The Relevance of Scapular Dysfunction in Neck Pain: A Brief Commentary

Neck pain is a common musculoskeletal complaint, with a 12-month prevalence of 30% to 50% in the adult population. One factor that has been implicated in the pathogenesis of neck pain is scapular dysfunction. Scapular dysfunction is a collective term that refers to an abnormal position and/or movement of the scapula. Scapular dysfunction is often described separately in terms of “altered scapular position at rest” and “altered scapular motion during upper-limb tasks,” which are often referred to collectively as “scapular dyskinesia.” Currently, the relevance assigned to scapular dysfunction in neck pain is based more on clinical observation and extrapolation from shoulder studies than on direct scientific evidence. Compared to conditions of the shoulder such as subacromial impingement, few studies have explored the relationship between scapular dysfunction and neck pain. Although it is convenient to generalize knowledge derived from shoulder disorders to neck disorders, it is potentially misleading, as there may be important differences between these patient populations with regard to scapular function and subsequent rehabilitation.

The purpose of this brief clinical commentary was to identify current scientific evidence concerning scapular dysfunction in relation to neck pain disorders, and to discuss its relevance to contemporary clinical practice. The paper is composed of 3 sections. The first section reviews the evidence for scapular dysfunction in neck pain, the second section discusses the implications of scapular dysfunction for the clinical assessment of a patient with neck pain, and the third section presents an overview of current themes in rehabilitation of scapular dysfunction associated with neck pain.

**Scapular Dysfunction in Neck Pain**

Studies investigating scapular dysfunction in painful neck disorders usually evaluate the scapula at rest in upright postures or during upper-limb activities such as elevation of the arm or typing. There is some initial evidence that scapular position at rest and scapular motion during elevation of the upper limb may be altered in some individuals with neck pain when compared to a healthy population. For example, symptomatic office workers were observed to have slightly more scapular protraction than asymptomatic office workers during their computer work. These studies also suggest that alterations in scapular position/motion may differ between the dominant and nondominant scapula, and may be dependent on the type of neck disorder (traumatic or nontraumatic). While these studies offer preliminary evidence of an association between altered scapular posture/motion and neck pain, their limited sample size makes it difficult to draw any firm conclusions regarding specific patterns of impairment in neck pain that would inform clinical practice, and further investigation is needed.
Altered Function of the Axioscapular Muscles

Muscle impairment is a known feature of painful neck disorders. The scapula shares common muscle attachments with the neck, and it has been proposed that altered axioscapular muscle function potentially contributes to neck pain due to abnormal loading of the cervical spine, or through the formation of myofascial trigger points. Studies investigating the relationship between neck pain and axioscapular muscle function are now emerging.

Most studies of axioscapular muscle function in relation to neck pain have investigated muscle activity using tools such as electromyography (EMG) or muscle functional magnetic resonance imaging. Changes in the behavior of the upper trapezius (UT) muscle during typing or other similar upper-limb tasks have been shown in patients with both insidious-onset and traumatic-onset neck pain in clinical studies as well as in experimental pain studies. Zakharova-Luneva et al and Wegner et al evaluated the activity of all 3 portions of the trapezius muscle in participants with and without chronic mechanical neck pain using surface EMG. They found that during a typing task, the participants with neck pain had higher activity in the middle trapezius and lower activity in the lower trapezius compared to the control group. In contrast, during isometric shoulder abduction and external rotation, they observed significantly higher levels of lower trapezius muscle activity in the participants with neck pain compared to controls. The differences between these 2 studies indicate that aberrant behavior of the trapezius muscles in individuals with neck pain may not be direction specific (diminished or excessive) but may be dependent on the specific task. In individuals with neck pain, the UT has also shown a decreased ability to relax between and following repetitive arm movements and a higher activity level during tasks involving mental demand. Recently, studies have also identified changes in the behavior of the serratus anterior (SA) muscle in patients with neck pain during different arm-elevation tasks, using EMG and muscle functional magnetic resonance imaging. Compared to individuals with no neck disorder, Helgadottir et al demonstrated a significant delay in the onset and duration of activity of the SA muscles bilaterally during arm elevation in patients with neck pain. In addition, Sheard et al demonstrated some differences in the relative activity between the upper and lower portions of the SA muscle in individuals with neck pain compared to healthy controls.

