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Osteochondral Autologous Transfer System For The Treatment Of Osteochondral Defects At The Talus

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Abstract:
Background: *The aim of this study was to analyze functional and radiological results after osteochondral autologous transfer for osteochondral defects at the talar dome.*
Methods: *We did prospective study on 14 patients who had been treated by autologous osteochondral grafting for symptomatic osteochondral defects of the talus between May 2018 and June 2023. The osteochondral graft were harvested from the non-weight bearing part of lateral condyle of femur. International Cartilage Repair Society (ICRS) score was used to assess the quality of the grafts. The functional outcome was evaluated with the visual analog scale for pain, and the patients activity status was assessed by using Tegner activity scale.*
Results: *The average ICRS score was 10.5 (±1.3) points. All osteotomies healed radiologically. Ankle pain decreased and the ankle-related quality of life increased significantly from preoperatively to the subsequent follow-up. The patients activity measured with the Tegner activity scale also increased significantly.*
Conclusions: *Osteochondral autologous transfer system is a reproducible and a very promising surgical procedure to treat large osteochondral lesions of the talus. It demonstrates excellent post-operative scores including improvement of pain and function.*
Keywords: *Osteochondral lesion, OATS, Ankle joint; Talus Tegner activity scale, Cartilage repair.*

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I. Introduction:

Osteochondral defect (OCD) are acquired or idiopathic lesions of the articular cartilage and the adjacent subchondral bone [1]. The talar dome is the third most common site of OCD after the knee and the elbow [2,3]. It is more common in second and third decade of life [4], and in recreational and professional athletes. It is usually traumatic in origin, mostly subsequent to ankle sprains or repetitive microtrauma [5]. Up to 50% of acute ankle sprains and fractures will develop some form of osteochondral injury [6]. Central medial ridge and central lateral ridge of the talar dome involved up to 65% & 32% cases respectively. Only 3 % of lesions are located in the middle of the talar dome [3,7]. The diagnosis is usually confirmed by MRI [8].

The management of OCD of the talus is challenging to orthopaedic surgeons due to the limited surgical exposure and poor healing potential. The main aim of surgical treatment is to restore the articular surface with a repair tissue similar to native cartilage and to provide long-term symptomatic relief.

II. Patients And Methods:

We prospectively followed 14 patients who had been treated by autologous osteochondral grafting for symptomatic osteochondral defects of the talus between May 2018 and June 2023. The study was conducted after ethical committee approval from institute. The mean age of patients was 26.5 years (18–44 years). All patients had stage III or stage IV osteochondral defect of the talus according to the ICRS classification. The lesions were diagnosed by plain radiograph of ankle (AP & lateral view) and MRI. The mean size of the defects of the talar dome was 12.95 (±1.5) × 8.4 (±1.8) mm. All patients had history of unsuccessful conservative management. All

patients were operated by same surgeon after physical fitness and well informed written consent. The surgery was done under spinal anesthesia. Preoperatively, the defect size was determined on MRI [Figure 1].

