Perspective Review: The Scapular's Roles in Developing Shoulder Complex Function

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The scapulohumeral anatomy and biomechanics interact to provide adequate mobility, thus the scapula plays various functions in facilitating optimal shoulder complex function (Paine & Voight., 2013). To support shoulder complex function, they argued that the scapula should have a solid foundation for glenohumeral movement facilitated by periscapular muscles to synchronize shoulder movements and develop scapulothoracic joint stability. However, when scapular muscle weakness or dysfunction occurs, then normal scapular posture and mechanics may change and disturb shoulder complex function, which can lead to lower neuromuscular performance and increased risk of glenohumeral joint damage (Kibler., 1998; Paine & Voight., 2013; Voight & Thomson., 2000). Therefore, current perspective will provide a more detailed description of the scapular roles in forming stabilization and supporting complex shoulder movements.

Introduction

Given our better understanding of the shoulder and surrounding tissues, the scapula's responsibilities in the upper extremities have recently received much attention. As our knowledge of the shoulder and surrounding tissues has grown, it is now widely accepted that the scapula plays specific roles in facilitating optimal shoulder complex function when scapulohumeral anatomy and biomechanics interact to provide appropriate mobility. These roles help to maintain the glenohumeral link and provide a firm basis for muscle action (Paine & Voight., 2013). As a result, the scapula provides a smooth and coordinated movement around the shoulder girdle and performs three primary functions (Voight & Thomson., 2000).

Providing dynamic stability for glenohumeral joint movements

The primary role of the scapula is to provide dynamic stability with regulated movement at the glenohumeral joint (Voight & Thomson., 2000). To keep the glenohumeral joint stable and the humeral head confined within the glenoid throughout the whole range of shoulder motion, the scapula must move in harmony with the humerus (Neumann., 2017). In addition, the scapula should also create an ideal bony constraint and maintain adequate length-tension relationships for the rotator cuff muscles' efficient contraction, which helps facilitate muscular constraint,

which compresses the humeral head into the glenoid fossa(Halder et al., 2000). They also stated that the scapular musculature must simultaneously maintain dynamic stability and enable regulated movement. Consequently, medial-stabilizing muscles are eccentrically contracted to control this motion, including the rhomboids and the middle trapezius, which helps to dissipate part of the deceleration forces that develop during the follow-through phase (Culham & Peat., 1993; Gupta & Van Der Helm., 2004; Voight & Thomson., 2000).

Periscapular muscles attachment

The scapula's second role serves as a basis for muscular attachment. The scapula's position is regulated by the muscles that support it, which are attached to its medial edge (Culham & Peat., 1993; Neumann., 2017; Voight & Thomson., 2000). Voight & Thomson (2000) described that force couple paired muscles that control the movement or position of a joint or body part are the primary mechanisms by which this musculature regulates scapular motion. Thus, the fundamental goals of these force couples are to preserve ideal length-tension relationships, to provide maximum congruency between the glenoid fossa and the humeral head, and to offer dynamic glenohumeral stability (Kibler., 1998; Voight & Thomson., 2000).

Previous investigations found that the upper and lower parts of the trapezius, rhomboid, and serratus anterior muscle are the ideal force partners for scapular stabilization(Briel et al., 2022; Gupta & Van Der Helm., 2004; Voight & Thomson., 2000). They reported that the lower trapezius and serratus anterior, acting in tandem with the upper trapezius and rhomboid muscles, are the proper force partners for acromial elevation. On the other hand, muscles that attach along the lateral scapular border perform gross motor movements of the glenohumeral joint and stabilize the scapula (Briel., et al., 2022; Voight & Thomson., 2000). The rotator cuff muscles adhere to the whole surface of the scapula and are positioned so that their best stabilizing function happens when the arm is abducted between 70° and 100° (Kibler., 1998). These muscles, which Kibler called a "compressor cuff," compressed the humeral head into the socket in this way.

Transferring energy for shoulder optimal function

The third function of the scapula is a connection in the proximal to distal energy transfer that enables the ideal alignment of the shoulder for optimal function. The scapula plays a crucial role in moving heavy forces and high energy from the body's main sources of power and energy of the legs and trunk to the arms and hands (Gupta & Van Der Helm., 2004; Kibler., 1998). They reported that as forces flow from the proximal segments from the shoulder to the hand, they must be adequately transferred and controlled. Therefore, the most efficient way to do these activities is by using the scapula as a secure and controlled platform, so it allows the entire arm to rotate around the stable basis given by the scapulothoracic and glenohumeral joints (Kibler., 1998; Voight & Thomson., 2000).

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