**Introduction:** Osgood-Schlatter's disease (OSD) is the apophysitis which occurs in the tibial tuberosity of young children [1, 2]. During a growth period, the tibial tuberosity changes its structure from cartilaginous stage, to apophyseal stage, epiphyseal stage, and to bony stage [3]. In 1976, Ogden et al. reported OSD as an inability of the developing secondary ossification center to withstand tensile forces, resulting in avulsion of segments of the ossification center, and eventual formation of extra bone(s) between the fragments [4]. To reproduce the process of OSD, we constructed a 3D finite element model (3D FEM) including soft tissues from 3D MRI. The aim of this study is to analyze the changes in stress concentration at the tibial tuberosity due to the growth of bony structure.

**Materials and Methods:** The subjects were 12-year-old male who had OSD in left knee and is radiologically in epiphyseal stage and 10-year-old healthy male who is in cartilageous stage. 3D MR images were obtained from their knees using 1.5T machine (Sigma, GE, USA). 3D-SPGR sequence was used with the slice thickness of 0.4mm (sagittal), 0.4mm (coronal) and 0.8mm (axial). The contour of the bone, cartilage and tendon around the tibial tuberosity were manually segmented in each image using a visualizing software AMIRA (TGS, USA). These data were transferred to the software, where the main surfaces and solid version of the model were reconstructed. With tetrahedral elements, the bone, cartilage and tendon were constructed. A total number of 1318 elements for the cartilage, 20 elements for the secondary ossification center, 639 elements for the patellar tendon and 6406 elements for the tibia were modeled. These segmented 3D human knee model was brought into FEM analysis software MARC/MENTAT (MSC Software, USA), where finite element analysis of 3D model was performed under the arbitrary load. The material properties of the bone, cartilage and tendon were chosen from the data available in the recent literatures. To identify the effect of bone growth, we linearly changed the material property of the secondary ossification center and the cartilage in the model of the OSD patient.

The loads and boundary conditions were defined as follows; to exclude the influence of boundary conditions, we fixed distal end of the tibia. A combined load of 2700 N was applied to the patellar tendon. The direction of the load was consistent with that of the patellar tendon.

**Results:** Figure 2 shows the sagittal distribution of the von Mises stress under the load of 2700 N to the patellar tendon in the OSD model. The secondary ossification center and its backward had higher stress than the cartilage around. On the other hand, there was no stress concentration around the tibial tuberosity in the model of healthy knee. Figure 3A and 3B show the changes in the von Mises stress at the tibial tuberosity when we changed the material properties of the secondary ossification center and cartilage respectively. The maximum stress in the secondary ossification center was 57.9MPa with young module of 2000 MPa.

**Discussion:** We demonstrate that the stress concentration at the tibial tuberosity occurs when the secondary ossification center exists in OSD's patient and there is no stress concentration in the knee without the ossification center. Moreover, the stress at the tibial tuberosity became greater as the secondary ossification center gets harder and the cartilage gets softer. From these facts we have proved the reasons why OSD occur frequently in young children between the age of 12 and 15, when the secondary ossification center usually appears.


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