

The Articular Cartilages of the Human Sternoclavicular Joints are not only formed by a Fibrocartilage but a Hyaline Cartilage or Combination of Both Cartilage Tissue Types ; A Histological Study of 7 Japanese Autopsy Cases.

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ABSTRACT

Aim : The histologic details of the normal sternoclavicular joint (SCJ), especially the microscopic structure of the articular surfaces are not entirely clear, though the descriptions of famous text books affirm to be of dense fibrocartilage. We investigated the histology of the human SCJs, using seven autopsy cases. **Result** : Histologically, only three surfaces out of 14 articular cartilages show the features of typical fibrocartilage. The remaining 11 articular surfaces are formed by a hyaline cartilage, or combinations of hyaline cartilage and fibrocartilage tissue. There is no hyaline cartilage on the sternal surface, however, three clavicular surfaces are covered with hyaline cartilages. Moreover, the clavicular surfaces of 4 cases, and the sternal surfaces of 2 cases had thicker cartilage than the opposite one. **Conclusions** : Histologically, the articular cartilages of the human SCJs were complicated, not formed only by a fibrocartilage but a hyaline cartilage, or combination of both cartilage tissue types. Our observations are thought to indicate a controversial issue.

KEY WORDS

Human sternoclavicular joint, articular cartilage, hyaline cartilage, fibrocartilage

Introduction

It is well known that articular surfaces of human synovial joints are mostly formed by a variety of hyaline cartilage. As exceptions to this, surfaces of the sternoclavicular joint (SCJ), acromioclavicular joint and both temporomandibular surfaces are described to be of dense fibrocartilage¹⁾. Recently, the SCJ is noteworthy, because the SCJ grafts are reported to be usable to the temporomandibular joint

reconstruction²⁾. The incidence of mandibular hypoplasia is not known. Absence of growth at the mandibular condyle is observed in many disorders, including hemifacial microsomia, idiopathic hypoplasia of the mandibular condyle, hypoplasia from trauma and/or condylar fractures, infection, and juvenile rheumatoid arthritis³⁾. It is important to understand the normal structure of the human SCJ, as well as pathological one. But the histologic details of the normal

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Table. 1 Clinical summary of 7 cases used in this study

Case No.	Age	Gender	Sampling side	main disease	cause of death
1	21	F	L	non-Hodgkin lymphoma	respiratory failure
2	77	M	L	cholangiocarcinoma	multiple organ failure
3	76	F	L	non-Hodgkin lymphoma	multiple organ failure
4	63	F	R	multiple myeloma	heart failure
5	53	F	R	acute myeloid leukemia	respiratory failure
6	64	M	R	esophageal carcinoma	circulatory failure
7	72	M	R	gastric carcinoma	liver failure

SCJ, especially the microscopic structure of the articular surfaces are not entirely clear, although some observation has been accumulated³⁻⁶⁾.

The aim of this study was to examine the microscopic features of the human SCJs. Here we disclose the current result about the subject, though the study is on going. And our point of view is thought to be a controversial issue.

Material and Methods

SCJs were obtained from seven consecutive autopsy cases, executed from April to August 2000, at second department of pathology, Kanazawa university, school of medicine. The clinical features containing age, gender, main disease, and cause of death are summarized in Table. 1.

Unilateral sampling of the sternoclavicular joint was performed at the thoracotomy of each case. The

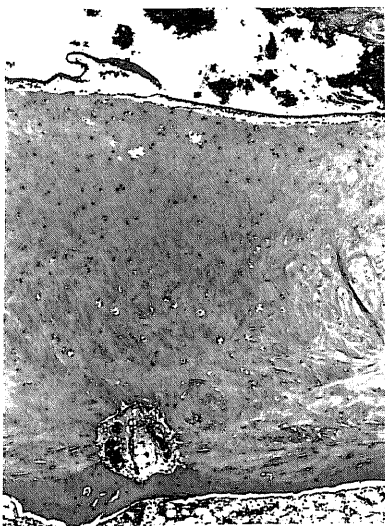


Fig. 1 Sternal surface of the case 4 shows visible collagenous fibers arranged in irregular bundles, with cartilage cells surrounded by a sparse cartilage matrix between the bundles. The features are those of fibrocartilage tissue. H&E stain. X40

