ALTERATIONS IN SCAPULAR KINEMATICS IN PATIENTS WITH SHOULDER IMPINGEMENT

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INTRODUCTION

Subacromial shoulder impingement is defined as compression and mechanical irritation of the rotator cuff and long head of the biceps tendons beneath the coracoacromial arch during elevation of the arm. In healthy subjects, the scapula must achieve a balance of adequate mobility to allow full arm motion, while maintaining stability on the thorax. Abnormal scapular motion on the thorax has been implicated as potentially contributing to shoulder impingement.[1-6] The purpose of this paper is to present an overview of findings regarding normal and abnormal scapular motion in subjects with shoulder impingement during elevation of the arm.

METHODS

Several investigators have compared scapular kinematics in subjects with shoulder impingement to healthy controls.[1-4, 6] Subjects are identified based on a history of localized shoulder pain and clinical examination demonstrating positive impingement tests.[3,4] Methods of data collection have included two-dimensional topographic and radiographic analysis, and three-dimensional static digitizing of surface landmarks, and dynamic motion analysis with surface or bone fixed sensors on the thorax, scapular acromion process, and humerus.[1-6]

Three-dimensional (3-D) scapular data relative to the thorax are described using anatomically embedded reference frames. Ordered Cardan angles for scapular internal / external rotation (protraction / retraction); upward / downward rotation (lateral / medial rotation); and anterior / posterior tilting are described relative to thorax cardinal plane axes. Scapular angles are typically described across humeral elevation angles where shoulder impingement is believed to occur in the “painful arc” of motion (60° to 120° of humeral elevation relative to the thorax).[3] Data have been described in healthy and symptomatic populations during shoulder flexion, abduction, and scapular plane abduction.[1-6]

RESULTS AND DISCUSSION

During elevation of the arm in the scapular plane in healthy subjects, the scapula typically undergoes upward rotation, external rotation, and posterior tilting,[5] while maintaining contact of the medial border and inferior angle of the scapula against the thorax. Subjects with impingement have demonstrated reductions in each of these component motions across different investigations. The most consistent abnormality across studies is a lack of normal posterior tilting.[1-4] Lack of normal posterior tilting and external rotation result in a loss of contact of the inferior angle (Figure 1) or medial border of the scapula with the thorax.[6] Some subjects demonstrate a pattern of progressive scapular anterior tilting throughout humeral elevation (Figure 2). Reductions in upward rotation early in the range of motion and reductions in

Figure 1: Subject demonstrating anterior tilting of the scapula during shoulder flexion.

external rotation under hand held loads have also been reported in impingement subjects.[3] The average magnitude of deviations is in the range of 4° to 6°. These deviations may be causative in the development of impingement syndrome or compensatory in response to pain and muscle inhibition. Although these deviations are believed to bring the acromion process in closer proximity to the humerus, the literature is inconsistent with regard to how these deviations may impact the subacromial space.

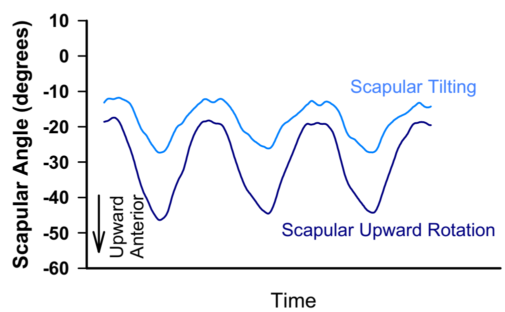

Figure 2. Graphical representation of anterior tilting pattern during three repetitions of humeral elevation.

CONCLUSIONS

Significant alterations in (3-D) scapular motions on the thorax are seen in subjects with clinical signs of shoulder impingement as compared to healthy controls. Greater understanding is needed with regard to how these deviations impact the subacromial space and pathology of the rotator cuff and long head of the biceps tendons.

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