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The relationship between age, rotator cuff integrity, and osseous microarchitecture of greater tuberosity: Where should we put anchor?

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ABSTRACT

Objective: The aim of this study was to compare the microarchitecture of the greater tuberosity with or without rotator cuff tear and to obtain optimum location for anchor screw insertion for rotator cuff repair.
Methods: Twenty-five humeral heads were harvested from 13 male cadavers of mean age 58.4 years, including 6 humeri with rotator cuff tear and 19 intact humeri. Six regions of interest (proximal, intermediate, and distal zones of the superficial and deep regions) were divided into the anterior (G1), middle (G2), and posterior (G3) areas of the greater tuberosity. Trabecular bone volume and cortical thickness were evaluated.
Results: Total trabecular bone volume was greater in subjects <50 years old than in subjects >50 years old but did not differ significantly in subjects with and without rotator cuff tear. Cortical thickness in both intact and torn rotator cuff groups was significantly greater in the proximal and intermediate zones than in the distal zone. Cortical thickness was related to anatomic location rather than age or cuff tear.
Conclusion: The optimal location for anchor screw insertion during rotator cuff repair is either the proximal or intermediate region of the greater tuberosity. Age has more influence in terms of trabecular bone volume loss than rotator cuff integrity.

Introduction

Surgical repair for rotator cuff tear include arthroscopic repair with suture anchor screws. Many factors will determine the successful of rotator cuff repair. One of which is bone quality of the tuberosity.[1] Poor bone quality may cause failure of such as loosening of anchor screws that will leads to failed repair.

Studies of the bony architecture of the proximal humerus have reported that bone density decreases with age and varies between each individuals.[2] Bone density of the humeral head has been reported to correlate with the pull-out strength of suture anchor screws.[3,4] Therefore, the need for radiographic study of the microarchitecture of the greater tuberosity is required. High resolution computed tomography (HRCT) has been reported to accurately evaluate bony microarchitecture,[5] still it has not been applied to evaluate detail microarchitecture around the greater tuberosity.

This study was designed to investigate the regional variation in bone quality parameters in the greater tuberosity correlated with rotator cuff integrity, and to provide optimal location for anchor screw insertion for rotator cuff surgery. HRCT was used to compare bone quality parameters, including trabecular bone volume and cortical thickness, in subjects with and without rotator cuff tear.

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Materials and methods

Sample preparations

Twenty-five humeral heads were harvested from 13 fresh male cadavers. Exclusion was made to humeri with bone lesions, fractures, tumors and of which had undergone surgical treatment.

Radiological examination

Three-dimensional quantitative CT scan

All humeri were scanned with 16 slice, 0.625 mm thickness, 64-row multi-detector CT helical scanner (LightSpeed VCT, GE Healthcare, Milwaukee, Wisconsin). Images underwent volume rendering, using a 512 × 512 matrix and a 140 × 140 mm field of view. Image data were obtained with Advantage Workstation 4.3 and saved as DICOM files and later processed and analyzed with Centricity AW Suite (GE Healthcare).

Regions of interest (ROIs)

The greater tuberosity was divided into anterior (G1), middle (G2) and posterior (G3) areas in respect to the biceps groove in the axial plane (Fig. 1-A). Coronal plane division of articular surface was made as proximal (supraspinatus attachment), intermediate (greater tuberosity protrusion) and distal areas (10 mm below intermediate areas) (Fig. 1-B). Each zone was subdivided according to its depth. Superficial zone was the area just below the outer cortex while deep zone was 10 mm below it. This division was made based on anchor's length used in rotator cuff repair (Fig. 1-C). A final ROIs were defined. A cubic ROI was placed in each region with ≥0.3 mm in vertical axis and ≥5 mm in length. Trabecular bone volume was defined as the ratio of bone volume to total volume and measured. Cortical thickness were measured in each cubic ROI and analyzed.

Statistical analysis

Differences in trabecular bone volume and cortical thickness of G1, G2, and G3 were analyzed with one-way ANOVA.

