LATISSIMUS DORSI TRANSFER TO TREAT IRREPARABLE ROTATOR CUFF TEARS: WHAT POINT OF FIXATION ON THE HUMERAL HEAD?

Introduction: Transfer of Latissimus dorsi (LD) to treat irreparable rotator cuff tears was published by Gerber in 1988 (1). Despite recent clinical studies, little information is available about the point of the humeral head where the transfer should be fixed to achieve the expected shoulder external rotation and abduction. The authors recently performed a video of LD transfer in a fresh cadaver with fixation on either supraspinatus (SS) or infraspinatus (IS) humeral head insertions, when fixation was on SS, a sudden bowstringing effect of the transfer around the humeral head (toward the joint space) was observed when 90° abduction with internal rotation was applied to the arm. The purpose of this paper was to study this phenomenon by (1) proposing a 3-D modelization of 3 types of LD transfers (fixation on SS, IS or teres minor (Tm) insertions) and of the innate IS muscle to serve as a reference (2) applying 0° to 90° scapular plane abduction to the humerus placed in neutral, 50° external rotation or 60° internal rotation and then calculating the theoretical abd/adduction and external/internal rotation moment arms of the modeled muscles.

Methods: Right scapula and humerus were harvested from a fresh cadaver and mounted together in a frame, in the « zero » clinical position of the shoulder. Three spherical steel balls were sequentially inserted in the center areas of humeral head insertions of SS, IS and Tm. Two other markers were placed in the center area of origin of the IS in the infrascapular fossa and at the expected location of the center of the LD muscle belly, close to the inferior tip of the scapula. Three dimensional modelization of muscle vectors was obtained by stereoradiography. The authors made the hypothesis that the center of rotation of the simulated joint was located in the geometric center of the humeral head. Four muscles were modeled: transfer of LD to supraspinatus (LDSS), infraspinatus (LDIS), or teres minor (LDTm) insertions, and innate IS. Three series of 0°-90° abduction in the scapular plane were performed (fig.1) for each muscle with the humerus in neutral, 50° external rotation or 60° internal rotation. In each series, abd/adduction and external/internal rotation moment arms were calculated by increments of 3°. « Rolling up » of the force vectors around the humeral head was taken into account. Information from a previous study about shoulder muscle physiological cross-sectional area (pca) of LD and IS muscles (2) were used. The figure used for muscle force-producing capability was 3.6 kg for 1 cm² of muscles pca.

Discussion: Assuming that external rotation and possibly abduction are the expected moment arms of LD transfer in irreparable cuff tears, this study suggests that the point of fixation of the transfer onto the humeral head has a significant influence on the direction and magnitude of the resulting moment arm. In this study, fixation on SS insertion created a deleterious internal rotation moment arm from 11° to 90° abduction when the humerus was internally rotated (Table 1), following a favorable external rotation moment arm from 0° to 11° of abduction. These 2 subsequent opposite moments arms are well correlated with the sudden bowstringing effect previously observed by the authors when LD was transferred onto supraspinatus insertion in a fresh cadaver. The present study suggests that fixation on SS insertion may not be the best compromise in LD transfer for irreparable cuff tears in terms of theoretical moment arms.

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