

Ultrastructural analysis of articular structures of normal and pathological human knee

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Human meniscus plays a crucial role for knee load transmission and distribution, shock absorption, joint stability, lubrication and congruity [1], while cartilage is a smooth tissue that promotes the sliding of the articular strands. The aim of this work is to compare healthy (control) and pathological articular structures. We have analyzed samples of meniscus and articular cartilage obtained from 3 multiorgan donors (median age, 66 years), 5 patients with traumatic meniscal tear (median age, 41 years) and 3 patients undergoing total knee replacement for osteoarthritis (OA) (median age, 72 years). In the different conditions we evaluated the ECM component (collagen fiber organization and proteoglycan presence), the appearance and distribution of calcification areas, and the modifications of the cellular structure. Ultrastructural analysis of control menisci and cartilage show rare condensed chromatin masses in diffuse chromatin and well preserved organelles. Both in trauma and in OA, increasing chromatin condensation, organelle degeneration and cytoplasmic vacuolization appear [2]. In pathological conditions, particularly in OA, autophagic vacuoles, which probably represent a cellular self-protection mechanism, also appear. The most evident ultrastructural changes have been observed when surgery takes place long time after trauma. In this case a high chromatin condensation, a large cytoplasmic vacuolization with degeneration of organelles and several necrotic cells can be observed. Calcification areas occur both in traumatic and osteoarthritic menisci and cartilage. In particular, specimens from traumatic menisci have a structure similar to osteoarthritic ones, especially if trauma occurs in a more adult subject. In both disorganization of collagen fibers, replaced with proteoglycans, appears. A reduction of collagen fibers sizes can be also observed, if compared to control condition. We can conclude that trauma might induce an increasing meniscal and cartilage degeneration, comparable to physiological aging. In all experimental conditions, in particular in traumatic meniscal tear, we observed apoptotic-like features. Traumatic and degenerative meniscal lesions have peculiar anatomic features and different proposed etiologies, yet both are associated with development or OA progression.

References

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Key words

Meniscal tear, osteoarthritis, collagen fiber, ultrastructural analysis.