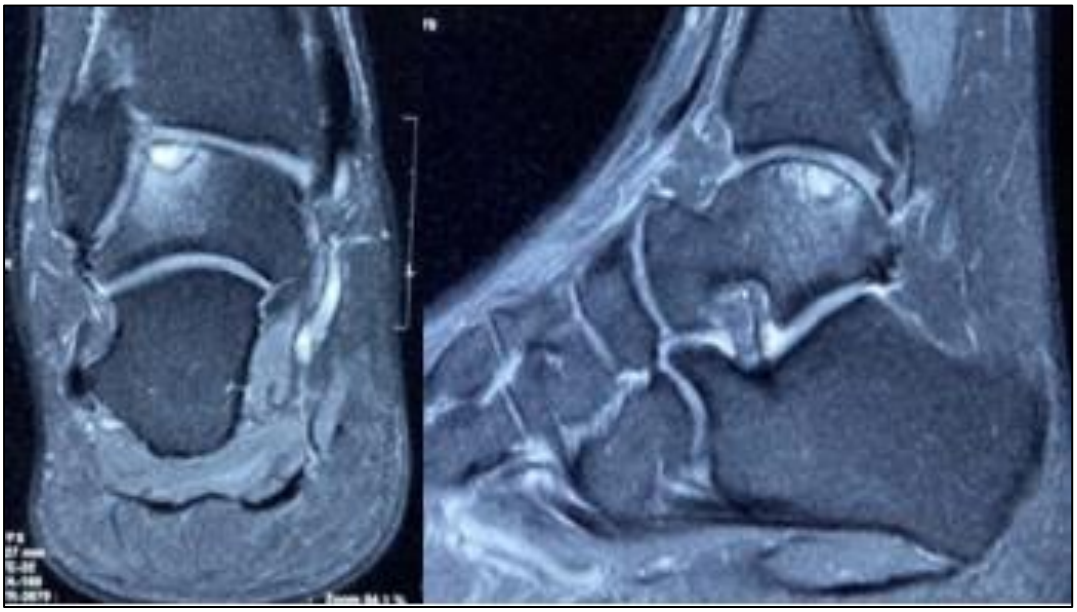

Fig.1: MRI of the ankle joint showing an osteochondral defect in the anterolateral aspect of the superior articular surface of talus.

Operative Steps

The patient was positioned supine under spinal anaesthesia. High thigh level tourniquet applied. Trans-lateral approach to distal fibula adopted. Lateral malleolus exposed and oblique lateral malleolus osteotomy was performed and lateral malleolus was flipped laterally. With ankle in plantarflexion, varus and inversion the superolateral talar dome visualized [Figure 2]. A medial malleolar osteotomy was performed in patients with medially placed lesion on talar dome.

The detached osteochondral fragment was debrided and the defect was prepared by curetting and drilling the base of the lesion to increase vascularity. Using Arthrex recipient cutting tube, cylindrical hole were made at recipient site. In 12 patients, two cylindrical hole were made and in two patients only one cylindrical hole was made. The diameter and depth of the cylindrical hole was measured and the size was ranged between 8.45 and 13 mm. We used Arthrex Osteochondral Autologous Transport System (OATS) kit for graft harvesting. Now two osteochondral cylindrical grafts of measured size were harvested arthroscopically from ipsilateral non-weight bearing part of lateral femoral condyle. Grafts were plugged into the defect without any gap or articular step by press-fit method. Direct repair of ankle joint capsule was performed. Lateral malleolus was fixed with 1/3rd tubular plate. At the end of the procedure, the tourniquet was released, haemostasis was achieved and ankle was immobilized in a below knew slab.

