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The novel technique Clavicle Tunnel Helical Suture- bridge (CTHS) reconstruction is biomechanically stronger than a conventional coracoclavicular ligament reconstruction

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Faculty Disclosure Information

- Nothing to disclosure

Introduction

- Acromioclavicular (AC) joint injuries are common, compromising approximately 12% of shoulder injuries.
- Stability of the AC joint is conferred by the acromioclavicular and coracoclavicular (CC) ligaments. Currently many procedures are focused on CC ligament reconstruction to address vertical instability. This does not adequately address horizontal stability.
- Recent studies have shown that neglected or underdiagnosed horizontal instability of the AC joint leads to chronic AC joint injuries and poor patient outcomes in terms of pain and instability. [1-2]

- **Aim:** To evaluate the horizontal and vertical stability of 2 techniques for AC joint stabilization.

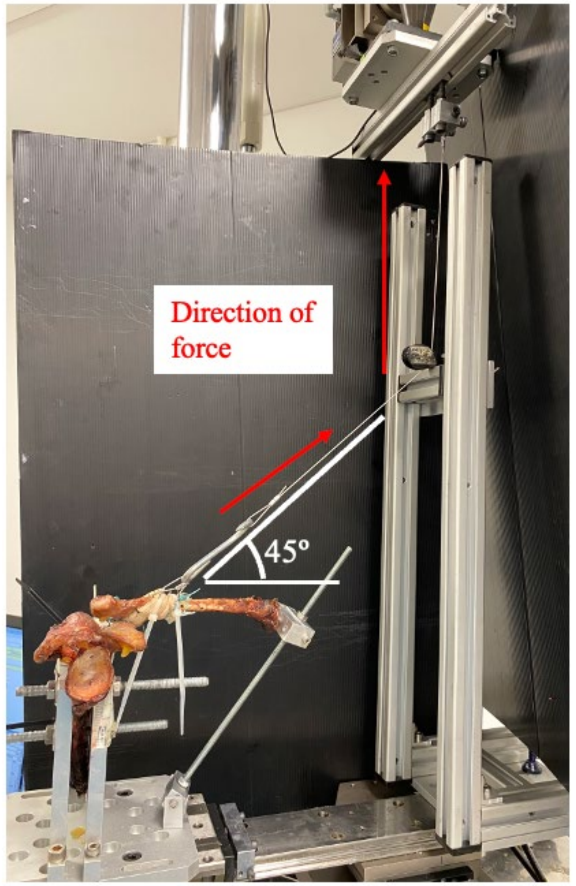
Methods

- 8 human cadaveric specimens (mean age 78 ± 7 years) were randomly allocated to 2 treatment groups:
  - Clavicle Tunnel Helical Suture-bridge (CTHS)
  - Clavicle Tunnel (CT)

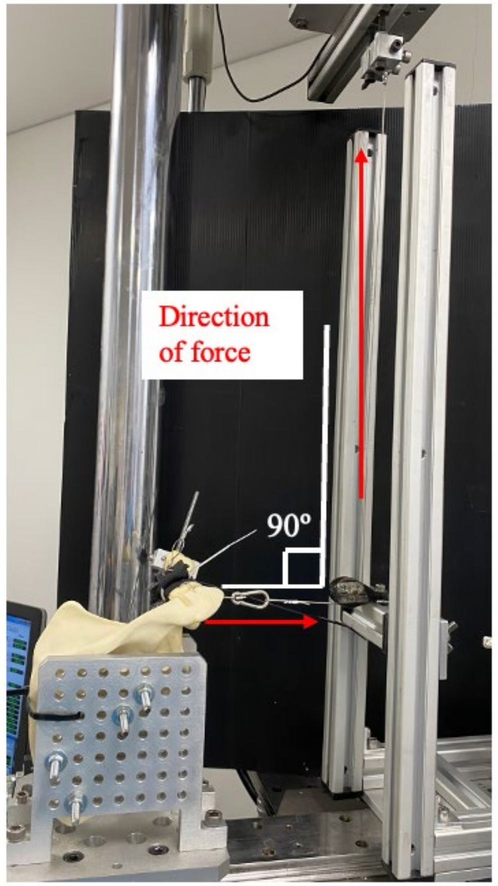
- The CTHS group underwent a single tunnel CC ligament reconstruction using Dog-Bone (Arthrex Inc.) and FiberTape sutures (Arthrex Inc.), with incorporation of an additional helical suture over the AC joint to reconstruct the AC ligament. The other group only had the former procedure.

