FUNCTIONAL REHABILITATION OF SHOULDER MUSCLES
Evidence & Application

Presenter
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Associate Professor Ginn teaches functional, applied musculoskeletal anatomy and is a musculoskeletal physiotherapist in part-time private practice. She is involved in research related to the assessment and treatment of shoulder dysfunction including: clinical trials investigating the efficacy of conservative and surgical treatment for shoulder dysfunction; electromyographic (EMG) studies investigating shoulder muscle activation patterns in normal subjects and patients with shoulder dysfunction; EMG studies evaluating shoulder exercises; studies evaluating the validity and reliability of components of the physical examination of the shoulder; experimental shoulder pain studies; and investigations of shoulder stiffness and cortical changes associated with shoulder pain.

Course Description
The shoulder joint is an extremely mobile, multiaxial ball and socket joint, the function of which is to facilitate maximum functional use of the hand. In order to achieve this extensive range of motion, the structure of the shoulder joint is characterised by minimal passive constraint. Consequently, passive structures do not significantly contribute to shoulder joint stability: the size differential between the glenoid fossa and the humeral head minimise the contribution of articular contact to joint stability; joint capsule is thin and lax to facilitate large range of movement; and the shoulder joint has relatively few ligaments to restrict joint motion.

One of the consequences of these modifications to bony and fibrous structures of the shoulder joint which permit its large range of movement is the unparalleled reliance on muscles to maintain active shoulder joint stability. Because of their horizontal orientation to the shoulder joint line and their intimate anatomical relationship with the shoulder joint capsule, the most important muscles performing this dynamic stabilising role are the four muscles of the musculotendinous rotator cuff (RC): subscapularis, supraspinatus, infraspinatus and teres minor. The RC muscles take origin from the mobile scapula and their tendons splay out and interdigitate to form a common, continuous insertion into the lateral shoulder joint capsule and onto the tubercles of the humerus.

The traditional view of the role of the RC muscles to provide functional shoulder joint stability is that they contribute in equal proportions to compress the humeral head into the glenoid fossa during all shoulder movements to limit humeral head translation as well as to depress the humeral head to prevent it translating superiorly due to deltoid activity. However, recent evidence that the RC muscles are recruited at significantly different activity levels during shoulder flexion and extension suggests that simultaneous recruitment of all the RC muscles in equal proportions is not an essential requirement to achieve dynamic shoulder joint stability[1,2]. This research indicated that different parts of the RC function to stabilise the shoulder joint by counterbalancing potential anterior and posterior translation due to flexor and extensor muscle activity respectively.

Another traditional view i.e. that the RC muscles are functioning as stabilisers of the shoulder joint during all shoulder movements, may also require revision. Recent research indicates that maximal isometric shoulder adduction tasks are associated with minimal to low levels of RC muscle activity suggesting that either activity in shoulder adductor muscles does not produce translation forces on the humeral head, or that muscles other than the RC are functioning to stabilise the shoulder joint during adduction[3].

In order to achieve full range movement of the shoulder co-ordinated movement of the scapula with the humerus is required to position the glenoid fossa for optimal articulation with the humeral head throughout range as well as to maintain the mechanical advantage of the scapulohumeral muscles, including the RC muscles. It is the role of axioscapular muscles to accurately position the scapula for optimal articular surface and muscle alignment. However, because the mobile scapula provides the origin of important shoulder muscles, including the RC muscles, activation of these muscles has implications for axioscapular muscle function. Contraction of the RC has the potential to move the scapula away from the midline, requiring co-ordinated contraction of axioscapular muscles to maintain the correct scapula position ie to stabilise the scapula, to enable optimal RC function.

Complex, co-ordinated muscle function is the most important requirement to achieve full range movement and maintain functional stability at the shoulder joint. Accurate knowledge of the complexity of these muscle mechanisms is necessary to provide the detailed sound functional anatomical basis to inform the clinical reasoning processes underpinning Physiotherapy assessment and treatment of the shoulder. Re-evaluation of current assessment and treatment strategies at the shoulder in light of recent evidence regarding the function of the RC is likely to improve outcomes for patients with shoulder dysfunction.

Course Objectives

At the end of this course participants will be able to:-

1. critically evaluate the contribution of the current diagnostic classification system, imaging procedures & special orthopaedic tests in directing effective treatment for shoulder dysfunction

2. critically evaluate the evidence in support of surgery & active (exercises) & passive conservative treatment for shoulder pain

3. critically evaluate the functional anatomy of the normal shoulder joint in particular:
    - the relative contribution of active and passive stabilising structures
    - the specific mechanisms whereby rotator cuff (RC) muscles contribute to shoulder joint movement and stability
    - the role of the scapula and axioscapular muscles in optimising shoulder joint & shoulder muscle function
    - the multiple roles muscles perform, and the level of muscle co-ordination required, in normal shoulder region function

4. critically evaluate commonly used methods of assessing and treating shoulder muscle dysfunction

5. incorporate functional anatomical principles into the clinical reasoning process to aid in:
    - understanding the anatomical basis for the presenting shoulder symptoms

- determining the most appropriate exercise rehabilitation strategy

6. investigate alternative methods of assessing and restoring shoulder function that better reflects normal functional anatomy

Course Structure

- two day course
    - Day 1 lecture/discussion format:
        - exploration of recent research into shoulder muscle function
        - critical evaluation of current Physiotherapy assessment and treatment of shoulder dysfunction
    - Day 2 practical format:
        - critical evaluation of the functional anatomical basis of current Physiotherapy assessment and treatment of shoulder dysfunction
        - exploration of alternative methods of assessing and restoring shoulder function that better reflects normal functional anatomy

References:

1. Wattanaprakornkul D, Cathers I, Halaki M, Ginn K. The rotator cuff muscles have a direction specific recruitment pattern during flexion and extension exercises. *J Sc Med Sport.* 2011;14:376-382.
2. Rathi S, Taylor N, Green R. The effect of in vivo rotator cuff muscle contraction on glenohumeral joint translation: an ultrasonic & electromyographic study. *J Biomech.* 2016;49(16):3840-3847.
3. Reed D, Halaki M, Ginn K. The rotator cuff muscles are activated at low levels during shoulder adduction: an experimantal study. *J Physiother.* 2010;56(4):259-264.