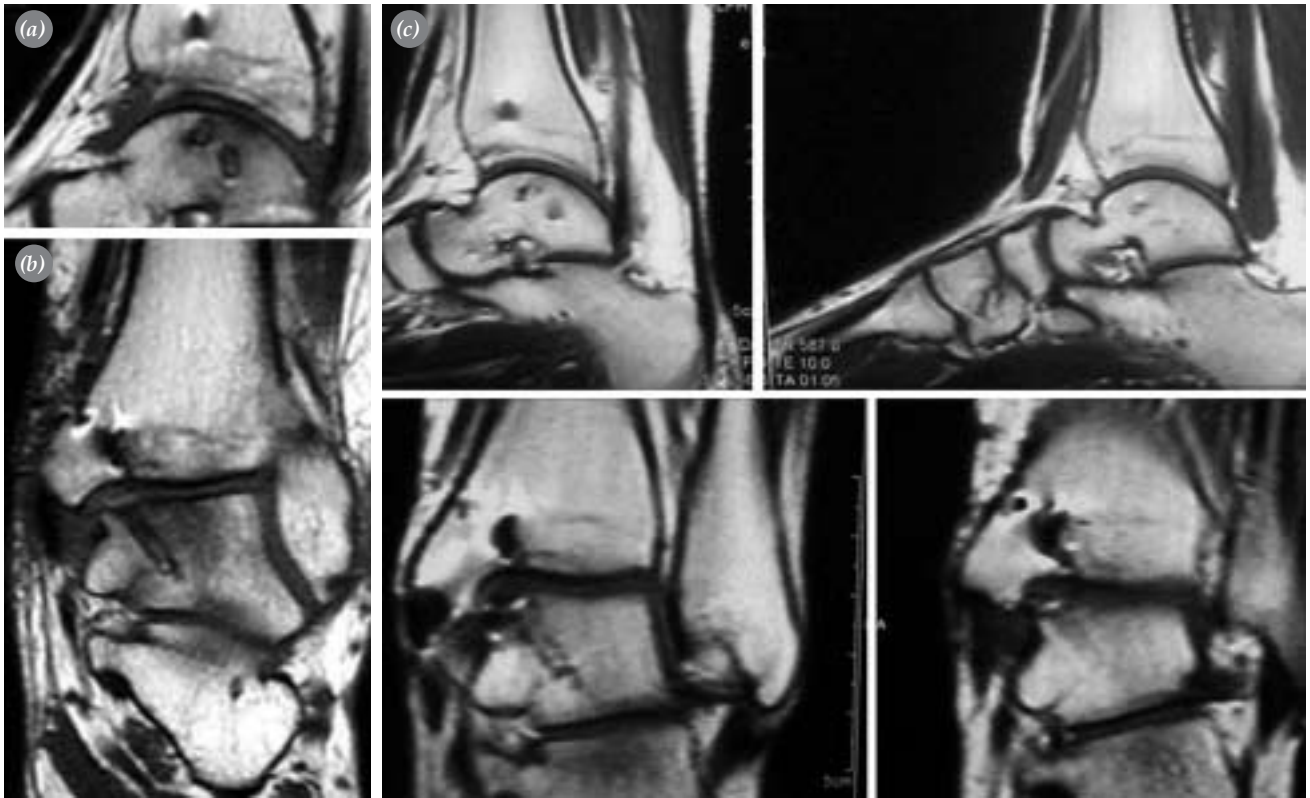


**Figure 3.** (a, b) An osteochondral lesion site has shown intraoperatively (c) A mosaicplasty kit for single use (d) Abrasion arthroplasty of the osseous base of the defect and planning of the ideal filling with use of the drill-guide, (e) The graft is harvested by toggling the harvesting chisel. (f) has shown osteochondral bone pegs. (g) defect area on lateral femoral condyle (donor area). (h) intraoperative image showing 100% filling of the defect. (i) graft pegs showing medial articular shoulder of talus in plain radiographs postoperatively.

## Discussion

If conservative treatment of chronic OCL for 3 months or longer fails to achieve expected goals, utilization of surgical methods should be taken into account.<sup>[9, 10]</sup> Predominant factors in the selection

of surgical method include age and expectations of the patient as well as the experience of the surgeon and technical eligibility of the hospital.<sup>[14, 15, 19-21]</sup> Yet multiple treatment modalities are currently available, and the best option for each particular clinical situation is not necessarily clear.<sup>[4, 22]</sup>



**Figure 4.** (a, b) 19-year-old female with an osteochondral lesion of right talus at eight months after operation showing incomplete bony union and c) 34 months after operation showing complete bony union in MR scans.

