

# The Effect of Middle Trapezius Transfer on Humeral Head Translation and Subacromial Pressure in Irreparable Supraspinatus Tears- a dynamic biomechanical investigation

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## Background

Despite advancements in the treatment of rotator cuff tears, there remain significant challenges in managing irreparable supraspinatus (SSP) tears. Recent methods like middle trapezius transfer (MTT) have been introduced to restore function; however, biomechanical data on its efficacy in restoring superior humeral head translation and physiological subacromial pressure conditions in the setting of an irreparable SSP tear is lacking.

## Methods

Ten fresh-frozen cadaveric shoulders were mounted to a 6-DOF robotic arm (KUKA KR-60) (Figure 1) and underwent biomechanical testing in three states: (1) intact, (2) simulated irreparable SSP tear, (3) MTT (Figure 2). Each shoulder was brought to 30°, 45°, 60°, 75°, and 90° of abduction, and 60 N of superior force was applied to the humerus at each position to simulate loaded glenohumeral abduction. Superior humeral displacement was measured by the robot and subacromial contact area and peak pressure were measured using a contact pressure sensor (Tekscan 5503).



Fig 1. Robot Set up

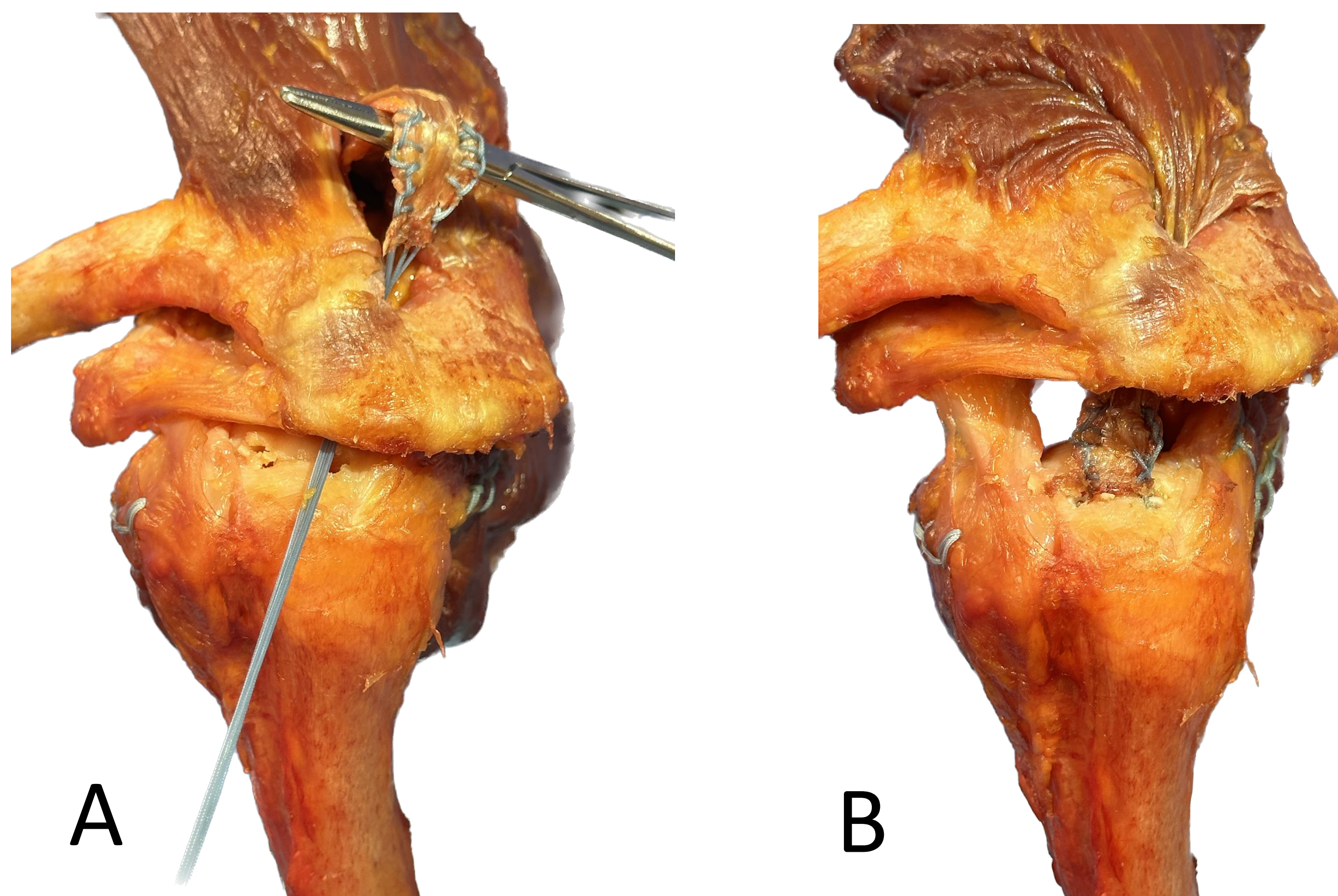
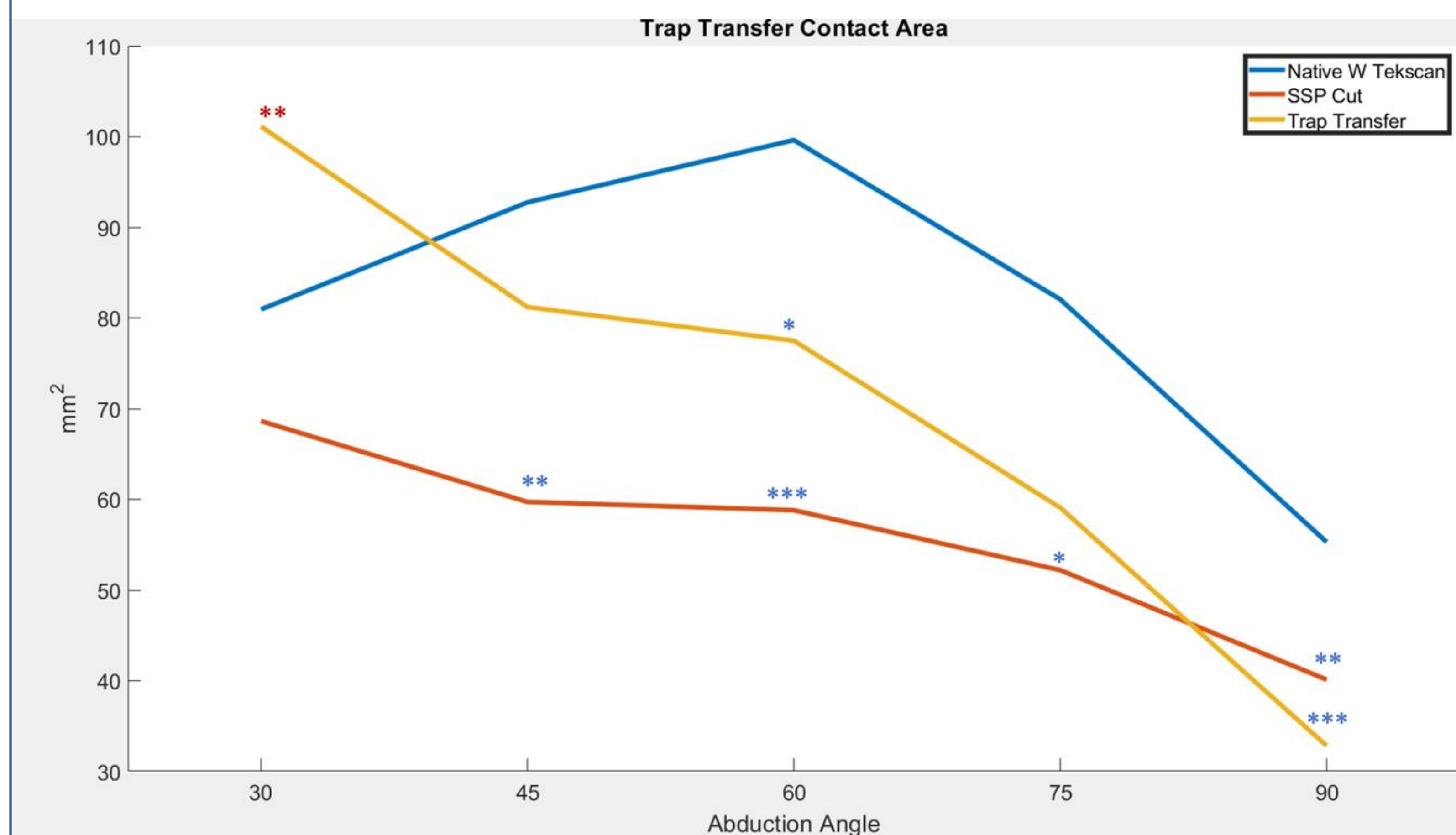
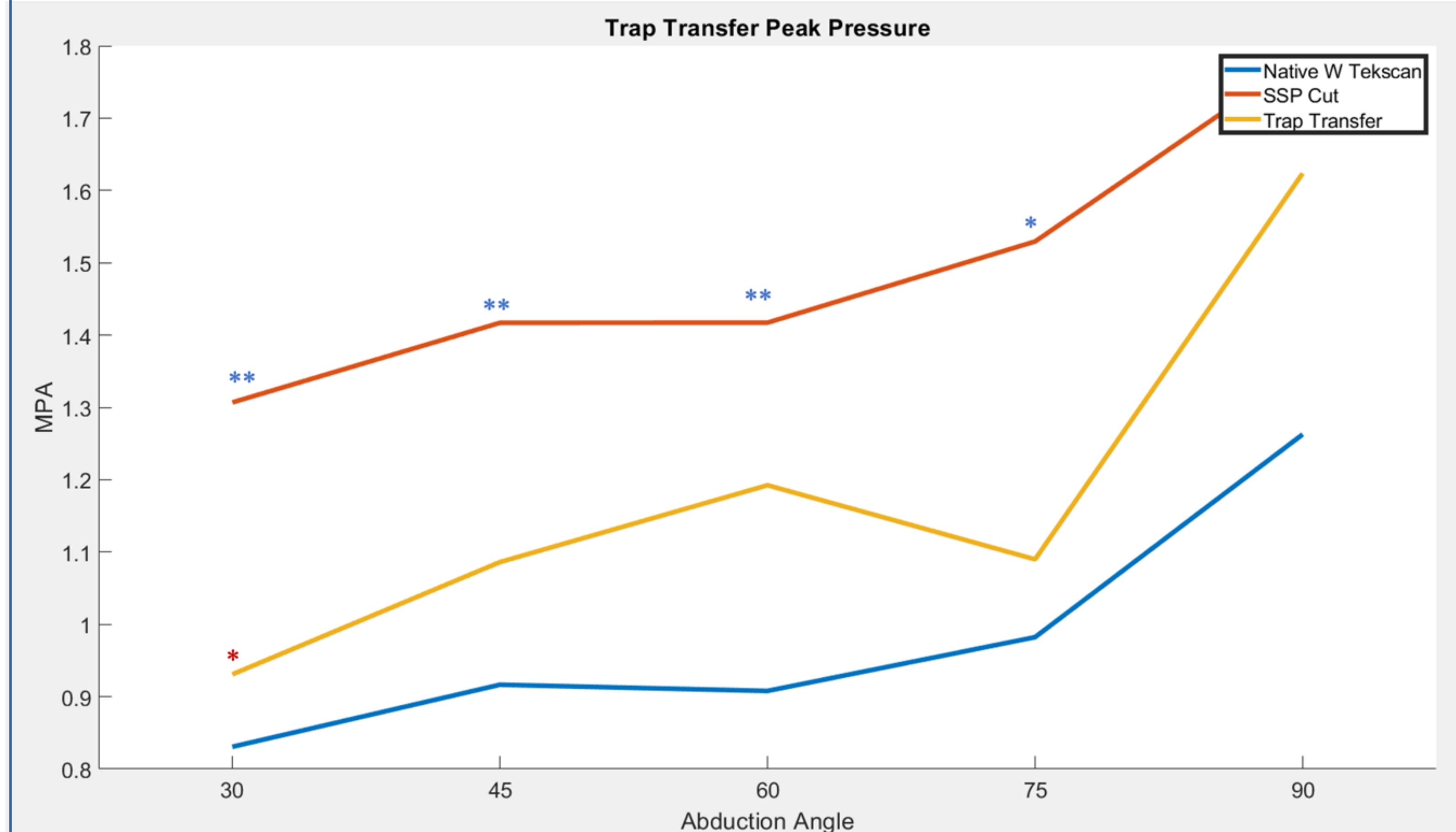
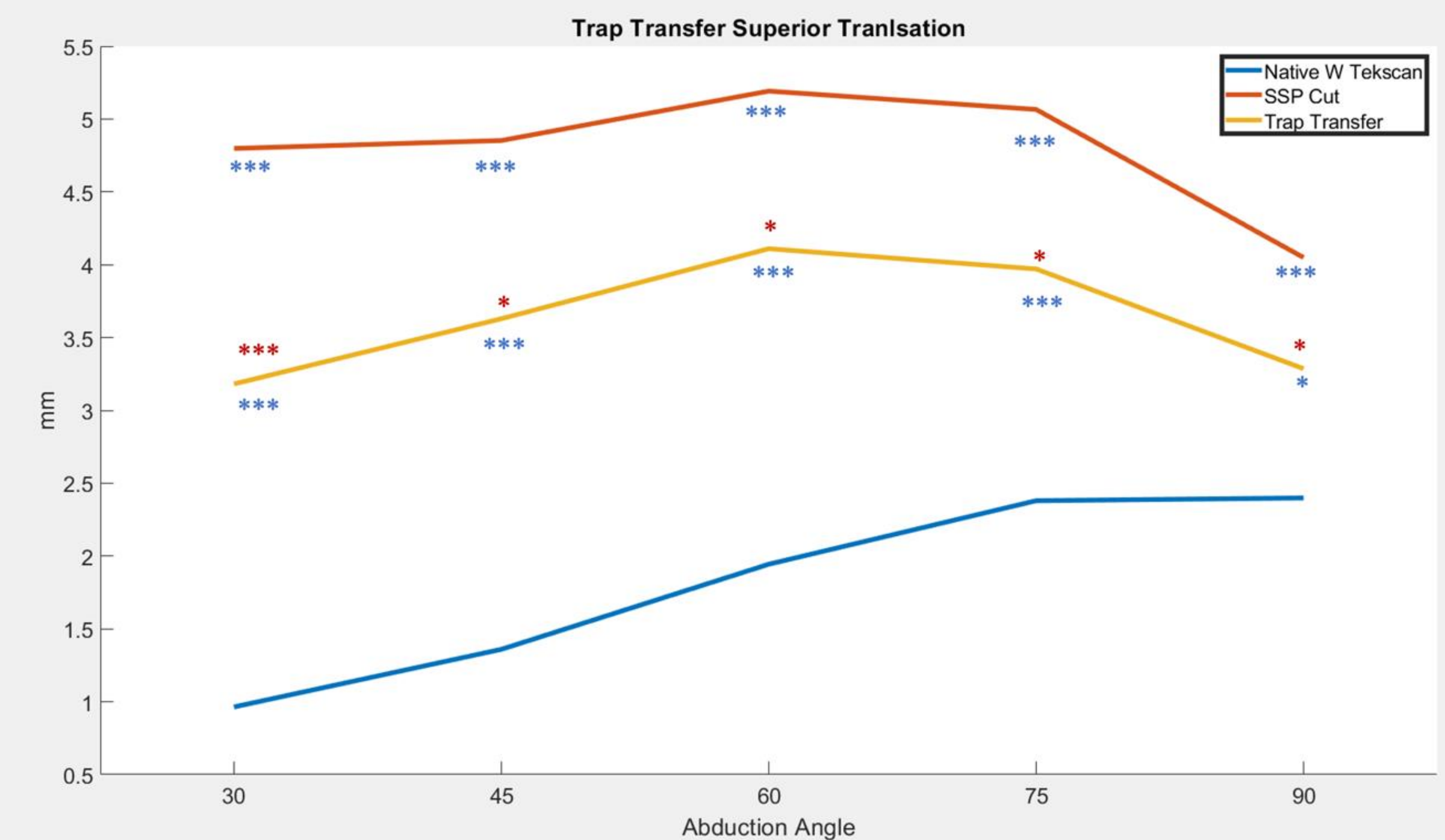