- Using a specialised jig and materials testing machine (MTS), superior-inferior (vertical) and anterior-posterior (horizontal) stiffness and displacement were measured in the intact, AC cut, AC+CC cut and reconstructed joints when a 70N load was applied to the distal clavicle.

Methods



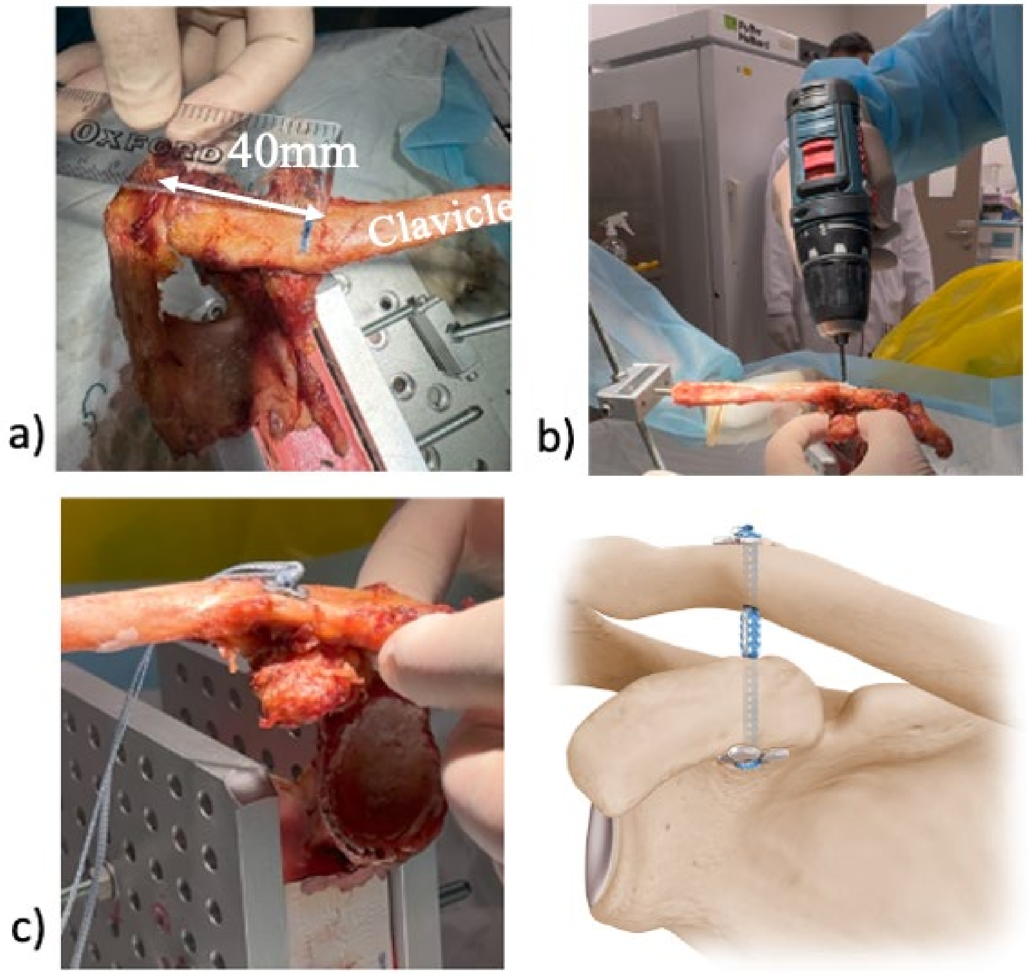
a)



b)