In mosaic grafting procedure (mosaicplasty) developed by Hangody et al, cylindrical osteografts relocated in abreast manner conceals the defects at lesion site.<sup>[18]</sup> It becomes possible to transfer spongy bone material required to repair the collapse at subchondral area together with the hyaline cartilage. In short and medium term studies, mosaicplasty pioneered by Hangody et al is reported to achieve good-to-excellent results in 80-94% of all cases.<sup>[3, 9, 11, 16]</sup>

As a result of objective and subjective assessment, mosaicplasty was concluded to be successful for all patients included. Patient satisfaction was obtained in all cases. Our preference of conducting classical surgery in contrast to many of those studies in the literature was due to the difficulties in reaching the osteotomy site with arthroscopy and our lack of experience in this technique. However, we should consider the fact that even the experienced surgeons were reported to prefer malleol osteotomy in 50% of their series.<sup>[17, 19, 22]</sup> Apart from its ease of observation and implementation, mosaicplasty conducted with osteotomy aided arthrotomy minimizes the probability of

fractures of osteochondral blocks. But on the other hand, as an alternative approach, arthroscopic mosaicplasty conducted via trans-malleolar intervention may bring some other problems.<sup>[19]</sup> Moreover, the tunnel needs to be fixed to prevent consecutive fractures in malleol. However mosaicplasty is disadvantageous for its higher surgical morbidity and limited amount of harvested graft material. Debridement drilling/microfracture technique, on the other side, is based on the idea that mesenchymal cells of subchondral bone would reach the defect and treat the lesion as a fibrocartilage tissue.<sup>[11, 19, 23]</sup> Though some studies suggests that this method could be preferred for lesions up to 1.5 mm, lesion size and existence of a cyst is known to adversely affect the treatment success.<sup>[4, 24]</sup> Though it leads to higher morbidity, the most significant superiority of mosaicplasty over debridement drilling/microfracture is to enable concealment of the site of lesion with a hyaline cartilage that is very similar to the natural chondral tissue. Chondrocyte transplantation, in contrast was introduced as a new technique that brings less surgical morbidity and ability to conceal bigger lesions with hyaline cartilage.<sup>[22, 25-27]</sup>

This method has disadvantages such as requiring multi-phase surgery and high technology, necessity of multi-disciplinary collaboration and being an expensive solution. Today, there is no universal agreement about the indications of those three approaches and are reported to provide comparable benefits.

The most remarkable complication of mosaicplasty conducted with osteotomy aided mini arthrotomy is nonunion of osteotomy, yet we did not observe such a complication. However, a medial malleol fracture was developed due to the complication in fixation in one case. In another case, the graft was observed to remain 1 mm higher than the targeted position. But integration of graft was not affected adversely due to the thickness of the chondral tissue at this part of talus.<sup>[28, 29]</sup>

Our study limited by small sample size, limited follow-up and lack of comparison cohort.

Finally, we concluded that cartilage losses located on the dome of talus with a diameter over 10 mm and especially those of cystic type could be treated with mosaicplasty. As a method that facilitates the regeneration of hyaline cartilage in the area of chondral loss, may be an effective, complication-free treatment alternative with short learning curve.

