Anterior Latissimus Dorsi Transfer for Irreparable Subscapularis Deficiency Restores the Anteroposterior Force Couple in a Dynamic Biomechanical Cadaveric Shoulder Model

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INTRODUCTION:

In young patients with irreparable subscapularis deficiency and absence of severe osteoarthritis, anterior latissimus dorsi transfer (aLDT) has been proposed as a treatment option to restore the anteroposterior muscular force couple to regain sufficient shoulder function. However, evidence regarding the biomechanical effect of an aLDT on glenohumeral kinematics remains sparse. The purpose of the study was to investigate the effects of an aLDT on range of glenohumeral abduction motion, superior migration of the humeral head, and cumulative deltoid forces in a simulated subscapularis deficiency model using a dynamic shoulder simulator. It was hypothesized that an aLDT would restore native shoulder kinematics by re-establishing the insufficient anteroposterior force couple.

METHODS:

Eight fresh-frozen cadaveric shoulders were tested using a validated shoulder simulator. Outcome parameters included 1) glenohumeral abduction angle (gAA; degree), 2) superior humeral head migration (SM; mm) relative to the native state, and 3) cumulative deltoid force (cDF; N). gAA and SM were recorded using a 3-dimensional (3D) motion tracking system utilizing four infrared cameras. Motion analysis software was used to analyze recorded 3D motion video. SM was calculated as the change in distance between the two tripods relative to the native state. Deltoid force was recorded in real time throughout range of motion by loadcells connected to the actuators. cDF was calculated as the sum of anterior, middle, and posterior deltoid forces. Specimens underwent three testing cycles for each condition.

Outcomes measures were compared across three conditions: 1) native; 2) subscapularis deficiency (SSC-D); 3) aLDT.

RESULTS:

Glenohumeral Abduction Angle: The SSC-D significantly decreased gAA compared to native (Δ-9.8°; P<.001). The aLDT showed a significantly increased gAA compared to the SSC-D condition (Δ3.8°; P<.001) (**Table 1** and **Table 2**). For the aLDT, no anterior subluxation or decentralized glenohumeral abduction was observed.

Superior Humeral Head Migration: The SSC-D resulted in a significant increase in SM when compared to the native state (Δ 2mm; P=.003) (Table 1and Table 3). There were no differences in SM when comparing the aLDT to the native and SSC-D condition (P>.05, respectively).

Cumulative Deltoid Forces: The aLDT showed a significant decrease in cDF compared to the native shoulder (Δ-28.4°; P<.001) and to the SSC-D state (Δ-36.1°; P<.001) (Table 1 and Table 4).

DISCUSSION AND CONCLUSION:

In this cadaveric biomechanical study, performing an aLDT for an irreparable subscapularis insufficiency restored the anteroposterior force couple and prevented superior and anterior humeral head migration, thus improving glenohumeral kinematics. Further, compensatory deltoid forces can be reduced by performing an aLDT. Given the favorable effect of the aLDT on shoulder kinematics in this dynamic shoulder model, performing an aLDT may be considered as a treatment option in patients with irreparable subscapularis deficiency.