

## Stress Distribution within the Osteochondral Lesions of the Talus with Nonshoulder-type and Shoulder-type.

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**Introduction/Purpose:** Arthroscopic bone marrow stimulation techniques including excision with curettage and microfracture are recommended as initial treatments for osteochondral lesions of the talus (OLT). However, several reports have indicated that lesion size and location are important prognostic factors for the clinical outcomes. A cutoff point regarding the risk of clinical failure exists for a lesion size of approximately 15 mm diameter or 150 mm<sup>2</sup> area. A recent study reported that shoulder-type lesions had significantly worse clinical outcomes than nonshoulder-type lesions. However, to the best of our knowledge, no previous reports have provided biomechanical data for how nonshoulder-type and shoulder-type OLT affect the clinical outcomes. The purpose of this study was to clarify the stress distribution in articular cartilage of the talus with nonshoulder-type and shoulder-type OLT using finite element (FE) analysis.

**Methods:** The healthy 33-year-old male and 29-year-old female volunteers participated in the present study. They underwent computed tomography (CT) scans, and three-dimensional FE models of his ankle joint were created from the CT data using Mechanical Finder software (version 7.0, extended edition; Research Center of Computational Mechanics, Tokyo, Japan). Six different sizes of nonshoulder-type and shoulder-type OLT were simulated in the present study. For the nonshoulder-type lesion models, circular cartilage defects with diameters of 5, 7, 9, 11, 13, and 15 mm were created on the medial half of the talar dome using a cutting tool. The shoulder-type lesion models were created in the medial half of the talar shoulder, also with cartilage defect diameters of 5, 7, 9, 11, 13, and 15 mm. We set the loading condition at 686 N on the upper part of the tibia from the tibial axis for body-weight loading. The peak and average articular cartilage stress and defect rim stress were compared between the two models and among the six different defect sizes.

**Results:** In both lesion models, stress concentration was seen at the cartilage defect rim. The peak and average cartilage stress and defect rim stress increased with increasing defect size of the two models. In the cartilage defect with the diameter of 13 mm and more, the shoulder-type lesion models exhibited higher peak defect rim stress than the nonshoulder-type lesion models.

**Conclusion:** Lesion size of OLT was the most powerful predictor of the clinical outcome by arthroscopic bone marrow stimulation. The shoulder-type OLT experience a worse clinical outcome than the nonshoulder-type OLT, even after adjustment for OLT size and regardless of location. In the present study evaluated the stress distribution in the articular cartilage of the talus with nonshoulder-type and shoulder-type OLT using FE analysis. In the cartilage defect with the diameter of 13 mm and more, the shoulder-type lesion models exhibited higher peak defect rim stress than the nonshoulder-type lesion models.

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