Introduction: Rotator cuff ruptures that extend into the infraspinatus may cause dysfunction and superior migration of the humerus. Due to a large defect associated with muscle retraction, it is not possible for some rotator cuff ruptures to be repaired. The correlation between degree of infraspinatus disruption and shoulder function is unknown. The purpose of this study was to determine if a critical size of infraspinatus defect exists that produces a substantial decrease in abduction torque generation and increased humeral head migration. The second aim was then to investigate if a patch graft can reconstruct the cuff to restore glenohumeral abduction force.

Methods: Ten cadaver shoulders were obtained. With the arm in a hanging arm and neutral rotation position, loads were applied to the rotator cuff muscles and the deltoid. The generated abduction torque to the humerus was measured with a tensile load transducer at the distal humerus, and superior migration of the humerus was measured with a digital indicator. The following rotator cuff conditions were simulated: intact rotator cuff (Intact), unloaded supraspinatus tendon (SSP unloaded), supraspinatus tendon defect with muscle retraction (SSP resected), supraspinatus muscle retraction and infraspinatus detachment in one-fifth increments (cut ISP 1/5, 2/5, 3/5, 4/5, & 5/5), infraspinatus and infraspinatus tendon defect with muscle retraction (SSP+ISP resected).

The abduction torque was then measured with patch graft conditions considering (1) the effect of reattachment to the greater tuberosity, (2) partial narrowing of the defect by using a smaller graft, and (3) suturing the graft anteriorly to the rotator interval tissue versus to the subscapularis. Under each condition the measurement of the abduction torque and the superior translation was performed three times and the average was calculated. The result was expressed as percentage of the abduction torque generated by the intact rotator cuff.

The different conditions were statistically compared using repeated measures ANOVA. When a significant effect was identified, comparisons of all pairs with that factor were performed using paired t-tests. All statistical tests were two sided and the threshold of significance was set at alpha = 0.05.

Results: Glenohumeral abduction torque progressively decreased with greater infraspinatus detachment. When detachment extended to three-fifths of the infraspinatus, abduction torque reduced to 52% of intact, significantly less than supraspinatus release alone (61%; p<0.05) (Fig 1). Superior translation following complete supraspinatus and infraspinatus detachment increased significantly (p<0.05), although no intermediate critical threshold was detected (Fig 2).

Compared to supraspinatus release, abduction torque significantly increased with a graft between the infraspinatus and either the rotator interval (68%) (p<0.01) or the subscapularis (80%) (p<0.01) (Fig 3). The optimum grafting technique for restoring abduction torque occurred with a patch of decreased size between the infraspinatus and subscapularis with a suture to the greater tuberosity.

Discussion: The rotator cable extends from the biceps to the inferior margin of the infraspinatus, spanning the supraspinatus and infraspinatus insertions.

As the lower part of the infraspinatus includes the rotator cable, it might be thought that detachment of the inferior two-thirds of the infraspinatus would decrease the generated torque significantly. The entire infraspinatus, and not just the inferior portion, contributes to abduction torque generation and stabilizes the humeral head against superior subluxation. This indicates that the inferior portion, which includes the rotator cable insertion, plays a role in transmitting the compression forces across the glenohumeral joint. In addition, this study confirmed the potential for a patch graft to restore glenohumeral abduction torque due to a tenodesis effect. Even though a torn supraspinatus may have severe muscle dysfunction due to retraction and degeneration, a patch graft may be a surgical option for the irreparable rotator cuff tear. However, to obtain maximum benefit, the graft should be smaller than the defect (in the sagittal plane) and sewn directly to the subscapularis anteriorly with a suture to the greater tuberosity.