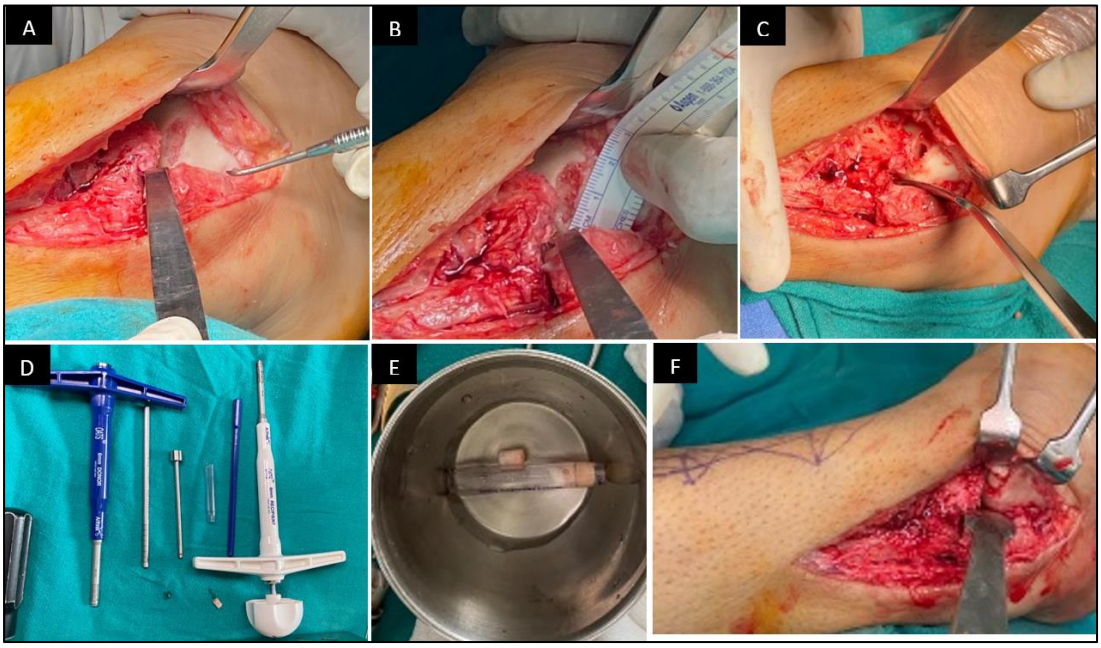

Figure 2: (A) The osteochondral defect is exposed via osteotomy. (B) The defect size measured.(C) The defect site is prepared. (D) Arthrex OATS kit. (E) Harvested grafts. (F) The defect is completely filled with two osteochondral donor cylindrical grafts.

Rehabilitation protocol

Post-operatively, the patient was observed for 24hours to administer IV antibiotics and control pain. Knee drain was removed on POD 1. Physiotherapy was started from POD 1 and patient was mobilized non-weight bearing from day one. Immediate post-operative X-ray showed good reduction and fixation of lateral malleolus and stable ankle joint [Figure 3].

Suture removal was done on POD 14. After suture removal below knee cast was applied for 2 months. Partial weight bearing over cast was started at 2 months, and after removal of cast, at 3 months, ankle ROM exercises were started, graduated weight bearing followed by strengthening, balance training and proprioception exercises were given. Serial radiographs showed union at the osteotomy site. At the end of 6 months patient had asymptomatic and pain-free mobilization with full range of motion at ankle and a stable joint.

Figure 3: X-ray (antero-posterior and lateral view) right ankle joint showing of well reduced lateral malleolus and fixed with 1/3rd tubular plate and screws

Follow-up

Any intra-op and or postoperative complications were documented. The minimum follow-up was 18 months (mean 22.5 months) after surgery. During follow-up, clinically patients was evaluated by measuring knee and ankle range of motion, stability of joint, local tenderness and crepitation. Radiologically, X-ray of the ankle and the knee was performed to examine healing of the osteotomy site and the defect site before. International Cartilage Repair Society (ICRS) score was used to assess the quality of the grafts. This score checks the degree of cartilage repair, integration to the border zone and macroscopic appearance. The score range is 0-12 points. Pain was evaluated using a VAS (visual analog scale) score. The Tegner activity scale was used to assess the patients activity status.

Statistical analysis was performed using Wilcoxon test or Shapiro–Wilk test. A p-value of <0.05 was statistically significant.

III. Results:

There were no intra-op or postoperative complications such as nerve injuries, thrombosis, pulmonary embolism, delayed wound healing or infections. All osteotomies were healed radiologically. The radiolucent area of the defects disappeared on the radiographs in all cases. There was no dislocation of graft. The defect was filled with the bone cylinder. The ICRS arthroscopic score for the graft was 10.5 (±1.3). Ankle pain at walking, running, jumping and stair climbing was decreased significantly. There were statistically significantly increased in the Ankle-related quality of life and patients activity status on Tegner activity scale.

