

Autologous Chondrocyte Implantation Versus Bone Marrow Stimulation for Talar Osteochondral Defects: A Comparative Study of Clinical Outcomes, MOCART Score, and T2 Cartilage Mapping

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Summary:

Although the short-term clinical outcomes of arthroscopic BMS are comparable with arthroscopic/open ACI for symptomatic primary focal osteochondral defects of the talus, the radiological results (MOCART and T2 mapping) of ACI are significantly better than BMS when using injectable fibrin-ACI delivery systems.

Abstract:

Autologous chondrocyte implantation versus bone marrow stimulation for talar osteochondral defects : a comparative study of clinical outcomes, MOCART score, and T2 cartilage mapping.

Background:

The optimal treatment for symptomatic primary osteochondral defects (OCD) of the talus is a matter of debate. Bone marrow stimulation (BMS) has been the traditional treatment of choice in view of good functional outcomes, however, the fibrocartilage nature of the repair is a matter of long-term concern. Autologous chondrocyte implantation (ACI) remains unpopular in the ankle despite its ability to resurface the defect with hyaline-rich cartilage. The arthrotomy and malleolar osteotomy required to perform ACI in the ankle is a major deterrent since this is the foremost source of morbidity and cause for inferior outcomes of ACI when compared to BMS. The latest generation of ACI (Chondron, Regenerative Medical Systems) incorporates an injectable delivery system for the cultured chondrocytes-fibrin mixture, and is particularly suited to approach talar OCD via an arthroscopic approach. This retrospective study of prospectively collected data compares the short-term clinical and radiological outcomes of arthroscopic BMS versus arthroscopic ACI versus open ACI with or without bone grafting for symptomatic primary osteochondral defects of the talus.

Study Design:

Retrospective comparative study with minimum 1 year follow-up.

Patients & Methods:

The study group included 30 patients (23 males, 7 females) (mean age 28 years, range 19 to 43 years) with symptomatic primary osteochondral defects (OCD) of the talus. Inclusion criteria were presence of a focal talar dome osteochondral lesion of size > 100 mm², which had failed a non-operative trial of treatment. Exclusion criteria were coexisting synovial pathology or ligament instability, presence of uncorrected limb malalignment, presence of secondary arthritis, and patients over 45 years of age. There were 16 medial, 12 lateral, 1 medial and lateral, and 1 central talar lesions, with a mean size of 15 x 12 mm (180 mm²). Patients were divided into 3 groups. Group A (n=13) underwent single stage arthroscopic debridement of the lesion with bone marrow stimulation using microfracture awls. Group B (n=9) underwent two-stage arthroscopic autologous chondrocyte implantation. Stage 1 involved ipsilateral knee arthroscopic chondral biopsy. Stage 2 involved arthroscopic debridement of the talar lesion with

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implantation of the cultured chondrocytes 4-6 weeks following stage 1. This latest generation of ACI (Chondron, Regenerative Medical Systems) is delivered to the lesion site as an injectable mixture of chondrocytes and fibrin that solidifies within 4 minutes of implantation. The step of cell implantation was performed as a dry arthroscopy with the use of a CO2 insufflator. Group C (n=8) underwent two-stage open autologous chondrocyte implantation and included patients with depth of lesion > 8 mm on MRI or arthroscopy, or posterior talar lesions not amenable to arthroscopic implantation. Stage 2 implantation using either a medial malleolar osteotomy or anterolateral arthrotomy often involved bone grafting for lesions with depth > 8 mm. Patients from all groups underwent a similar postoperative rehabilitation program that included 6 weeks of non-weight bearing. Each patient was evaluated preoperatively and postoperatively with the American Orthopaedic Foot and Ankle Society ankle & hindfoot score (AOFAS), radiographs, and by magnetic resonance imaging (MOCART score). T2-mapping cartilage scans were performed at a minimum 1 year follow-up. The mean follow-up was 31 months (range 12 to 63 months).

Results:

All 3 groups had a similar distribution of cases with respect to patient age, lesion chronicity, defect location, and defect size. The mean preoperative AOFAS scores were group A 44 +/- 16 points, group B 41 +/- 8 points, group C 37 +/- 11 points. The mean postoperative AOFAS scores were group A 85 +/- 6 points, group B 89 +/- 11 points, group C 84 +/- 10 points. There was significant improvement from preoperative to postoperative AOFAS scores ($P < .001$) in all groups. There was no statistically significant difference in results between the groups. No patient in either group had any complications related to surgery, no patient in groups B/C had any knee complaints related to chondral biopsy, and no patient required any additional surgical procedures to the ankle joint besides implant removal in group C. The mean MOCART scores were group A = 71, group B = 87, group C = 82. Restoration of the articular surface with a remodeled articular topography was commonly noted in groups B and C, whereas 38% of group A had incomplete defect repair with incongruent restoration of the articular topography. Most group A patients with poor MOCART scores had lesion size exceeding 200 mm² and lesion depth > 5 mm. On MRI T2-mapping at minimum 1 year follow-up 31% of group A and 65% of groups B/C revealed regenerated cartilage that was similar to surrounding healthy hyaline cartilage.

Conclusion:

Although the short-term clinical outcomes of arthroscopic BMS are comparable with arthroscopic / open ACI for symptomatic primary focal osteochondral defects of the talus, the radiological results (MOCART and T2 mapping) of ACI are significantly better than BMS. Both techniques are effective and safe as demonstrated by the significant and similar clinical improvements with no complications at a minimum 1 year follow-up. Although arthroscopic BMS is attractive in that it is a cost-effective single stage surgery, arthroscopic ACI has better radiological repair and the theoretical advantage of a more durable hyaline-rich cartilage repair. Further investigation is necessary to determine if this superior radiological repair results in improved structural and biomechanical properties, and whether this translates into better long-term outcomes.