Fractionation of the Glycosaminoglycans of Human Articular Cartilage on Ecteola Cellulose in Ageing and in Osteoarthrosis

A. O. BJELLE, C. A. ANTONOPOULOS, B. ENGELDT, and S.-O. HJERTQUIST
Department of Rheumatology, University Hospital, Lund (Sweden)
Department of Physiological Chemistry II, Chemical Centre, University of Lund
Lund (Sweden)
Department of Pathology, University of Uppsala (Sweden)
Department of Pathology, Sundsvall's Sjukhus (Sweden)

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Articular cartilage from the lower femoral epiphysis of human autopsy cases was collected in ten age groups from birth to 95 years and in osteoarthrosis of two grades of severity. By chromatography on Ecteola cellulose columns, the different glycosaminoglycans were separated and keratan sulphate was fractionated. The results are consistent with earlier studies using CPC-cellulose column technique, i.e. a higher content of total hexosamine and chondroitin sulphate was found in early childhood. Furthermore, normal articular cartilage in adults showed a higher content and a higher degree of heterogeneity of keratan sulphate than in childhood. In osteoarthrosis, a decreased content of total hexosamine due to a decrease both of chondroitin sulphate and keratan sulphate was found.

Key words: Cartilage — Glycosaminoglycans — Chromatography — Ions — Ageing.
Introduction

The biological function of the various components of connective tissue is not well understood. Further information might be obtained from a detailed study of the changes in their composition and concentration with age and in various pathological conditions. Several studies on the content and the composition of glycosaminoglycans in human articular cartilage have been reported. In adults, small or negligible variations with age have been found (Loewi, 1953; Miles and Eichelberger, 1964; Bollet et al., 1963; Anderson et al., 1964; Maroudas et al., 1969) while others have reported a decline in the content of glycosaminoglycans with increasing age (Kuhn and Leppelmann, 1957; Greiling and Stuhlsatz, 1969). The changes correspond to a decrease in the content of galactosamine (Kuhn and Leppelmann, 1958) but a gradual decline in both chondroitin sulphate and keratan sulphate has also been indicated (Greiling and Stuhlsatz, 1969). In newborn children, articular cartilage has been shown to have a higher hexosamine content (Kuhn and Leppelmann, 1957) and a higher galactosamine/glucosamine ratio (Kuhn and Leppelmann, 1958) than cartilage obtained from individuals 10–40 years of age. A higher chondroitin sulphate content in the middle layer and keratan sulphate content in the deep layer of articular cartilage have been found (Stockwell and Scott, 1967; Maroundas et al., 1969). By histochemical techniques a change in distribution of chondroitin sulphate and keratan sulphate with age has been indicated (Stockwell and Scott, 1965).

A decrease in the content of glycosaminoglycans (Hirsch, 1944; Matthews, 1953; Kuhn and Leppelmann, 1957; Bollet et al., 1963) in osteoarthritic cartilage has been reported. This change seems to be localized, since no differences have been shown between normal articular cartilage from adults and the non-osteoarthritic parts of cartilage from joints with osteoarthritis (Matthews, 1953; Anderson et al., 1964; Bollet and Nance, 1966).

In a preliminary work by Hjertquist and Engfeldt (1967) it was found that the concentration of total hexosamine in normal articular cartilage was highest in early childhood. In adults, it remained relatively constant with advancing age. A decrease in the amount of total hexosamine was found in osteoarthritic cartilage compared with adjacent normal cartilage. In a further study using a CPC-cellulose column, the major fraction isolated, chondroitin sulphate, showed the highest concentration in early childhood (Hjertquist, in preparation). By the methods applied in that investigation, keratan sulphate could not be determined separately from glycoproteins since both are recovered in the 1% CPC fraction. This was found to be greater in cartilage from adults than from children, and smaller in osteoarthritic than in adjacent normal cartilage.

In this preliminary investigation, an Ecteola cellulose column (Antonopoulos et al., 1967, 1969) was used in order to obtain more information about differences in keratan sulphates in articular cartilage with advancing age and in osteoarthritis, necessary when the chemical composition of articular cartilage in joint disease is to be studied.

Material and Methods

Human articular cartilage was obtained from the right knee joint from individuals aged from a few days up to 95 years of age. Twelve to forty-eight hours post-mortem, all the articular cartilage of the lower femoral epiphysis was excised with a scalpel. Bone was carefully excluded.