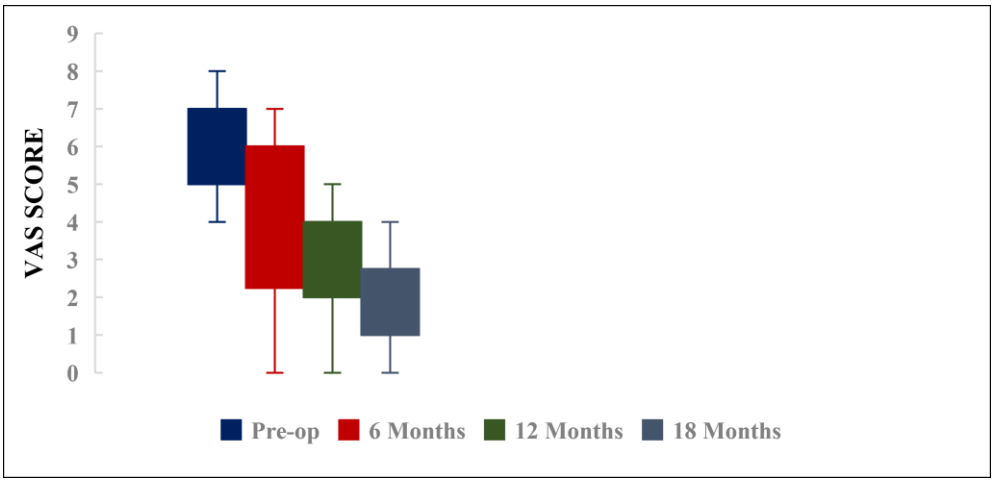

Figure 4: VAS score of patients.

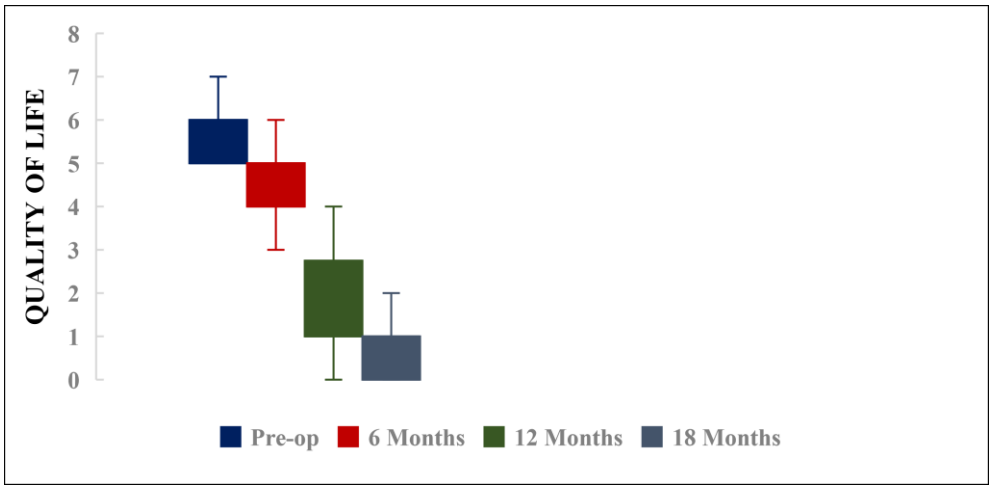

Figure 5: Ankle-related quality of life measured with a Visual Analog Scale.