Changes in axioscapular muscle strength in individuals with neck pain have also been reported. Shahidi et al recently demonstrated that the muscle strength of the rhomboid and middle trapezius muscles in patients with neck pain was significantly reduced compared to that in a control group. Similarly, Peterson and Wyatt revealed that individuals with unilateral neck pain exhibited significantly less lower trapezius strength on the side of neck pain compared to the contralateral side.

In summary, current literature demonstrates an association between altered function of the axioscapular muscles and neck pain. However, there are limitations to the findings of these studies. In particular, measures of axioscapular muscle activity and kinematic measures of the scapula are usually not recorded simultaneously. Therefore, the observed changes in activity of axioscapular muscles in these studies are difficult to interpret with regard to their relevance to the control of scapular position or motion. Furthermore, there is some inconsistency in the pattern of reported axioscapular muscle behavior in patients with neck pain. This suggests significant individual variation in muscle behavior in those with neck pain, as well as differences in muscle behavior with differing upper-limb tasks used in these studies. As a consequence, at this stage, the studies indicate that axioscapular muscle function should be considered in the management of neck pain but no specific pattern of aberrant axioscapular muscle activity can be labeled as specific to neck pain.

Tightness of the Axioscapular Muscles

While the clinical literature has implied that “tightness” of muscles such as the UT and levator scapulae is a feature of mechanical neck pain, direct evidence of an association between “muscle tightness” and neck pain is yet to be established. The pectoralis minor, however, has been investigated extensively within the context of shoulder pain, and tightness of this muscle has been linked to aberrant scapular motion. Because of the anatomical position of the pectoralis minor muscle, shortening could lead to an increase in anterior tilting and internal rotation, and a decrease in scapular upward rotation, creating a possible predisposed condition for shoulder and neck pain. This association was recently demonstrated by Shahidi et al, who found a significantly reduced muscle length of the pectoralis minor bilaterally in a group of patients with neck pain compared to healthy individuals. To the best of our knowledge, the tightness of other axioscapular muscles as a feature of mechanical neck pain has not been investigated.

RELEVANCE OF SCAPULAR DYSFUNCTION

A comprehensive description of the clinical evaluation of the scapula in the patient with neck pain has been provided elsewhere and is not the intention of this paper. Practically, clinicians do not have access to sophisticated motion analysis and EMG measures utilized in biomechanical studies of the scapula, and, as such, clinical ex-
amination is dependent on more basic tests, many of which have questionable reliability.25,33,39,44,45

The case for prioritizing rehabilitation aimed at improving scapular function is stronger when a clear link between observed signs of potential scapular dysfunction and the patient’s reported symptoms can be established. Lewis20 suggested that the clinician apply a series of manual techniques to slightly modify the scapular position, to see whether symptoms change during the aggravating movement in patients with subacromial impingement. These symptom modification procedures can also be implemented as a means of determining if scapular malalignment is relevant to cervical symptoms by manually correcting scapular orientation or motion during provocation testing.

In this case, as suggested by Lewis,20 the starting point is to select a (cervical) movement that reproduces the patient’s symptoms. Information from the patient’s history will help to identify the most relevant activity/movement in which to examine the patient. If altering scapular position causes an immediate improvement in the cervical movement and/or symptoms, this implies that scapular dysfunction is a potential factor contributing to the cervical symptoms and should be addressed during rehabilitation.

There is some evidence that passive alteration to scapular orientation can result in immediate changes in pain and mobility during provocative movements of the neck.2,39,48 Van Dillen et al39 showed that passive elevation of the scapulae resulted in a decrease in symptoms with neck rotation in the majority of patients with neck pain. Likewise, Ha et al39 demonstrated that a passive correction of scapular position in patients with neck pain associated with bilateral scapular downward rotation resulted in a decrease in neck pain symptoms and improved neck rotation and proprioception. These studies confirm the relevance of a modification technique to establish the link between scapular dysfunction and neck pain.

