INTRODUCTION  Total shoulder arthroplasty (TSA) has become an accepted method to treat end-stage glenohumeral arthritis. Unfortunately, because of the crucial role of soft tissue balancing, the ultimate function of the joint as well as impingement related pain has been difficult to predict. While modular components have expanded surgical options, the concept of measured resection has not been fully incorporated in TSA systems. This study measures the effects of soft tissue tensioning on range of motion, efficiency, and impingement in TSA in a cadaveric model.

MATERIALS AND METHODS  Six cadaveric specimens without radiographic evidence of arthritis or arthroscopic evidence of rotator cuff tears were dissected to the level of the rotator cuff tendons. The specimens were rigidly attached to a shoulder simulator. Muscle forces were simulated using computer controlled pneumatic cylinders attached to the cuff tendons and the deltoid insertion. Each shoulder was abducted to its full range of motion by applying proportional load to each of the cuff tendons and the deltoid in the distribution: deltoid 46%, subscapularis 26%, teres minor 22%, and supraspinatus 9%. The abduction maneuver was performed at a constant loading rate of 8.9 N/s.

RESULTS  Prosthetic heads tended to reduce the efficiency of the abductors in raising the arm. After joint replacement, abductor efficiency was greatest with the smallest head size (-2mm), averaging 91% (range, 66-108%, p=0.32) and decreased dramatically as head size was progressively increased.

DISCUSSION  This study demonstrates that displacement of the humeral head during total shoulder replacement can dramatically reduce the mechanical efficiency of the abductor muscles. This suggests that efforts should be made to avoid lateralization of the humerus by preserving the original position of the joint line. If a glenoid resection is not performed at surgery, maximum efficiency will be preserved if the humeral head is undersized to compensate for the thickness of the glenoid component. There appears to be no definitive contribution of humeral head size to subacromial impingement following shoulder arthroplasty.