

High differences in subacromial space height and gleno-humeral compression according to shoulder muscle exercise type

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Introduction

Numerous types of exercises have been described targeting specific shoulder muscles. Determination of tendons and joint compression is required for recommendation of the types of exercises to use in presence of pathologies of the rotator cuff or gleno-humeral osteoarthritis. Our objective was to determine subacromial space narrowing and articular as well as labrum compression forces in most commonly trained shoulder muscles and exercise techniques.

Methods

One healthy male volunteer (28 years old) underwent magnetic resonance (MR) arthrography and motion capture of the shoulder. Motion data from the volunteer were recorded during 31 rehabilitation exercises targeting 11 most frequently trained shoulder muscles or muscle groups and using up to four different techniques when available: cable bar machine, dumbbell, body weight and TheraBand™.

Glenohumeral kinematics was computed and applied to the subject's shoulder 3D models. All measures were acquired on the entire range of motion during motion simulation. Subacromial space height was assessed by measuring the minimum distance between the inferior acromial surface and the humeral head surface. Compression between humeral, glenoid cartilages and labrum surfaces were computed as maximal surface-to-surface distance between each structure.

Results

Minimal subacromial height varied up to 14.1-fold for targeted muscles exercises according to the training technique used. Cartilages compression varied up to 6.6-fold and labral compression up to 5.7-fold. Contacts were all located between the antero- and postero-superior sectors of the glenoid. Least favorable target muscles training with respect to cartilages and labrum compression were biceps brachii, pectoralis major and supraspinatus. Overhead strength training resulted in significant decrease ($p=0.001$) of subacromial space height compared to non-overhead strengthening exercises, as expected.

Conclusion

Important variations in subacromial space height, as well as cartilages and labrum compression were observed according to the type of strengthening exercise. Results allow for design of pathology specific shoulder strengthening protocols.