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Review Article

Understanding posterior meniscal roots lesions: from basic science to treatment☆

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ABSTRACT

The variability of symptoms and the fact that they are not easily recognized in imaging studies make the diagnosis and treatment of posterior meniscal roots lesions a challenging task to the orthopedist. In recent years, a more precise understanding of the anatomy and biomechanical impair of the knee joint in these cases has enabled great advances in therapeutic approaches. Well-documented studies have shown that the repair of these lesions presents superior functional and clinical improvement when compared with meniscectomy. However, the progression of degenerative joint changes in the long-term still exhibits conflicting results.

Compreendendo as lesões das raízes posteriores dos meniscos: da ciência básica ao tratamento

RESUMO

A variabilidade da sintomatologia e o fato de não serem facilmente reconhecidas nos exames de imagem tornam o diagnóstico e o tratamento das lesões das raízes posteriores dos meniscos tarefas desafiadoras para o ortopedista. Nos últimos anos, uma compreensão mais precisa da anatomia e do comprometimento biomecânico da articulação do joelho nessas lesões têm possibilitado grandes avanços nas abordagens terapêuticas. Estudos bem

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documentados demonstram que o reparo dessas lesões oferece uma melhoria clínica e funcional superior à meniscectomia. Entretanto, os resultados da progressão das alterações degenerativas articulares em longo prazo ainda são conflitantes.

Introduction

In the past, lesions of the meniscal roots were underdiagnosed and often unrecognized, but now they are better understood and have been biomechanically proven to be a source of overload in the knee joint.[1–6] They are possibly related to early-onset osteoarthritis.[1,7–9] The first description of a meniscal root lesion in the literature was made by Pagnani et al.,[10] who in 1991 described the process of extrusion of the medial meniscus in a football player. Historically, this type of lesion was treated by partial or total meniscectomy, which, despite its good short-term subjective results, presented a higher risk of long-term joint degeneration.[11]

The menisci play important roles in the knee; their integrity is essential for the proper functioning of the joint.[1,12,13] In addition to sharing the loads and reducing the joint contact pressure by increasing the contact surface between the femur and tibia,[12] other functions assigned to the menisci are proprioception,[14] stabilization,[15] lubrication,[16] and nutrition of the joint cartilage.[17] The meniscal roots are essential for maintaining the meniscal ability to convert axial loads into circumferential tension.[1,5] Biomechanical studies show that lesions in these structures are comparable to a complete meniscectomy.[1]

As lesions of the posterior root of the meniscus are the most frequently reported in the literature,[18,19] this study aimed to provide the surgeon with a comprehensive review of this important condition in order to facilitate its understanding, diagnosis, and treatment.

Anatomy and composition

Knowledge of the anatomy of meniscal roots is important not only to allow a precise repair in cases of injury, but also to prevent iatrogenic damage during procedures close to their location, such as reconstruction of the anterior cruciate ligament (ACL) or intramedullary tibial nailing. Meniscal roots are defined as the insertion of the meniscal horns into the tibial plateau, and extend to a distance of 0.9 mm from the attachment site.[20] Respecting some characteristics, the roots of the meniscus are basically formed by a dense fiber core, surrounded by additional fibers.[1,21,22] Histologically, meniscal roots have a structure similar to a typical enthesis, comprised of four zones: meniscus fibers, non-calcified fibrocartilage, fibrocartilage, and calcified bone.[23]

In addition to the qualitative anatomy, it is important that the surgeon is familiar with the quantitative descriptions of relevant surgical landmarks when performing arthroscopic procedures.

Medial meniscus posterior root (MMPR)

The additional fibers of the MMPR were first described by Anderson et al.[24] as shiny white fibers (SWF). These fibers increase the attachment area of the medial meniscus to the posterior portion of the plateau. In a quantitative study, Johannsen et al.[22] demonstrated that the area of the denser MMPR fiber insertion was on average 30.4 mm^2, corresponding to a 6-mm diameter tunnel to reproduce its native attachment area. When SWFs were included in the measurement, the insertion area increased to 77.7 mm^2. In the same study, the authors determined the distances from the center of the MMPR to the main arthroscopic frames. The MMPR was located 9.6 mm posterior and 0.7 mm lateral to the apex of the medial tibial eminence (the most reproducible landmark); 3.5 mm lateral to the inflection point of the medial tibial plateau articular cartilage; and 8.2 mm anterior to the most superior tibial attachment of the posterior cruciate ligament (PCL; Fig. 1).

Lateral meniscus posterior root (LMPR)

The attachment area of the main fibers of the LMPR measures 39.2 mm^2, corresponding to a 7-mm diameter tunnel to reproduce its original attachment area.[22] This area does not include the additional fibers, which extend to the lateral edge of the medial tibial eminence. Some authors have reported an LMPR area of 115 mm^2.[25] This discrepancy in measurement may be related to the inclusion of the additional fibers as part of the root. Johannsen et al.[22] demonstrated that the center of LMPR is located 4.2 mm medial and 1.5 mm posterior to the lateral tibial eminence; 4.3 mm medial to articular cartilage margin of the lateral tibial plateau; 12.7 mm anterior to the superior aspect of the PCL tibial insertion; 10.1 mm posterior to the posteromedial corner of the anterior root attachment of the lateral meniscus; and 10.8 mm posterior to the posteromedial ACL band.[22]

An important consideration regarding the LMPR anatomy is the presence of the meniscofemoral ligaments (MFLs), which attach the LMPR to the medial femoral condyle.[26] These ligaments play an important role in stabilizing the lateral meniscus and preventing or reducing extrusion in cases of injury to this root.[26]

Biomechanics

Approximately 50–70% of the load transmitted through the knee is supported by the medial and lateral menisci, respectively.[12] The menisci are able to convert axial load into circumferential (hoop) stress; they aid in a uniform weight

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