Localization of Degenerative Cartilage in the Acromioclavicular Joint: A Histological Investigation
Hatta, T; + Sano, H; Zuo, J; Itoigawa, Y; Shinozaki, N; Sakoma Y; Yamamoto, N; Itoi, E
+Department of Orthopaedic Surgery, Tohoku University, Sendai, Japan
Senior author; sanohirotaka@med.tohoku.ac.jp

INTRODUCTION
Acromioclavicular joint provides a structural connection between the scapula and clavicle which facilitates support of the upper extremity on the thorax. It is known that repetitive movements during shoulder motion including tilting, translation, rotation and abutment may cause attritional damage in the joint [1][2]. However, it is still unclear how degenerative changes occur within the joint, including their localization and severity. The purpose of the current study was to clarify the extent of histologic degeneration in the acromioclavicular joint using cadaver specimens.

MATERIALS AND METHODS
Forty-eight acromioclavicular joints (mean age: 83 years, range: 69-95 years, 26 male and 22 female) were obtained from 30 embalmed cadavers. No shoulders represented a prior history of shoulder surgery in the present series.

After decalcification, each specimen was sectioned in the coronal plane at the center of the joint. Then, histological staining with hematoxylin-eosin and safranine O were performed. For histologic assessments, both distal end of the clavicle and acromion were divided into upper and lower halves (Fig.1).

![Fig. 1](A) Cutting plane: Both the anterior and the posterior edges of acromioclavicular joint (dotted lines) were marked on each specimen, and then sectioned in the coronal plane at the center of the joint (a solid line). (B) Macroscopic findings of the cutting surface: Articular cartilage of each bone was divided into upper and lower halves, which were then assessed separately (C: upper half of the distal end of clavicle, C': lower half of the distal end of clavicle, A: upper half of acromion, A': lower half of acromion).

Histological assessments
Thickmess of articular cartilage, staining property with safranine O and tidemark integrity were evaluated (Fig. 2). Thickness of articular cartilage: Mean distance from the articular surface to the subchondral bone was measured using the software, Image J.
Staining property with safranine O: To assess the degree of degeneration of articular cartilage, staining property with safranine O was assessed using the grading system by Mankin et al [3]. 0: normal, 1: slight reduction, 2: moderate reduction, 3: severe reduction, 4: no dye noted.

Tidemark integrity: The extent of tidemark integrity was classified to four grades. 0: intact, 1: \(< 1/4\) damaged (multilayered or indistinct) area in the joint surface, 2: \(< 1/2\) damaged area in the joint surface, 3: over 1/2 damaged area in the joint surface.

RESULTS
For both the distal end of the clavicle and the acromion, articular cartilage was significantly thinner in the lower half than in the upper half (Fig. 3) (C to C': p < 0.001, A to A': p < 0.01). As for the staining property with safranine O staining and the integrity of the tidemark, articular cartilage in the lower half represented more degenerative changes than in the upper half (Fig. 4).

DISCUSSION
The current study revealed that the lower part of the acromioclavicular joint was more degenerated than its upper part in the elderly population. These findings might reflect the presence of repetitive biomechanical stresses in the lower part of this joint. This may also indicate that there may be a change in stress distribution in the acromioclavicular joint among the elderly people due to kyphotic postural deformity with aging. More anatomical and biomechanical studies need to be undertaken to further clarify the mechanism and progression of osteoarthritis of the acromioclavicular joint.


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