11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Comparison of Parapatellar and Transpatellar Approaches in Lateral Meniscal Allograft Transplantation Using Finite Element Analysis

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Key Words: *Meniscal Allograft Transplantation, Finite Element Analysis, Parapatellar, Transpatellar, Chondroprotection.*

Background: Lateral meniscal allograft transplantation (MAT) using a parapatellar approach has been widely performed to treat meniscectomized knees. However, inserting the meniscal allograft in an anatomically correct position is not always possible using the parapatellar approach.
Purpose/Hypothesis: To investigate the associations of extrusion with the position of the grafted meniscus by three-dimensional (3D) analysis, the contact pressure and area on grafted menisci and stress patterns on the articular surface of the knee joint were estimated using finite element (FE) analysis. Outcomes were compared between parapatellar and transpatellar approaches in lateral MAT. We hypothesized that correct positioning of the meniscal allograft would differ between approaches, and that loading on the femoral and tibial articular cartilage may be altered depending on the position of the grafted meniscus.
Study Design: Cohort study; Level of evidence 3.
Methods: Biomechanical data from patients who underwent MRI evaluation after lateral MAT were used as baseline input for 3D and FE analyses. Patients were divided into parapatellar (25 patients) and transpatellar groups (20 patients) according to surgical approach.
Results: The parameters of the grafted meniscus including relative percentage of extrusion (RPE), angle between bony bridge and center of tibial plateau, and distance from entry point of the bony bridge to the center of the tibial plateau significantly differed between groups ($P < .001$). RPE was significantly correlated with the grafted meniscus parameters only in the parapatellar group ($P =.014$ and $P = .025$, respectively). In FE analysis, maximum contact areas and pressures of lateral grafted and medial menisci, as well as compression stress and Tresca stress, were more similar to the intact knee model in the transpatellar group after lateral MAT.
Conclusions: Compared to the parapatellar approach, the transpatellar approach achieved more anatomically correct positioning of the grafted meniscus with less development of meniscal extrusion, lower contact pressure on menisci, and lower maximum shear stress and compressive stress on the femoral and tibial articular surface. Therefore, the transpatellar approach provided a greater chondroprotective effect leading to reduced overall risk of degenerative osteoarthritis after lateral MAT.

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