

Morphological evaluation of the scapula in relation to the development of rotator cuff tears using a homologous model

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INTRODUCTION: The relationship between rotator cuff tears and local geometry in the scapula, such as the glenoid fossa and acromion, has been discussing. But any of them have not been reached on a sufficient consensus. We believe that one of the reason of this unclarity would be not global but local analysis of scapular geometry. Recently, a method called homologous modeling has been developed to standardize three-dimensional geometric data (Fig.1), which making it possible to examine the relationship between the global shape of bone and specific disease. But the association between rotator cuff tears and global scapula shape has not been reported. The purpose of this study is to extract variables representing variations in global scapula shape using a homologous model and to characterize the global scapula shape in case of rotator cuff tears.

METHODS: CT images of the scapula among 558 patients (58 patients underwent rotator cuff repair) were acquired. A homologous model of the scapula comprising 19,563 vertices was created based on 40 landmarks. Principal component (PC) analysis on the three dimensional coordinates of all vertices for both sexes was performed. The morphological variation represented by each PC was interpreted based on the virtual shape of each PC score. The ROC curve and area under the curve (AUC) based on the PC scores were calculated between males and females, respectively. This study was approved by the Sapporo Medical University IRB Committee.

RESULTS SECTION: PC analysis showed that a wide variety of scapular variations were extracted in both males and females. The ROC curve showed that the AUC of PC8 in males and PC6 and PC9 in females were more than 0.6 (AUC = 0.62, 0.65 and 0.64, respectively). The morphological variations of these components revealed the following morphological characteristics in rotator cuff tears: (1) medial shift of the acromion in the coronal plane and small kyphosis of the scapular body in the sagittal plane (Fig.2), (2) medial tilt of the acromion in the coronal plane, anterior tilt of the glenoid fossa and coracoid process in the sagittal plane, and enlargement of anterior-posterior diameter of the supraspinatus fossa in the horizontal plane (Fig.3), and (3) posterior tilt of the acromion in the sagittal plane, change of orientation of the coracoid process from downward to outward, and small kyphosis of the scapular body in the sagittal plane (Fig.4).

DISCUSSION: This study revealed that the small kyphotic morphology of the scapular body in the sagittal plane is an important characteristic in rotator cuff tears. This morphology may imply the predisposition of scapular forward tilt in relation to the rib cage. Relative forward shift of the acromion may cause subacromial impingement resulting in rotator cuff tear. Thus, treatment to tilt the scapula posteriorly may be effective for rotator cuff tears with the small kyphotic morphology of the scapular body. The limitation of this study was no examination of the morphologies among other adjacent bones or the relationship to surrounding shoulder muscle function, including the rotator cuff.

SIGNIFICANCE/CLINICAL RELEVANCE: (1-2 sentences): The characteristics of the global scapular morphology involved in the development of rotator cuff tears were elucidated. This result could contribute to the development of individualized physical therapy interventions that take morphological features into account.

Figure

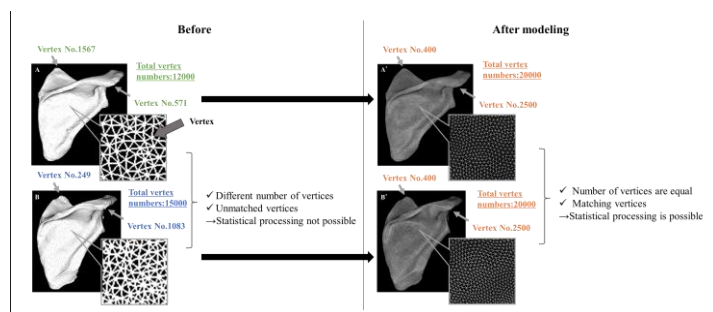


Fig.1 Summary of homologous modeling

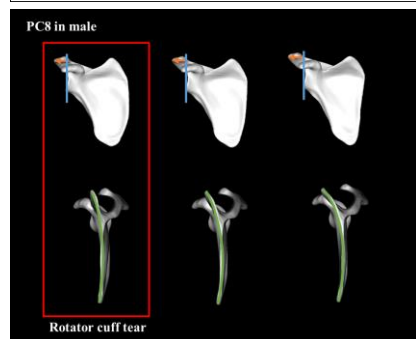


Fig.2

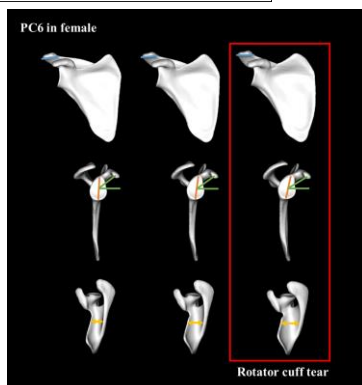


Fig.3

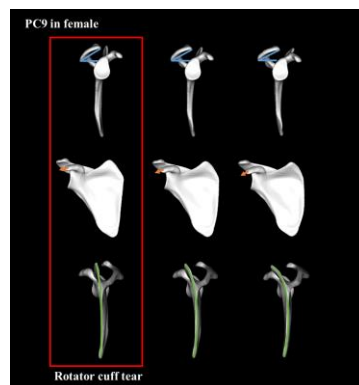


Fig.4