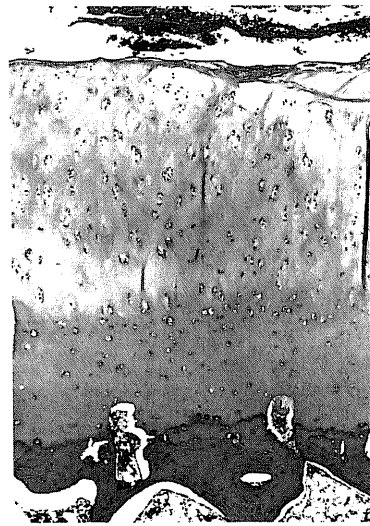


Fig. 2 Clavicular surface of the case 3 shows homogenous matrix with chondrocytes buried in it. The features are those of hyaline cartilage tissue. H&E stain. X40

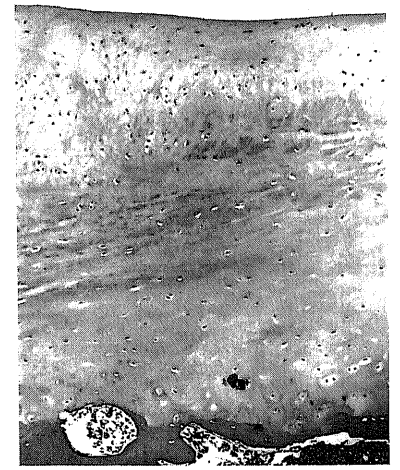


Fig. 3 Clavicular surface of the case 1 are covered with combination of fibrocartilage and hyaline cartilage tissue. H&E stain. X40

Table. 2 Histologic type of articular cartilage of the sternoclavicular joints

Case no.	Clavicular surface	thickness	sternal surface
1	almost fibrous	>	almost fibrous
2	combined	<	combined
3	almost hyalinous	>	almost fibrous
4	combined	<	combined
5	combined	<	combined
6	almost hyalinous	<	combined
7	almost hyalinous	unknown	combined

specimens were fixed in 10% neutral buffered formalin, decalcified in 7% aluminum chloride, 3.6% hydrogen chloride, and 4.6% formic acid solution for 1 day, and, subsequently, embedded in paraffin. Sections of 3 μ m thickness were cut from each paraffin block, and were stained with hematoxylin and eosin (H&E), Azan Mallory, and Elastica-van Gieson. Then, we observed the stained sections under a light microscope (BX-50, Olympus Co., Japan).

Result

The main clinical data of 7 cases used in this study were shown in Table. 1. The age ranged 21 to 77 years, and male to female ratio was 3 : 4. No musculo-skeletal disease was diagnosed in all cases.

Histologically, the articular cartilages of the SCJs were complicated. There was a spectrum of histologic features between the fibrocartilage and the hyaline cartilage. We classified the cartilages into 3 histological type, namely, almost fibrous, combined, and almost hyalinous. The term "almost fibrous" means the tissue type like the orthodox type of the fibrocartilage (Fig.1). The term "almost hyalinous" means the tissue type like the ordinary type of the hyaline cartilage (Fig.2). And the term "combined" means the combination of the fibrocartilage and the hyaline cartilage, or the intermediate style of both tissue type (Fig.3).

The histological findings of the articular cartilages were shown in Table. 2. The clavicular surfaces of

the case 3, 6, and 7 were formed by a hyaline cartilage or the resemblance. Both articular surface of the case 1 and the sternal surface of the case 3 were formed by a fibrous cartilage or the resemblance. The remaining 8 articular surfaces, the clavicular surfaces of the case 2, 4 and 5, and the sternal surfaces of the case 2, 4 through 7 were formed by combinations and/or intermediate style of both cartilage tissue type. The thickness of the cartilages was compared between the clavicular surface and the sternal surface of same case. The result was that the clavicular surfaces of 4 cases (case 2, 4, 5, and 6), and the sternal surfaces of 2 cases (case 1 and 3) had thicker cartilage than the opposite cartilage. The remaining case 7 was not able to compare the thickness of both surfaces, because of the bad sampling condition.

Discussion

The classification of cartilage tissue is vague, it may classified into 3 or 4 types, namely, hyaline, white fibrocartilage and yellow elastic cartilage, and additional cellular cartilage⁷⁻¹⁰. But the precise definition or borderline of both histologic types is not yet described.

