**Histological appearance of subchondral structure in spontaneous osteonecrosis of the knee**

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**INTRODUCTION**

Spontaneous osteonecrosis of the knee (SONK) usually occurs in elderly patients with no osteonecrosis risk factors, and the lesion is confined to the medial femoral condyle in most cases. The histopathology of SONK lesion was initially thought to show signs of cell death. Recent reports have suggested that there is no histological evidence of true osteonecrosis in SONK, and the primary event leading to SONK is subchondral insufficiency fracture. However, the exact etiology and histopathological conditions of SONK remain unclear. The purpose of this study is to characterize the histopathological aspects of SONK using core biopsy specimens.

**METHODS**

All patients were enrolled with informed consent using a protocol approved by the Institutional Review Board of Yokohama City University. Eleven patients with spontaneous osteonecrosis of the medial femoral condyle underwent osteochondral autografting. The diagnosis was confirmed by an assessment of clinical history, plain radiographs, and magnetic resonance images. The patients included 7 females and 4 males, with a mean age of 68 years (range: 40-84 years) at the time of surgery. Koshino's radiographic classification was Stage IV in all cases. None of the subjects had a history of steroid intake, excessive alcohol consumption, or any systemic disease.

The articular surface of the lesion was exposed through the medial parapatellar arthrotomy, and 3.5-mm-diameter cylindrical osteochondral sample was biopsied from all subjects. These tissue samples were fixed with a formaldehyde solution. After decalcification, the samples were embedded in paraffin. Longitudinal sections were prepared and stained with hematoxylin and eosin for histological assessment. Each slide was digitally using a digital camera attached to a microscope with a motorized x-y stage. A montage of the entire image was assembled for histomorphometric analysis. The depth of subchondral lesion, trabecular bone area and numbers of empty osteocyte lacunae were measured.

**RESULTS**

Changes of articular surface with cartilage degeneration, detachment of cartilage or exposure of subchondral bone were macroscopically observed in all cases. Histological analysis revealed abnormal changes, including detachment of the cartilage layer, bone fragments with empty lacunae, woven bone formations, and proliferation of fibrous tissues in the subchondral lesion (Fig. 1). These abnormal structures were present up to a depth of 5 mm in the subchondral bone (Fig. 2). The empty osteocytic lacunae were measured and compared between cases with abnormal structures over 3.5 mm deep and cases with abnormal structures 3.5 mm deep or less. The percentage of empty osteocytic lacunae relative to the total numbers of osteocytes in cases with over 3.5 mm of subchondral lesion was significantly higher than in cases with 3.5 mm of subchondral lesion or less. Cases with over 3.5 mm of subchondral lesion demonstrated higher cellularity of empty osteocytic lacunae than those with 3.5 mm of subchondral lesion or less, while the percentage of trabecular bone area and total osteocyte numbers per area were not significantly different.

**DISCUSSION**

In this study, subchondral SONK lesion was limited to the superficial layer. Among these cases, the cellularity of empty osteocytic lacunae was higher in cases with deeper subchondral lesion. The depth of the subchondral lesion appearing as abnormal structures in this study was consistent with previous studies that suggested it was the result of insufficiency fracture. However, no clear signs of fracture were observed in this study. Recent reports have demonstrated a decrease of bone mineral density and an elevation of bone metabolic markers in SONK. It is still unclear whether abnormal bone metabolism affects the osteocyte death. One limitation of this study is the lack of control data from healthy subjects to show the ratio of empty osteocytic lacunae as a baseline. Although empty osteocytic lacunae are present during normal bone remodeling, the ratio of empty lacunae as a sign of cell death may affect the size of SONK lesion.

**REFERENCES**