## References

- Berndt AL, Harty M. Transchondral fractures (osteochondritis dissecans) of the talus. *J Bone Joint Surg [Am]* 1959; 41:988-1020.
- Canale ST, Belding RH. Osteochondral lesions of the talus. *J Bone Joint Surg [Am]* 1980;62:97-102.
- Schachter AK, Chen AL, Reddy PD, Tejwani NC. Osteochondral lesions of the talus. *J Am Acad Orthop Surg* 2005;13:152-8.
- Giannini S, Buda R, Faldini C, Vannini F, Bevoni R, Grandi G, et al. Surgical treatment of osteochondral lesions of the talus in young active patients. *J Bone Joint Surg [Am]* 2005;87 Suppl 2:28-41.
- Hepple S, Winson IG, Glew D. Osteochondral lesions of the talus: a revised classification. *Foot Ankle Int* 1999; 20:789-93.
- De Smet AA, Fisher DR, Burnstein MI, Graf BK, Lange RH. Value of MR imaging in staging osteochondral lesions of the talus (osteochondritis dissecans): results in 14 patients. *AJR Am J Roentgenol* 1990;154:555-8.
- Flick AB, Gould N. Osteochondritis dissecans of the talus (transchondral fractures of the talus): review of the literature and new surgical approach for medial dome lesions. *Foot Ankle* 1985;5:165-85.
- Özenci AM, Aydın AT. Osteochondral lesions of the talus in adolescents. [Article in Turkish] *Acta Orthop Traumatol Turc* 2004;38 Suppl 1:138-44.
- Easley ME. Osteochondral lesions of the talus: diagnosis and treatment. *Ankle and foot. Curr Opin Orthop* 2003; 14:69-73.
- Chodos MD, Schon LC. Osteochondral lesions of the talus: current treatment modalities and future possibilities. *Ankle and foot. Curr Opin Orthop* 2006;17:111-6.
- Merian M, Easley M. Diagnosis and treatment of osteochondral lesions of the talus. [Article in German] *Orthopade* 2008;37:204.
- Tol JL, Struijs PA, Bossuyt PM, Verhagen RA, van Dijk CN. Treatment strategies in osteochondral defects of the talar dome: a systematic review. *Foot Ankle Int* 2000; 21:119-26.
- Gautier E, Kolker D, Jakob RP. Treatment of cartilage defects of the talus by autologous osteochondral grafts. *J Bone Joint Surg [Br]* 2002;84:237-44.
- Assenmacher JA, Kelikian AS, Gottlob C, Kodros S. Arthroscopically assisted autologous osteochondral transplantation for osteochondral lesions of the talar dome: an MRI and clinical follow-up study. *Foot Ankle Int* 2001; 22:544-51.
- Al-Shaikh RA, Chou LB, Mann JA, Dreeben SM, Prieskorn D. Autologous osteochondral grafting for talar cartilage defects. *Foot Ankle Int* 2002;23:381-9.
- Hangody L, Füles P. Autologous osteochondral mosaicplasty for the treatment of full-thickness defects of weight-bearing joints: ten years of experimental and clinical experience. *J Bone Joint Surg [Am]* 2003;85 Suppl 2:25-32.
- Scranton PE Jr. Osteochondral lesions of the talus: autograft and allograft replacement. *Tech Foot Ankle Surg* 2004;3:25-39.
- Hangody L, Ráthonyi GK, Duska Z, Vászárhelyi G, Füles P, Módis L. Autologous osteochondral mosaicplasty. Surgical technique. *J Bone Joint Surg [Am]* 2004;86 Suppl 1: 65-72.
- Sasaki K, Ishibashi Y, Sato H, Toh S. Arthroscopically assisted osteochondral autogenous transplantation for osteochondral lesion of the talus using a transmalleolar approach. *Arthroscopy* 2003;19:922-7.
- Pettine KA, Morrey BF. Osteochondral fractures of the talus. A long-term follow-up. *J Bone Joint Surg [Br]* 1987; 69:89-92.
- Lee CH, Chao KH, Huang GS, Wu SS. Osteochondral autografts for osteochondritis dissecans of the talus. *Foot Ankle Int* 2003;24:815-22.
- Sexton AT, Labib SA. Osteochondral lesions of the talus: current opinions on diagnosis and management. *Sports medicine. Curr Opin Orthop* 2007;18:166-71.
- Kreuz PC, Steinwachs M, Edlich M, Kaiser T, Mika J,

- Lahm A, et al. The anterior approach for the treatment of posterior osteochondral lesions of the talus: comparison of different surgical techniques. *Arch Orthop Trauma Surg* 2006;126:241-6.
24. Scranton PE Jr, Frey CC, Feder KS. Outcome of osteochondral autograft transplantation for type-V cystic osteochondral lesions of the talus. *J Bone Joint Surg [Br]* 2006; 88:614-9.
25. Baums MH, Heidrich G, Schultz W, Steckel H, Kahl E, Klinger HM. Autologous chondrocyte transplantation for treating cartilage defects of the talus. *J Bone Joint Surg [Am]* 2006;88:303-8.
26. Dozin B, Malpeli M, Cancedda R, Bruzzi P, Calcagno S, Molfetta L, et al. Comparative evaluation of autologous chondrocyte implantation and mosaicplasty: a multicentered randomized clinical trial. *Clin J Sport Med* 2005;15:220-6.
27. Gobbi A, Francisco RA, Lubowitz JH, Allegra F, Canata G. Osteochondral lesions of the talus: randomized controlled trial comparing chondroplasty, microfracture, and osteochondral autograft transplantation. *Arthroscopy* 2006; 22:1085-92.
28. Nakagawa Y, Suzuki T, Kuroki H, Kobayashi M, Okamoto Y, Nakamura T. The effect of surface incongruity of grafted plugs in osteochondral grafting: a report of five cases. *Knee Surg Sports Traumatol Arthrosc* 2007;15:591-6.
29. Sugimoto K, Takakura Y, Tohno Y, Kumai T, Kawate K, Kadono K. Cartilage thickness of the talar dome. *Arthroscopy* 2005;21:401-4.