

Articular Cartilage Changes in MRI T1-rho and T2 Mapping in an Open-Wedge Osteotomy of the Proximal Tibia with Hemicallotasis for the Medial Knee Osteoarthritis

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Summary:

This study clarified that, within the correction angle up to 18 degrees in an open-wedge osteotomy of the proximal tibia with hemicallotasis for the medial knee osteoarthritis, the fibrocartilage-like repair tissue appeared on the articular surface of the medial compartment with no changes of the lateral compartment postoperatively as evidenced by MRI 3D WATS, T1-rho and T2 mapping.

Abstract:

[Background]

Medial opening-wedge osteotomy has gained popularity for the medial knee osteoarthritis with a varus deformity. An open-wedge osteotomy of the proximal tibia with hemicallotasis (HCO) was described as a new technique with an external fixator using a gradual distraction. In the previous prospective trial, we reported good clinical outcomes and radiological alignment maintenance at the averaged 14 years following HCO. However, it is not yet clear how the articular cartilage changes postoperatively in the medial and lateral compartment of the involved knee underwent HCO. The purpose of this study is to clarify those changes using MRI 3D T1-weighted fast field echo with water-selective excitation (3D WATS), T1-rho and T2 mapping.

[Patients and Methods]

A total of 20 patients were underwent HCO for their unilateral medial knee osteoarthritis. The correction angle was planned so that the Mikulicz line would pass through a point approximately 65 % of the distance from the medial edge of the proximal tibial plateau on radiograph. Coronal 3D WATS, T1-rho and T2 mapping MRI were obtained from all patients pre-operatively and at one year after surgery. On those MRIs, we set the regions of interest on the full-thickness cartilage of the medial (medial femoral condyle: MFC and medial tibial plateau: MTP) and the lateral compartment (lateral femoral condyle: LFC and lateral tibial plateau: LTP) of the knee. And that, we measured the cartilage thickness (mm) and T1-rho and T2 relaxation times (ms). Statistical analysis of time-dependent changes in the cartilage thickness and both relaxation times was performed using one-way ANOVA, and Scheffe's test for post hoc multiple comparison. We obtained approval from the IRB of our institution, and all patients provided their informed consent to participate in this study.

[Results]

The mean correction angle at one year after surgery was 18 degrees. On the cartilage surface of the MFC and MTP, the cartilage-like repair tissue appeared and each thickness showed a significant increase post-operatively (MFC; $p = 0.003$, MTP; $p < 0.001$). The T1-rho values of the cartilage-like repair tissue showed no change post-operatively while the T2 values showed a significant decrease (MFC; $p = 0.004$, MTP; $p = 0.040$). On the other hand, the cartilage thickness and both relaxation times in the lateral compartment showed no changes post-operatively.

[Discussion and Conclusion]

ISAKOS

**International Society of Arthroscopy, Knee Surgery and
Orthopaedic Sports Medicine**

11th Biennial ISAKOS Congress • June 4-8, 2017 • Shanghai, China

Paper #158

HCO has several attractive advantages compared to conventional procedures, including the simplicity of the surgical procedure, earlier allowance of mobilization and weight bearing, easier acquisition of accurate correction, and the great correction angle. On the other hand, we also reported that T1-rho and T2 values correlated with the degree of cartilage degeneration in the previous clinical studies. There are some limitations of the MRI analysis only up to one year after surgery and no histological examination by biopsy. In conclusion, however, this study clarified that, within the correction angle up to 18 degrees in HCO, the fibrocartilage-like repair tissue appeared on the articular surface of the medial compartment with no changes of the lateral compartment postoperatively as evidenced by MRI 3D WATS, T1-rho and T2 mapping.