This assessment technique can in turn be implemented as an intervention technique to induce longer-lasting effects. If immediate changes in symptoms cannot be achieved, despite clinical suspicion of scapular involvement, the effect of altering scapular orientation can be assessed over a longer duration with the assistance of strapping tape.28

REHABILITATION OF SCAPULAR FUNCTION

STUDIES INDICATING ALTERATIONS IN scapular orientation and axioscapular muscle function in patients with neck pain described in the preceding sections have warranted clinicians to consider rehabilitation specifically aimed at the scapula in the management of neck pain.9 Training scapular function in a patient with neck pain should be performed in a manner that is relevant to the physical examination findings (ie, specific to the aberrant pattern observed) and should be focused toward restoring normal scapular function during the patient’s functional and aggravating activities. This may require a combination of therapeutic strategies. These strategies may include the integration of active scapular control training into problematic functional activities (FIGURE 1), followed by or in combination with conditioning of axioscapular muscles with targeted exercises, alleviation of passive flexibility issues with manual therapy techniques, and stretching (FIGURE 2), as well as addressing ergonomic factors and technique modification.49 In the presence of significantly deconditioned axioscapular muscles or substantial flexibility issues within the upper quadrant, the incorporation of more complex functional rehabilitation strategies may need to be delayed until improvement in muscle conditioning or flexibility issues has been achieved.

The incorporation of scapular control training into problematic daily activities can often quickly induce meaningful changes in patient symptoms. Active control exercises of scapular orientation, specific to the pattern of aberrant position/motion observed during the examination, should be introduced in the early stages of scapular training.8,27 Patients are taught to practice scapular control during daily functional activities relevant to their disorder, such as during computer work. There has been some initial evidence that correcting scapular orientation during a task such as typing may alter the distribution of activity in mus-
ules such as the trapezius to better reflect that displayed by healthy individuals.\textsuperscript{49} There are numerous examples of relevant functional tasks that can be immediately utilized as a scapular control training exercise, depending on what the patient reports as a problematic activity during the interview. Progression can be made by increasing holding time, repetitions, resistance, and speed parameters of exercise relevant to the patient’s functional needs. When incorporating specific scapular control training, the initial emphasis is on ensuring that the patient acquires adequate skill in achieving the desired scapular posture. This requires a variety of facilitation techniques (eg, tactile feedback) and substantial practice. Once the patient has learned to correctly control scapular position and motion, the focus shifts to repetition of these correction exercises, facilitated with cues during the day, with the intention of facilitating new patterns of automatic scapular postural and movement behavior.\textsuperscript{29} If during the clinical examination aberrant spinal posture is identified, specific training of this posture should be initiated in conjunction with scapular control training. This incorporation is indicated, as previous studies have shown the effect of spinal posture on scapular orientation. Spinal posture correction, including strategies to facilitate attainment of neutral spinal alignment of the lumbar, thoracic, and cervical spine regions, has been described in detail elsewhere.\textsuperscript{37}

Functional rehabilitation of the scapula may be enhanced with a structured program of progressive resistive exercise to condition specific muscle groups. There are numerous examples in the literature of recommended exercises to target specific muscles, such as the trapezius and SA muscles, but these recommendations mainly originate from the shoulder literature.\textsuperscript{41} Perhaps an important factor that often varies between these exercises is their emphasis on conscious control of scapular orientation during exercise.\textsuperscript{10} Progressive resistive exercise that emphasizes the cognitive positioning of the scapula may result in better skill acquisition by the patient in controlling the scapula during daily function. This is assumed, because motor outputs are specific to the mode of training.\textsuperscript{1,2,3,7,8} Though speculative and as yet untested, exercise with an emphasis on controlling scapular orientation is complementary to a functional training approach. Moreover, it is hypothesized that this form of exercise may encourage a more normal pattern of muscle coordination between axioaxillary muscles during the performance of exercise, as has been shown to occur during other activities, such as typing.\textsuperscript{40} This could be advantageous when attempting to restore normal activity in muscles that clinically appear to be persistently maintained in a shortened or lengthened position, such as the levator scapulae and UT, respectively, when the patient’s scapula is persistently downwardly rotated. Although anecdotal, exercise that incorporates a correct scapular orientation may permit the axioaxillary muscles to function in a more optimal mechanical environment.

CONCLUSION

A BERRANT SCAPULAR FUNCTION IS often apparent during the clinical examination of patients with neck pain. While scientific evidence continues to emerge, decision making regarding the clinical relevance of any observed scapular dysfunction during the assessment of patients with neck pain is still largely dependent on clinical judgment. This paper presented the current status of scientific inquiry into scapular dysfunction in neck pain and considered the implications for contemporary clinical practice.

REFERENCES

16. Fernández-de-las-Peñas C, Gröbli C, Ortega-