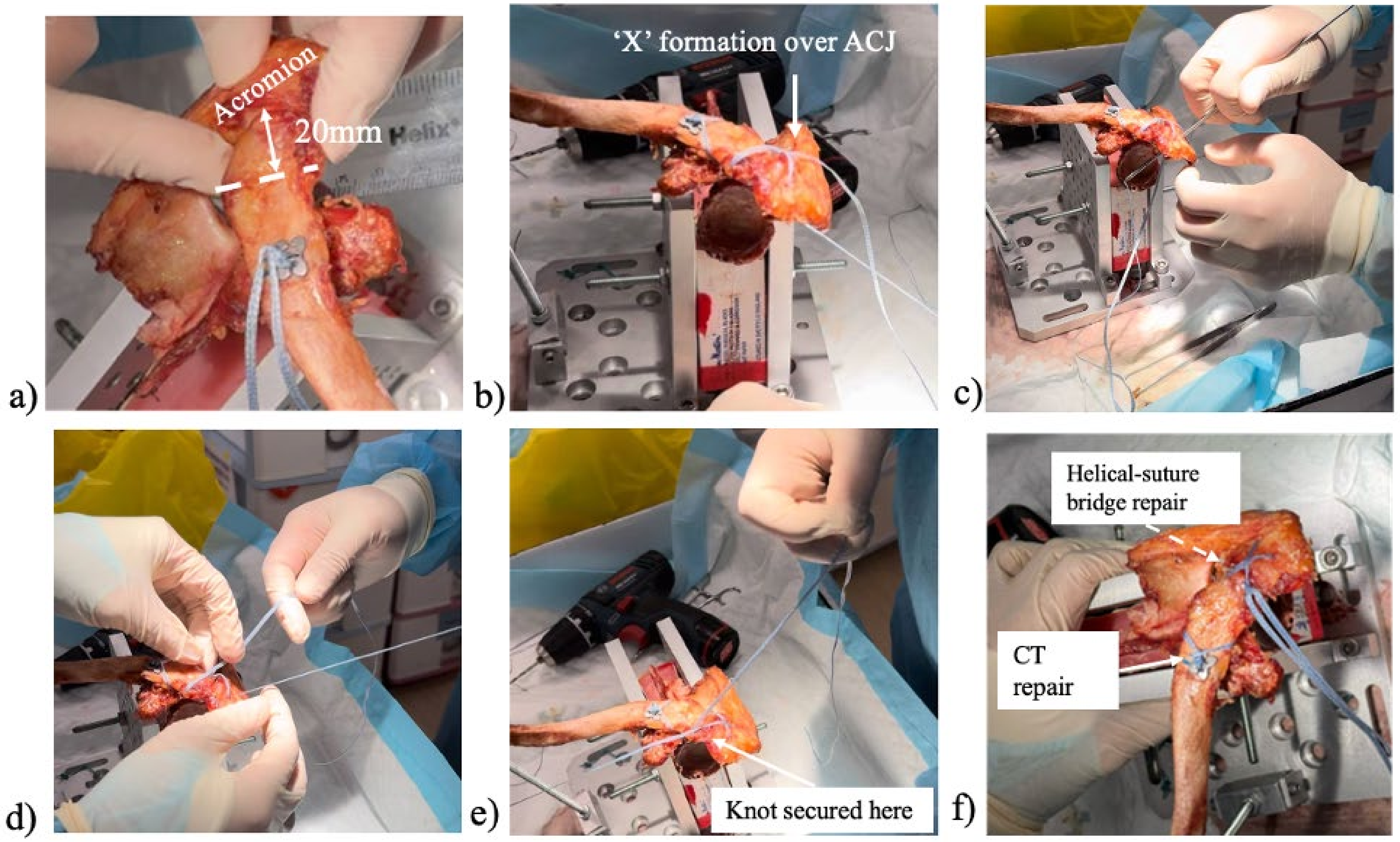
- **Biomechanical testing setup**
- a) Superior-inferior testing setup allowing for 45º angle between clavicle and line of force (red arrows).
- b) Anterior-posterior testing setup showing 90º angle between the plane of AC joint and the line of force (red arrows).