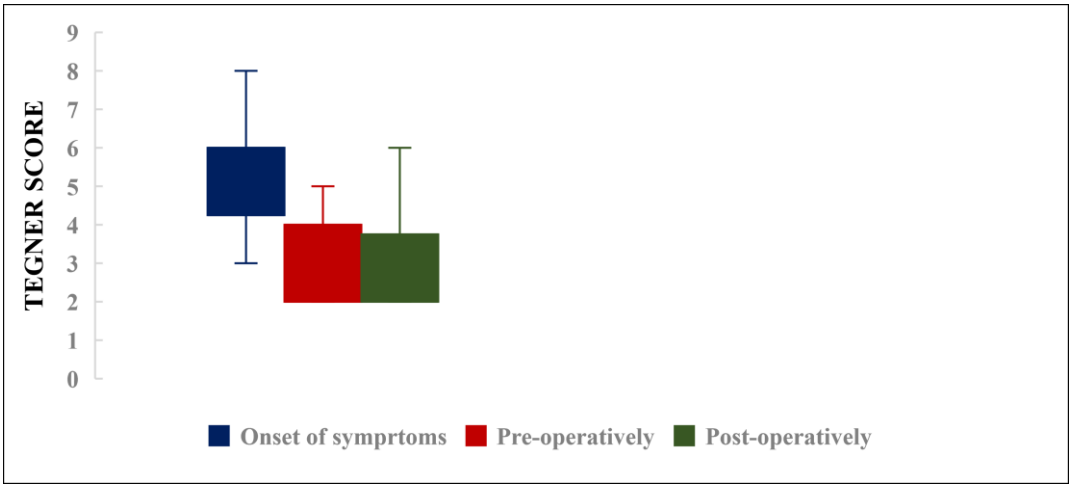

Figure 6: Patients activity status on Tegner Activity Scale

IV. Discussion:

An osteochondral ankle defect is a lesion involving talar articular cartilage and subchondral bone and can lead to partial or complete detachment of the fragment with osteonecrosis. The talar dome is the third most common site of osteochondral defects (OCD) [2,3]. OCD may occur in any location on the talar dome, but typically observed posteromedially or anterolaterally. Usually lateral OCD are traumatic, while medial lesions are spontaneous. The consequences are pain with weight bearing, swelling, ankle instability, stiffness, catching, locking, difficulty in walking and may affect activities of daily living [9]. The Berndt and Harty classification, based on radiological or intraoperative findings, is the most widely recognized classification for OCD of talus [10].

The management of OCD of the talus is challenging because of the talus is covered with articular cartilage which is avascular structure and having poor healing potential and also there is limited access to the ankle joint. The treatment options for OCD include bone marrow stimulation, radiofrequency ablation, microfracture, retrograde drilling, abrasion chondroplasty, osteochondral autologous transfer system (OATS), mega OATS, osteochondral allograft transplantation, autologous chondrocyte implantation (ACI) and biological adjuncts [11]. Small and stable defects can be treated with minimally invasive arthroscopic procedures like debridement, retrograde drilling, bone grafting, etc. For larger and unstable OCD lesions, replacement and integration of type-specific hyaline cartilage is the ultimate aim of the surgical management. OATS is the good option for management of OCD lesion, even it provides good results for lesion sizes greater than 15 mm in diameter or 150 mm^2 [12]. OATS reproduce the mechanical, structural and biochemical properties of the original hyaline articular cartilage at the defect site. In OATS, we harvested one or more tubular units of cartilage and bone from non-weight-bearing areas of the ipsilateral knee, and implanted it to a defect site in the talus to restore the proper osteochondral layer [13]. Mosaicplasty is the type of OATS and consists of implantation of multiple cylindrical osteochondral plugs, often of varying sizes, in a side-by-side configuration. Use of multiple (2-3) smaller grafts instead of one large block helps to avoid donor site morbidity and also improve the incongruity at the recipient site. Zengerink M et al. demonstrated 87% good/excellent results (74 – 100%) in his systematic review of various studies with OATS or mosaicplasty [9]. Hangody L et al. demonstrated 94.44% good/excellent results (34 out of 36 patients) in patients treated with OATS [1]. Georgiannos D et al. demonstrated 93.4% good results in his study [14]. As the time progress, OATS graft remodelled and mimic the appearance of the surrounding cartilage [15]. The main concern with OATS or Mosaicplasty is the donor site morbidity. But properly selected donor site and graft harvested from non-weight bearing area decreased this problem to some extent. Patients age more than 50 years, or who had multiple previous surgeries and pan-articular arthritis or articular cartilage thinning with irrespective of age or previous surgical history have higher failure rate of OATS [16].

V. Conclusion:

Osteochondral autologous transfer system is a reproducible and a very promising surgical procedure to treat large osteochondral lesions of the talus. It demonstrates excellent post-operative scores including improvement of pain and function.

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