INTRODUCTION: Joint instability caused by anterior cruciate ligament (ACL) deficiency is a known risk factor for posttraumatic osteoarthrosis (OA), but aging-related changes in the ACL and their relationship to changes in articular cartilage and onset of OA are not well characterized. The purpose of this study was to investigate the correlation between histological changes in the ACL and cartilage lesion patterns and severity in human knee joints at autopsy.

MATERIALS AND METHODS: Human knee joints were obtained at autopsy with approval of the Scripps Human Subjects Committee. In this study 124 human knee joints were analyzed and none of the donors had a history of joint trauma. There were 30 male donors and 32 female donors with mean age of 66.7 years (range 24-92 years).

Tissue grading: Macroscopic grading of all cartilages was performed using a modified Outerbridge scoring system and the ICRS knee map. The macroscopic appearance of ACL was classified as normal, abnormal or ruptured [1]. For histological analysis ACLs were resected at the insertion sites on the femur and tibia. Approximately 1 cm thick transverse and longitudinal sections were harvested from the ACL subsurface and femur attachment side where ACL tears frequently occur. ACL sections were stained with hematoxylin and eosin and graded histologically using a modification of previously reported scoring systems [2]. Both sagittal and axial sections of each ACL were scored on a scale from 0 to 3 for each of the following criteria: 1) orientation of collagen fibers; 2) formation of new blood vessels and inflammatory cell infiltrates; 3) gap formation between fascicles. The most severe summed score is 9. Inflammation surrounding the ACL was analyzed separately as the extent of synovial hyperplasia in the ligament sheath by using a histological grading system for synovitis [3] where the most severe summed score is 9.

Immunohistochemistry and western blotting was performed with antibodies to MMP-3 and CD45. For statistical analysis, Pearson correlation coefficient was used to determine the level of statistical correlation and Student’s t test was used to determine the significant differences between groups.

RESULTS AND DISCUSSION: Relationship between ACL pathology, aging and OA On macroscopic examination 72 knees had normal, 40 abnormal and 12 ruptured ACLs. ACL histological scores increased with aging (r=0.573 p<0.001) and synovial sheath score also increased with aging (r=0.430 p<0.001). We compared ligament scores with summed cartilage scores to determine the relationship between ACL and cartilage degeneration. ACL degeneration correlated with cartilage degeneration, especially in the medial compartment of the knee joint (Fig.1).

To address the relationship between ACL changes and aging versus OA we hypothesized that ACL substance score and synovial sheath score are significantly increased with OA rather than aging. To test this hypothesis, over 60 years old knees were divided into two groups: normal/mild (grade I/II) and moderate/severe (grade III/IV) OA. Moderate and severe OA groups showed significantly higher ACL substance scores and synovial sheath scores, suggesting that induction of ACL degeneration is more closely related to the presence of OA rather than aging (Fig.2).

CONCLUSION:
ACL degeneration correlates with cartilage degeneration, especially in the medial compartment of the knee joint. This suggests that ACL deficiencies contribute not only to posttraumatic OA but also to aging-related development of cartilage degradation and OA pathogenesis. The inflammation within and surrounding the ACL in OA-affected joints may contribute to ligament degeneration and biomechanical dysfunction.


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