3D Knee Joint Modeling from MRI Images

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Introduction
Osteoarthritis is one of the major diseases that cause disability. Previous research studies implicate that the onset of osteoarthritis is associated with the changes in biomechanics of articular cartilages in the knee joint. In recent years, computer models have been extensively used to study the biomechanics of the cartilaginous tissues. One of the first steps of such studies is to construct anatomically accurate models of the tissues using available software packages. The objective of this study was to compare the capabilities of two software packages, Rhinoceros 3D and Mimics.

Method
MRI data was collected from two volunteer subjects (one female age: 28 and one male age: 27). The subjects had no records of previous knee injuries or surgeries.
In Rhinoceros 3D, the original MRI data was first imported to Sante DICOM Viewer and then exported as JPEG format. The exported images then were imported by Rhinoceros 3D for segmentation. Mimics software has a built-in tool to read MRI data directly. A tool called 3D LiveWire was used for segmenting. Finally, 3D surface models were obtained using segments.

Results
Both Rhinoceros and Mimics have successfully obtained a model for femur. However, Rhinoceros has problems constructing other cartilaginous surfaces. Using Mimics, all other tissues of the knee joint were successfully constructed.
A completed joint model included the following parts:
- Femur, Tibia, Fibula
- Femoral, Tibial and Fibular Cartilages
- Menisci
- Collateral and Cruciate Ligaments
- Patella and Patellar Cartilage

Discussion
Rhinoceros 3D had problems constructing cartilages with complicated surfaces, but its open-programming feature allows it to integrate customized tools and scripts to help construct surfaces. Nevertheless, Mimics has many tools for segmentation and 3D model calculating. It also includes options to modify and optimize the models. In summary, the models from Mimics are qualified for future Finite Element studies.

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