SYNTHESIS OF COLLAGEN TYPE II AND AGGREGAN IN KNEE AND ANKLE CARTILAGE LESIONS

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Objective: Knee and ankle joints are characterized by different frequencies in degenerative changes and osteoarthritis [1-4]. In order to better understand how these degenerative changes can be different in these two joints, the early stages of human articular cartilage degeneration from the ankle and knee were analyzed for changes in the synthesis of type II collagen (Col II) and aggrecan.

Introduction: Col II and aggrecan are the main structural components of articular cartilage. The C-terminal propeptide of Col II (CP II) is said to be a marker of cartilage collagen synthesis [5], whereas the 846 epitope is used as a marker of aggrecan synthesis [6]. Previous studies have shown collagen and aggrecan degradation to be different in knee and ankle joints [7,8]. The purpose of the present study is to show that the different frequencies in osteoarthritis in knee and ankle joints are also reflected by a differential synthesis of Col II and aggrecan.

Methods: Human articular cartilage was obtained from the Regional Organ Bank of Illinois with institutional approval. Cartilage plugs (5x5 mm) without any sign of degeneration (Collins grade 0) were harvested from the medial aspect of the talar dome (n=21, age 16-75 years) and from the medial femoral condyle of the knee (n=2, age 39 and 53 years), as well as from early degenerative lesions (fibrillation and fissures, Collins grade 1-2) from 10 ankles (talar dome) and 7 knees (femoral condyles). By immunoassay, the 846 epitope of aggrecan and the C-propeptide of Col II (CP II) were measured, as well as the total Col II and Glycosaminoglycan (GAG) content.

Results and Discussion: Statistically, there is no difference in the data sets from normal ankle compared to normal knee cartilage (groups 1 and 3, respectively, Fig. 1 and 2). However, in damaged ankle cartilage there is an almost 2fold increase in CP II whereas in damaged knee cartilage there is no increase but rather a decrease of 50 percent (Fig. 1). Regarding the 846 epitope there is an even more pronounced increase in damaged ankle cartilage compared to normal ankle cartilage. As well as for CP II, there is no increase in the 846 epitope in the knee lesion site detectable (Fig. 2).

These data are also reflected by a slight increase in total Col II [nmoles/mg wet weight] and GAG [µg/mg wet weight] content in ankle lesion sites (Col II: 1.88 ± 0.84, Median 1.95; GAG: 47.12 ± 22.24, Median 50.3) as compared to normal ankle cartilage (Col II: 1.28 ± 0.15, Median 1.29; GAG: 40.63 ± 14.24, Median 39.29). In the knee however, there seems to be no increase in Col II and GAG in the lesion site (Col II: 1.04 ± 0.32, Median 1.14; GAG: 40.31 ± 14.31, Median 45.44) as compared to normal cartilage (Col II: 1.24 ± 0.26, Median 1.24; GAG: 38.4 ± 0.4, Median 38.4). Previous studies of osteoarthritic cartilage arthropathy revealed increases in the CPII and 846 epitopes. Clearly there are differences in this turnover synthesis of type II collagen and aggrecan during lesion development compared to what is observed at end stage disease.

Conclusion: The present data suggest that the ankle cartilage has a better capacity to respond to cartilage injury or focal matrix degradation by new synthesis of both collagen and proteoglycan. This could in part help to explain, why full thickness cartilage defects and osteoarthritides are more frequent in the knee than in the ankle.


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Figure 1: The C-terminal propeptide of Col II (CP II) in normal (group 1: 6.9 ± 3.6, Median 5.9) and damaged ankle (group 2: 12.7 ± 9.7, Median 9.2) as compared to normal (group 3: 4.95 ± 1.2, Median 4.95) and damaged knee (group 4: 4.5 ± 5.8, Median 2.2) cartilage.

Figure 2: The 846 epitope of aggrecan in normal (group 1: 0.19 ± 0.24, Median 0.1) and damaged ankle (group 2: 33.8 ± 13.8, Median 37) as compared to normal (group 3: 0.44 ± 0.32, Median 0.43) and damaged knee (group 4: 0.13 ± 0.28, Median 0.03) cartilage.