# The Meniscus

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The C-shaped, wedge-like, fibrocartilaginous menisci of the knee joint were once thought to contribute little to joint function but are now credited with playing a critical role in maintaining joint health. The menisci facilitate joint stability, congruency, force distribution, lubrication, and proprioception. Thus, meniscal injury leads to altered mechanics and biochemical changes that combine to result in a cascade toward the development of posttraumatic osteoarthritis.[1]

Surgical treatment of knee joint meniscal injuries has remained unchanged for over two decades: when meniscal damage causes pain and/or a locking sensation and cannot be repaired, the torn meniscal tissue is removed in a partial meniscectomy. Partial meniscectomy is aimed at relieving pain and restoring function. However, more than half of all patients who undergo partial meniscectomy will exhibit changes in articular cartilage as early as 6 months after surgery[2] and develop osteoarthritis within 10 to 20 years.[3] Because of such variability in outcome, counseling patients as to expectations after surgery is difficult.

With the development of scaffolds for the repair and/or replacement of the meniscus, changes in the clinical management of meniscal injuries are on the horizon. Meniscal reparative technologies range from fully degradable scaffolds intended to facilitate cell ingress and matrix generation as the scaffold degrades, to nondegradable scaffolds that remain present in the joint despite matrix ingrowth, to completely synthetic nonporous replacements intended to replace an entire meniscus.[4] But before adopting these technologies into widespread clinical care, there is a need to identify patients most at risk for degenerative changes and therefore most likely to benefit from new technologies.

Several studies aimed at understanding patient-specific factors indicative of outcome are emerging. Brophy et al[5] found that gene expression in the menisci of patients with tears varied by age, sex, and injury pattern. Most notably, patients less than 40 years of age had an increased catabolic response to injury and elevated levels of several osteoarthritis-related genes. Realizing that younger patients tend to sustain acute traumatic tears whereas older patients are prone to chronic degenerative tears, the study nonetheless suggests that younger patients are more prone to inflammatory changes than their older counterparts. In an elegant analysis of patients about to undergo surgery for meniscal tears, Carter et al[6] demonstrated increased total matrix metalloproteinase activity in synovial fluid, the magnitude of which was positively correlated with increased cartilage strain, while Gilbert et al[7] used a cadaveric study to illustrate the complexity of load distribution patterns under the menisci and across the tibial plateau during gait and stair climbing. It is possible that as we gain a better understanding of the interaction between the location and volume of meniscal tissue removed and the local changes in tissue mechanics,[8] we might be in a better position to understand the mechanical

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factors that contribute to variability in outcome following meniscal resection.

In summary, innovative studies are allowing the relationship between joint-level mechanics and biologic response of the joint to be evaluated in a patient-specific way. If we can successfully consolidate such approaches into a unified clinical paradigm and combine it with sensitive measures of outcome, vis-à-vis articular cartilage health[9] and joint function, then the possibility of predicting outcome in a clinical environment is within our reach. Until that time, it will remain unclear which patients are most likely to benefit from modified meniscal surgical techniques.

## References

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