Developing an experimental model of early knee osteoarthritis after medial meniscus posterior root release: An in vivo study

Lika Dzidzishvili[1], Irene Isabe López-Torres[2], Emilio Calvo
[1]Orthopaedic Surgery and Traumatology, Hospital Universitario Fundación Jiménez Díaz, [2]Orthopaedic Surgery and Traumatology

INTRODUCTION:

The importance of meniscal root injuries has been widely recognized. The natural history of root tears treated conservatively has yielded less than desirable outcomes. On the other hand, several root repair techniques have been described with good to excellent outcomes. However, the progression rate to knee osteoarthritis still is a concern and has attracted considerable attention.

The purpose of this experimental study was to develop a predictable and reproducible model of knee osteoarthritis after medial meniscus posterior root release.

METHODS: Posteromedial meniscal root tears were created in 12 rabbit knees. The contralateral limbs were used as healthy controls. The animals were euthanized at 16 weeks postoperatively; tissue samples of femoral and tibial articular cartilage were collected and processed for macro and microscopic analyses to detect signs of early degeneration. Each sample was histopathologically assessed by an experienced cartilage pathologist using the AORSI grading and staging system. Knees were evaluated with high resolution magnetic resonance imaging (MRI) at baseline, 8-, and 16-weeks post-surgery.

Clinical evaluation of the weight-bearing status on the affected knee was conducted at 0-, 4-, 8-, and 16-weeks postoperatively.

RESULTS:

Early and severe osteoarthritic changes were the hallmark and the main findings after 16-weeks post-surgery. Macroscopically, extensive osteoarthritic changes were observed across the femoral condyle and tibial plateau (Figure 1). Microscopic changes were marked by the ulcerations, fissures, fibrillations, pitting and loss of the superficial layer. Cellularity was diminished, the normal pattern of distribution in columns was lost, and subchondral bone exposure was also evident (Figure 2). Microscopic cartilage surface changes showed a trend to be more severe in the weight bearing area of the medial femur than in the non-weight bearing area and tibia and the combined histological scores were statistically significant between the different zones. Degenerative changes and joint space narrowing were evident comparing pre and 16 weeks post- surgery plain Rx (Figure 3).

Significant decrease in cartilage thickness was observed after 16-weeks of follow-up ($p=0.023$) using high resolution MRI (Figure 4). Meniscal extrusion were evident after 8 weeks of post-surgery in all 12 animals (Figure 5). Weight-bearing status assessment revealed gait disturbance patters beyond the 8-weeks post-surgery as the animals showed partial weight bearing status.

DISCUSSION AND CONCLUSION:

This study describes a novel model of knee osteoarthritis that may guide the development of tailored interventions to delay or prevent knee osteoarthritis. This knowledge could shift the current treatment paradigm toward more conservative and knee salvageable treatment options and increase surgeons' awareness of this injury pattern, and such considerations may have a positive impact on clinical decision-making and subsequent patient-reported clinical outcomes.