BIOMECHANICAL ANALYSIS OF ARTHROSCOPIC SINGLE ANCHOR REPAIR TECHNIQUES OF UPPER THIRD SUBSCAPULARIS TENDON TEARS

Paul Borbas, Sara Cammarata, Rafael Loucas, Simon Hofstede, Florian B. Imhoff, Lukas Ernstbrunner, Karl Wieser

Department of Orthopedics, Balgrist University Hospital, Zurich, Switzerland

INTRODUCTION

Isolated subscapularis (SSC) tendon tears account for about 10% of all rotator cuff tears. Most commonly the upper third of SSC is involved in these tears (Lafosse type 2 lesions). Clinical and magnetic resonance imaging results support the thesis that upper third repair of subscapularis lesions can be successfully treated with a single anchor. However, to date, there is no consensus regarding the biomechanical superiority of conventional fixation techniques compared with the newer, knotless repair techniques.

The purpose of the present study was to compare three single anchor repair techniques of Lafosse type 2 upper third subscapularis tears in a biomechanical test set-up on human cadaveric shoulders. The primary outcome measures were fixation strength, footprint coverage and contact pressure and the secondary outcome measure was ultimate load to failure. We hypothesized that the new knotless figure of eight technique will provide non-inferior fixation strength, footprint coverage, contact pressure and ultimate load to failure compared with the conventional mattress technique as well as compared to the lasso-loop technique.

MATERIALS AND METHODS

Eighteen human cadaveric shoulders were randomized in three groups with respect to the repair technique; group 1: knotted lasso-loop mattress, group 2: knotted mattress and group 3: knotless tape repair.

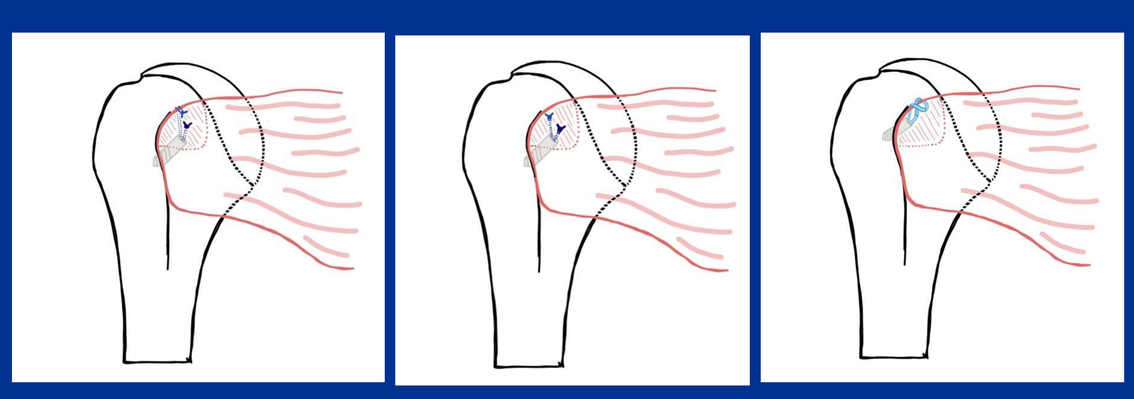
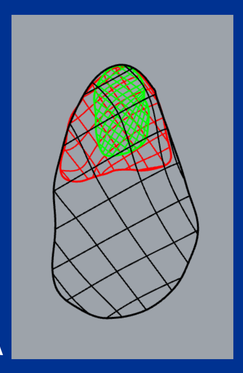


Fig. 1: Illustration of the three single anchor techniques of upper third subscapularis tears. Group 1: knotted lasso-loop mattress suture repair; Group 2: knotted mattress suture repair; Group 3: knotless tape repair

Upper third tears of the subscapularis tendon (Lafosse type 2) were created and repairs were performed with additional contact pressure and area measurement using a pressure mapping system. Cyclic testing was performed by loading the subscapularis from 10 to 100 N for 300 cycles. A position-controlled ramp protocol up to 30 N and 50 N was used to allow for pressure measurements. Finally, specimens were loaded to failure and failure modes were recorded.



2A

2B

Fig. 2A: Creation of upper third tears of the subscapularis tendon insertion at the lesser tuberosity under MicroScribe guidance, after the native footprint was outlined and saved (black). The repaired footprint (green) was outlined with respect to the native footprint (red) in the end.

Fig. 2B: Illustration of the repair set-up and the suture passage through pressure-sensitive film and tendon in a right shoulder in group 2 (knotted mattress suture repair).

Fig. 3: Left cadaveric should after knotless tape repair (group 3), illustrating the pressure-sensitive film placed between tendon and footprint.

RESULTS

All three groups provided similar stable repair constructs with an ultimate load to failure of 630.8 ±145.3 N in group 1, 586.9 ±220.7 N in group 2 and 678.2 ±236.5 N in groups 3, respectively (p = 0.827). Cyclic displacement was similar in all three groups with an average displacement of 1.2 ±0.6 mm. The highest stiffness was found in group 1 with 88 ±30.3 N/mm, which was not significantly different to group 2 (65 ±27 N/mm) and group 3 (83.9 ±32.9 N/mm) (p = 0.411).

The average footprint coverage after upper third subscapularis tendon repair (measured with MicroScribe) was 64.8 ±9.3% and did not differ between the groups. A significant difference was detected between group 1 (48.6 ±13.8%) and group 2 (25.9 ±5.7%) regarding pressurized footprint coverage (p = 0.028), but not between group 1 and group 3 (43.3±15.7%) (p = 0.569) and between group 2 and 3 (p = 0.087). The pressurized footprint force was higher in group 1 (38.3 ±23.3 N) and 3 (37.6 ±20.5 N) compared to group 2 (13.5 ±4.4 N), without statistically significant difference (p = 0.099 and 0.108).

The most common mode of failure was suture cut-through at the suture-tendon interface (8/18, 44%), followed by a fracture of the proximal humerus (5/16, 31%), failure at the musculotendinous junction (4/16, 25%) and bony avulsion of the lesser tuberosity (1/16, 6%) (Fig. 6).

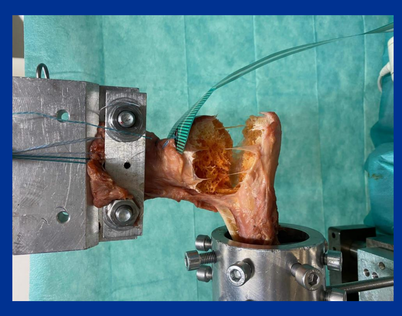


Fig. 4: Failure mode of left human cadaveric should in group 3 (knotless tape repair) with proximal humerus fracture after load to failure testing.

CONCLUSIONS

All three tested single anchor repair techniques of upper third subscapularis tears were able to provide sufficient biomechanical stability, with high ultimate failure loads of more than 550 N and a low cyclic displacement rates of less than 1.5 mm after 300 cycles. Knotted lasso-loop mattress and knotless tape repair were superior regarding pressurized footprint coverage compared to a knotted horizontal mattress technique.

References:

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