Trabecular bone volume and cortical thickness of specific ROIs were compared using independent t-tests, and the differences in greater tuberosity microarchitecture with and without rotator cuff tear were compared for each ROI.

Regression analysis test were used to evaluate the relationship between total trabecular bone volume for each ROIs and age.

Specimens were also divided into those <50 and >50 years old, and differences for each ROI in samples with and without rotator cuff tear were analyzed by ANCOVA.

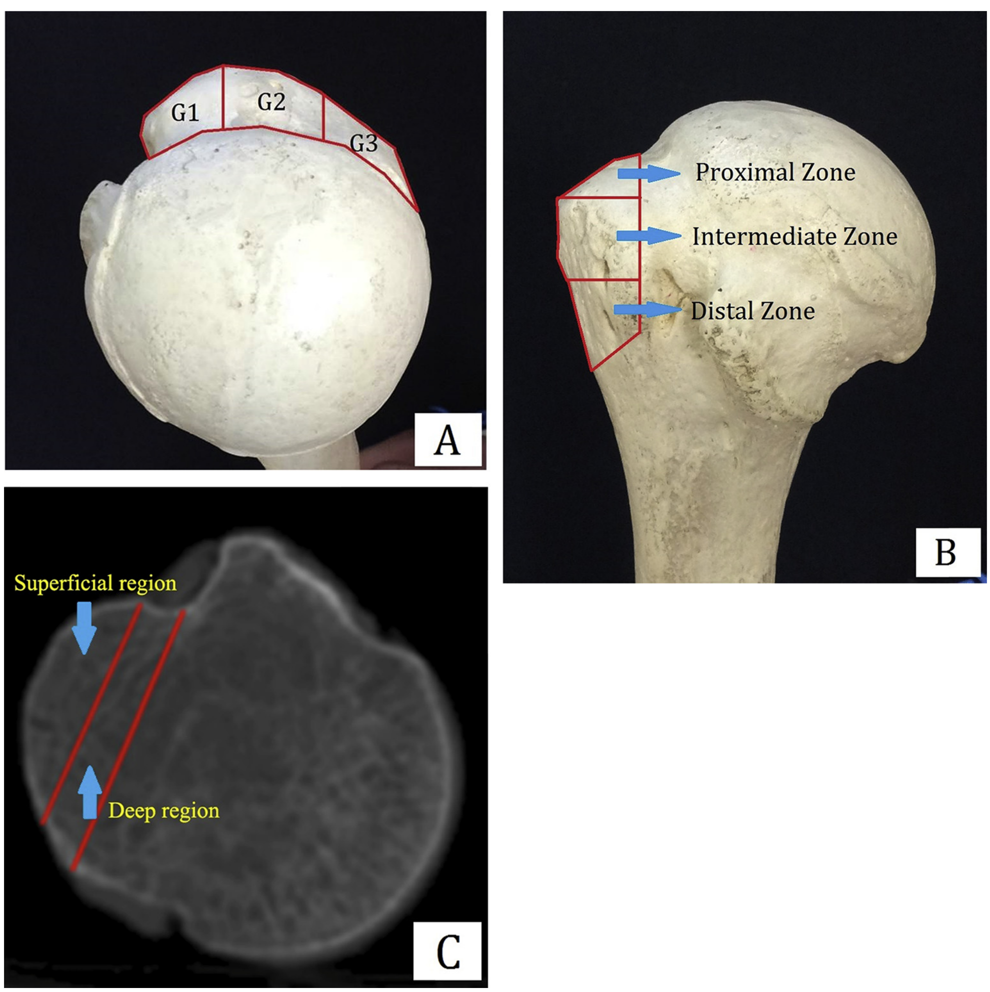

Fig. 1. Regions of Interest, (A) On an axial view of the humeral head, where the bicipital groove appears, the greater tuberosity was divided into three areas: (G1), middle (G2), and posterior (G3). (B) On a coronal view of the humeral head, the margin between the articular surface and greater tuberosity was defined as proximal, the apex of the greater tuberosity as intermediate, and 1 cm distal to the apex of the greater tuberosity as distal zone. (C) Each zone were divided according to its depth into superficial and deep regions.

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