

Ultrastructural Differences of the Medial Meniscus Depending on the Sites of Insertion

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The aim of our study was to trace out the structure of the sites of insertion of medial meniscus and his close parts in Wistar rats. The existent investigations concern only the layers of the menisci, but not their sites of insertion. The electron microscopy investigation we have made showed the presence of an electron dark stripe situated between the articular matrix and the collagen bundles. That stripe was very much folded and formed thin digit-like growths. The tense zone of the meniscus bears resemblance to the the transitional zone between articular cartilage ad synovial membrane. The cells from the zone lack a typical chondroblast character. They represent transient cellular forms with fibroblast phenotype, assigned the task to regulate the demands of cartilage matrix.

Key words: meniscus, proteoglycans, collagen, computer analysis.

Introduction

The structure of the sites of insertion of the menisci determines their steadiness to different abnormal mechanical influences [10]. Their individual structural characteristic defines various individual possibilities of the menisci to be injured and teared. The existent investigations concern only the layers of the menisci, but not their sites of insertion [5, 1, 2, 3, 6, 9, 11]. The aim of our study was to trace out the structure of the sites of insertion of medial meniscus and his close parts in Wistar rats.

Material and Methods

The materials of the investigation were 15 Wistar rats of both sexes, aged between 8 and 12 months. The material was taken from the anterior point of insertion (API) and the posterior point of insertion (PPI) and then was compared. The samples were investigated by routine light microscopy after staining in Mason. Routine transmission and scanning electron microscopy were used, as well as ultracytochemical examination with Safranin O was performed in order to prove the presence of proteoglycans. The electronograms were analyzed by Image analyzer "Olympus", Version 4.5. Electronograms with the same enlargement and taken down under equal

conditions were used for that purpose. They were calibrated for a size, intensity and density. The received data were worked up by a computer with a special program and then charts (barohistograms) were produced.

Results

The results from light microscopic examination in Mason showed that the meniscus was built on four zones: a sliding zone, a pressure zone, a tense zone and a parameniscal zone. It was established on bigger enlargement, the collagen bundles contacted directly with the articular cartilage or they separated on the articular cartilage by thin clefts. The electron microscopy investigation of the API showed the presence of an electron dark stripe situated between the articular matrix and the collagen bundles. That stripe was very much folded and formed thin digit-like growths (Fig. 1). Proteoglycan complexes were arranged between these growths. Sometimes the growths were situated densely and even contacted each other. Peripheral collagen structures were arranged in groups. These groups were in parallel and formed bundles. Their ultrastructural characteristic was of collagen type I. The parallel investigation by scanning electron microscopy confirmed those special features (Fig. 2). The examination of the structures of the PPI showed that the border electron dark stripe was not very much folded and it contacted with fibroblast-like cells. On their outside surface were situated crystalline calcium precipitations (Fig. 3). The collagen fibers situated peripheral on the site of insertion were unorganized and formed a collagen network. The scannogram showed that they were different in form and size. Sometimes the collagen fibers contacted each other.

