Effect of Concomitant Latissimus Dorsi Transfer on Joint Reaction Force for Reverse Total Shoulder Arthroplasty

INTRODUCTION:
Although reverse total shoulder arthroplasty (TSA) may restore shoulder abduction and forward flexion in the setting of a massive rotator cuff tear, the ability to use the extremity for ADL’s is often limited by external rotation weakness. Even though the reverse TSA restores abduction, the patient may be unable to bring the hand to his or her mouth because with the elbow flexed the weight of the hand causes the shoulder to fall into internal rotation. Concomitant transfer of the latissimus dorsi to the posterior greater tuberosity is a solution advocated by some surgeons. Gerber et al. reported significant improvement in abduction, forward flexion and external rotation in patients receiving concomitant latissimus dorsi transfer (LDT). While clinical results are promising, there is a need to document the effect of the inferiorly-directed force contributed by the LTD on the joint reaction force (JRF) because of its importance to fixation and stability. Therefore, it is hypothesized that this inferiorly-directed force partially counteracts the superiorly-directed force of the deltoid, resulting in decreased shear forces on the glenoid baseplate-bone interface.

METHODS:
Three cadaver shoulder specimens were dissected and implanted with the Equinoxe® Reverse TSA (Exactech, Inc., Gainesville, FL). The rotator cuff was completely released to simulate a massive rotator cuff tear. Each shoulder was mounted in a shoulder controller (Hansen et al.) that simulates neuromuscular control and replicates in vivo glenohumeral kinematics. The controller utilizes an optical, three dimensional tracking system (Optotrak, Northern Digital Inc., Waterloo, ON). The humerus was weighted to simulate the full mass of the upper extremity and stepper motors (Industrial Devices Corp, Salem, NH) were connected to the insertion points of the anterior, middle and posterior divisions of the deltoid by Spectra® cord. Simulated active abduction in the scapular plane was performed using position closed-loop feedback control. The joint reaction force at the glenosphere was measured at 5° intervals from 30°-70°. A fourth stepper motor was then connected to the greater tuberosity with 2.73kg applied to simulate a LDT and the test was repeated. Five trials were performed under each condition. Four-factor ANOVA statistical analysis with Bonferroni correction and α = 0.05 was performed.

RESULTS:
After simulated LTD the JRF demonstrated an increase in magnitude at abduction angles between 30° and 65° inclusive (p=0.033). The superiorly-directed shear force was significantly decreased as a result of the LTD between 45° and 70° (p=0.0001). The compressive component of the JRF was increased for all abduction angles (p=0.025). The force required to achieve abduction increased for the middle deltoid (p=0.035) and anterior deltoid (p=0.036) for the simulated LTD condition at all abduction angles. The posterior deltoid force required for abduction decreased at all abduction angles (p=0.031).

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