Methods



- **Clavicular tunnel (CT) repair.**
- a) + b) Clavicular tunnel is drilled through distal clavicle approximately 40mm away from acromion, in line with the coracoid process inferiorly.
- c) CT repair with illustration showing placement of Dog-Bones (Arthrex).

Methods



- **Clavicle Tunnel Helical Suture-bridge (CTHS)**
- a) Distal clavicular tunnel (dashed line) drilled approximately 20mm from joint line.
- b) 'X' formation over AC joint line, formed by crossing of sutures superiorly over the joint.
- c) Passing of suture tape through anterior acromial hole and exiting through the posterior acromial hole.
- d + e) Tying of knot adjacent to AC joint line to secure the reconstruction.
- f) Helical suture-bridge repair. White dotted arrow indicates the helical-suture bridge repair, while the white full arrow indicates the previously done CT repair.

Results

- Preliminary results using the CTHS repair for reconstruction restored anterior-posterior displacement (mean= 10.31±1.43mm), similar to displacement of the intact AC joint (mean = 8.58 ±1.06 mm) with a p-value > 0.05.

- The CTHS reconstruction was also able to restore superior-inferior displacement (mean = 10.38 ± 2.16mm) to similar values to that of the intact joint (mean = 9.82 ± 2.19mm), with a p-value > 0.05. However, for the CT reconstruction group (mean 12.70 ± 2.26mm), the anterior-posterior displacement was significantly higher when compared to the intact joint (mean = 9.82 ± 2.19mm), with a p-value < 0.05

- Superior-inferior displacement and anterior-posterior displacement was also significant between intact joint and AC+CC cut joint (mean = 12.79 ±1.35; 16.11 ± 4.60mm) with a p-value < 0.05.

- Regarding stiffness, the Superior-inferior displacement and anterior-posterior displacement was also significant between intact joint and AC+CC cut joint (mean = 12.79 ±1.35; 16.11 ± 4.60mm) with a p-value < 0.05.

Results

- Pairwise comparisons using the repeated ANOVA test with post-hoc Tukey test for AP displacement showed significance between intact and AC cut groups (p-value - 0.049), intact and AC+CC cut groups (p-value = 0.001), as well as between intact and CT reconstruction groups (p-value = 0.001) (Table 1)
- However, there is no significance found between the intact and CTHS reconstruction groups in AP displacement (p-value = 0.313).
- When analysing SI displacement, there was also a significant difference found between the intact and AC+CC cut groups (p-value = 0.003), as well as between the AC+CC cut and CTHS groups (p-value = 0.008) when analysing SI displacements. (Table 1)

Group 1	Group 2	N	P value	measurement
AC+CC cut	CTHS	7	0.008	SI displacement
Intact	AC cut	7	0.049	AP displacement
Intact	AC+CC cut	7	0.001	AP displacement
Intact	CT cut	7	0.001	AP displacement

Discussion

- Our findings suggest the CTHS reconstruction restored AC joint stability in both the AP and SI directions back to near intact state, which is also illustrated in the boxplot (Figure 1). This is compared to the CT reconstruction method which still resulted in a significant difference in AP displacement when compared to the intact state.

- Compared to other techniques, the main advantage for the CTHS technique would be that no additional augmentation material, such as extra sutures, native graft or additional metal, was required to restore the AC joint's bidirectional stability.

- **Conclusion**: these results show that CTHS reconstruction is better able to restore bi-directional instability in a joint that has both AC and CC ligaments torn, as compared to CT only reconstruction. This information is vital as it can influence the choice of surgical procedure in cases of AC joint instability.

References

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- 2. Hislop, P., Sakata, K., Ackland, D. C., Gotmaker, R., & Evans, M. C. (2019). Acromioclavicular joint stabilization: a biomechanical study of bidirectional stability and strength. Orthopaedic Journal of Sports Medicine, 7(4), 2325967119836751.