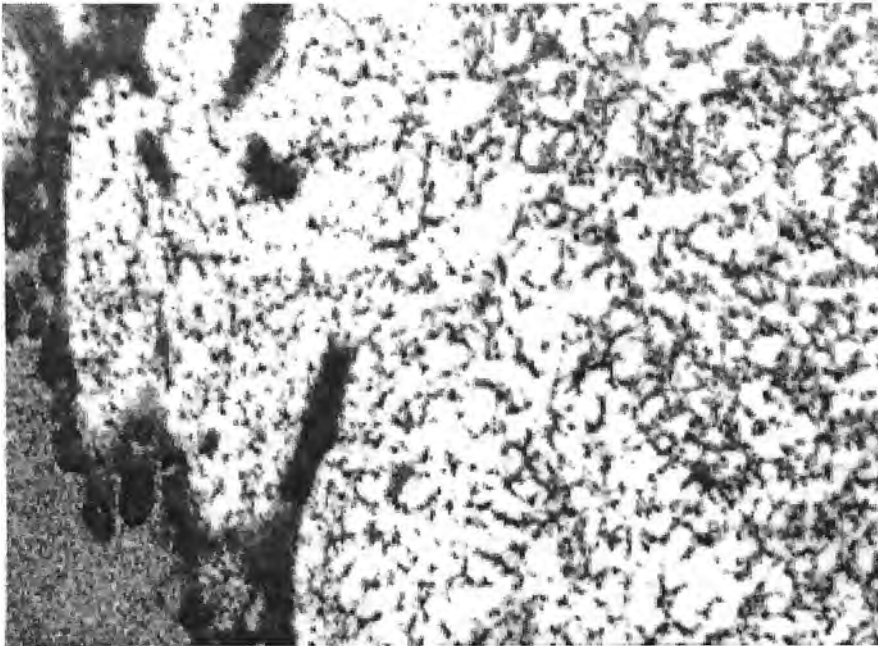


Fig. 1. The electron microscopy investigation of the API showed the presence of an electron dark stripe situated between the articular matrix and the collagen bundles. It was very much folded and formed thin digit-like growths ($\times 15\ 000$)

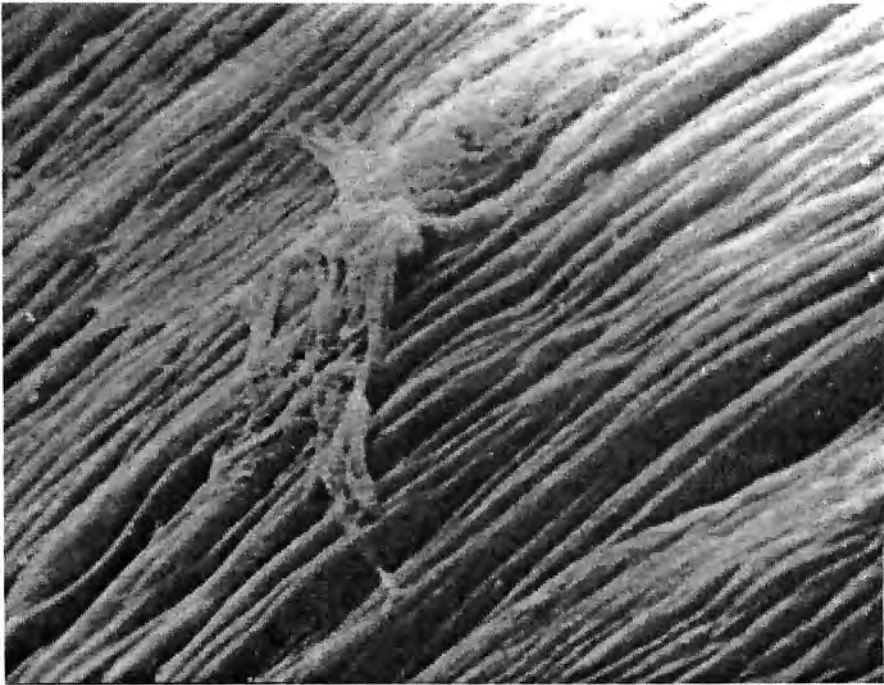


Fig. 2. SEM — the ultrastructural characteristic of the fibers was of collagen type I ($\times 6000$)



Fig. 3. Fibroblast-like cells. On their outside surface were situated crystalline calcium precipitations ($\times 10\ 000$)

Discussion

The results of our experiments show that there is a great percentage of variations in the insertion of the menisci. The impaired biomechanics clarifying different types of traumas. As shown by the study results, the tense zone of the meniscus bears resemblance to the transitional zone between articular cartilage and synovial membrane of the articular cartilage [12]. The cells from the zone lack a typical chondroblast character. Obviously, they represent transient cellular forms with fibroblast phenotype, assigned the task to regulate the demands of both cartilage and synovial matrix. Such duplicity of the cells defines their excessive metabolic involvement owing to which they undergo rapid wearing out with ensuing degeneration [5, 7, 8]. As in the articular cartilage, initially the cells of the zone react by activation becoming manifest with enhanced proteoglycan synthesis, documented by increased concentration of proteoglycans in the territorial matrix of the cells. The transient nature of the elements in the insertion of the meniscus determines the pronounced lability of this zone. That must be always taken into account when clarifying the causes for the pain in the knee joint and in the surgical interventions on the menisci in different types of traumas.

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