Do the Neer and Hawkins Signs Represent the Same Mechanism of Shoulder Impingement?

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Introduction: The Neer and Hawkins impingement signs are commonly used to diagnose subacromial pathology. The Neer sign has been thought to produce pain by “impaction of the greater tuberosity against the acromion(1).” The Hawkins sign has been thought to “impale the supraspinatus tendon against the coracoacromial ligament(2).” However, the anatomy and impingement mechanisms of these maneuvers have not been well elucidated. The purpose of this study was to characterize the anatomic relationships and impingement mechanisms present in the Neer and Hawkins signs by investigating gross anatomy and subsequent measurement of the subacromial dynamic contact pressure and the micromotion of the coracoacromial ligament.

Materials and Methods: Five fresh-frozen cadaveric shoulders (mean age, 78 years) were investigated. The skin, subcutaneous tissue, and deltoid were removed preserving the rotator cuff and subacromial bursa. The specimen was attached to a custom-designed shoulder-positioning device. A 22-N force was applied to the humeral head to keep the humeral head centered in the glenoid fossa. The arm was moved manually.

Gross Anatomy: The impingement site and the configuration of the coracoacromial ligament at the impingement were observed. The relationships of the rotator cuff tendons, the lesser and greater tuberosities of the humerus with the coracoacromial arch were demonstrated through both signs.

Contact Area and Pressure Beneath the Coracoacromial Arch: A flexible tactile force sensor (K-SCAN model 4000; Tekscan Inc, South Boston, MA) which was a paper-thin (0.1-mm thick) and high-resolution was placed between the coracoacromial arch and the subacromial bursa to measure the dynamic contact area and pressure. I-scan software (Tekscan Inc, South Boston, MA) was used to analyze the Tekscan-recorded measurements.

Bending of the Coracoacromial Ligament: One Linear Variable Differential Transducer (LVDT)(GT2500, RDP Electrosense, PA) sensor was used to monitor the micromotion of the bending of the coracoacromial ligament. A sensor positioning jig was rigidly attached to the acromion. The tip of the sensor was placed in the mid-lateral portion of the coracoacromial ligament. The sensor was connected through an amplifier to a multimeter to record the displacement data at 10° increments during motion.

Results: Gross Anatomy: The Neer sign demonstrated contact between the supraspinatus tendon on the greater tuberosity and the entire coracoacromial arch. The Hawkins sign demonstrated contact between the lesser tuberosity and the entire coracoacromial arch. The coracoacromial ligament was stretched upward by the movement of the supraspinatus tendon in the Neer sign and lesser tuberosity in the Hawkins sign and showed chevron-shaped at the contact.

Contact Area and Pressure Beneath the Coracoacromial Arch: Contact area and pressure of both the acromion and coracoacromial ligament progressively increased as the arm was elevated to maximum elevation in the Neer sign (Fig. 1). It was highest around the maximum internal rotation in the Hawkins sign (Fig. 2).

Discussion: Our results showed the contact phenomenon between the supraspinatus tendon on the greater tuberosity and the entire coracoacromial arch in the Neer sign and between the lesser tuberosity and the coracoacromial arch in the Hawkins sign. We found that there was extensive contact of the coracoacromial ligament was also demonstrated by the displacement measured by a LVDT sensor. Several previous studies using MRI noted that those two signs with the arm in full elevation were unlikely to represent compression of the rotator cuff under the acromion. Our data are not consistent with the finding of those studies. The contact area and pressure was increased with the increase of the arm motion. However, these previous studies were limited due to the static nature of their testing. In the current study, using a dynamic model, we have been able to demonstrate and localize the impingement phenomenon with both the Neer and Hawkins signs.