Fig 2. A: Passing Technique, B: MTT State

## Results

The MTT significantly **reduced superior translation** across all ABD angles (-0.7 to -1.6 mm,  $p < 0.05$ ) compared to the defect state. The **MTT partially restored native superior translation**, with a significant increase persisting throughout the entire ABD range of motion (+0.89 to +2.3 mm,  $p < 0.001$ ). The MTT successfully **restored peak pressure conditions** comparable to the native state across the entire ABD ROM and a notable reduction in peak pressure was observed at 30° and 45° of ABD when compared to the SSP cut state (0.33 to 0.38 MPA,  $p < 0.05$ ). After MTT, **the contact area was significantly higher** compared to the SSP cut state at 30° of ABD (+32 mm<sup>2</sup>,  $p < 0.005$ ). While the MTT was able to restore conditions that did not significantly differ from native in 30°, 45° and 75° of ABD ( $p > 0.05$ ), the MTT was **unable to fully restore native contact area** conditions, with a significant decrease persisting at 60° (-22 mm<sup>2</sup>,  $p < 0.05$ ) and 90° of ABD (-20 mm<sup>2</sup>,  $p < 0.001$ ).

## Results



## Conclusion

Isolated irreparable SSP tears significantly increased superior glenohumeral translation and subacromial peak pressure, while decreasing the subacromial contact area. Performing an MTT reduced superior translation, subacromial peak pressure, and increased subacromial contact area. Combining its unique advantage of addressing both static and dynamic components, this transfer partially restored the shoulder kinematics to native conditions in the presence of an irreparable SSP tear.