Hyaline cartilage in adults is present in the walls of the major respiratory tract (nose, larynx, trachea and bronchi), on the ventral ends of ribs, and on the bone surfaces of joints. Histologically, hyaline cartilage is composed of intercellular matrix of hyaline cartilage and chondrocytes embedded. The matrix

looks homogenous. Hyaline cartilage is unique in containing type II, IX, XI collagens, although water is the most abundant component. The collagen fibers are not visible, because most of the collagen is in the form of submicroscopic fibrils and the refractive index of collagen is very close to that of the surrounding ground substance. Chondroblasts and chondrocytes secrete the macromolecular constituents of cartilage matrix, such as tropocollagen molecules. Chondrocytes buried in the matrix live in tiny matrix spaces known as lacunae in the matrix they have secreted. Typically, chondrocytes have a rounded nucleus with one or more nucleoli, and vary in size and shape⁷⁻⁹⁾. In contrast, fibrocartilage is located in a few regions where firm support and tensile strength are necessary : the intervertebral disks, the pubic symphysis, the linings of tendon grooves, the attachments of tendons and ligaments, and the rims or bodies of certain articular cartilage. Fibrocartilage is composed predominantly of visible collagenous fibers arranged in irregular bundles, mainly containing type I collagen, with cartilage cells surrounded by a sparse cartilage matrix between the bundles, resembles the territorial matrix of hyaline cartilage. Fibrocartilage never occurs alone, but merges with neighboring hyaline cartilage, ligaments, or tendons⁷⁻⁹⁾.

It is described that articular surfaces are mostly formed by a special variety of hyaline cartilage reflecting their preformation as parts of cartilaginous models in embryonic life ; but as exceptions to this, surfaces of the SCJ as well as acromioclavicular and temporomandibular joints are of dense fibrous tissue, with isolated groups of chondrocytes and little surrounding matrix, again reflecting their formation by mesenchymatous ossification¹⁰⁾. But our observations are thought to disclose a controversial issue. Only three surfaces out of 14 articular cartilages show the features of typical fibrocartilage, or the analogue. The remaining 11 articular surfaces are formed by a hyaline cartilage, or combinations of hyaline cartilage and fibrocartilage tissue. To the best of our knowledge, only one report disclosed a human sternal surface covered by hyaline cartilage, using only one case⁶⁾.

Moreover, It is described that the clavicular articular surface, much the larger, is also thicker than the fibrocartilaginous lamina on the sternum¹⁾. But our results show the difference from the classical knowledge. We demonstrate the results that the clavicular surfaces of 4 cases, and the sternal surfaces of 2 cases had thicker cartilage than the opposite cartilage. We are also able to emphasize the observation that there is no hyalinous articular cartilage on the sternal surface, however, three hyalinous articular cartilages are found on the clavicular surfaces.

We, however, hesitate to indicate any critical conclusions, because the study uses only 7 cases. We now attempt to obtain more materials, and the farther investigation should clarify the evidence concerned with SCJ.

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胸鎖関節の関節軟骨は線維軟骨だけではなく、
硝子軟骨あるいは多様な軟骨組織から形成されている：
ヒト胸鎖関節の組織学的検討

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武村 啓住, 立野 勝彦, 灰田 信英, 荻原新八郎
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要 旨

目的：ヒト胸鎖関節関節軟骨の特徴，とりわけその光学顕微鏡的構造については，なお不明な点が多い。そこで，7例の剖検例を用いて組織学的に検索した。結果：関節軟骨が典型的な線維軟骨からなっていたのは，7例14個（胸骨側および鎖骨側）の関節軟骨のうち，3個の関節軟骨のみであった。残りの11個は，硝子軟骨もしくは，線維軟骨と硝子軟骨の混在したもの，あるいは中間的な性質を示す軟骨からなっていた。硝子軟骨からなる関節軟骨は，胸骨側には1例も見られず，一方，鎖骨側では3例に見られた。さらに軟骨の厚さについても，鎖骨側の関節軟骨が胸骨側の関節軟骨より厚いのが4例，逆が2例であった。結論：ヒト胸鎖関節の関節軟骨は，組織学的に複雑な様相を呈しており，教科書的な記述とは異なっていた。