

Electromyographic activity of supraspinatus during different shoulder movements in patients suffering from supraspinatus tendinitis

Thesis

*Submitted in Partial Fulfillment
of Master Degree in Physical Medicine, Rheumatology and
Rehabilitation*

By

Rowida Hamdy Ali

M.B., B.Ch.

Faculty of Medicine- Ain Shams University

Under the Supervision of

Prof. Dr. Nagwa Nassar

*Professor of Physical Medicine,
Rheumatology and Rehabilitation*

*Faculty of Medicine
Ain Shams University*

Prof. Dr. Neveen Ahmed Shaker

*Professor of Physical Medicine,
Rheumatology and Rehabilitation*

*Faculty of Medicine
Ain Shams University*

Prof. Dr. Heba Fawzy ElShishtawy

*Professor of Physical Medicine,
Rheumatology and Rehabilitation*

*Faculty of Medicine
Ain Shams University*

**Faculty of Medicine
Ain Shams University**

2012

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Acknowledgement

First and foremost, I feel always indebted to **Allah**, the most kind and the most merciful.

*I would like to express my sincere gratitude to **Prof. Dr. Nagwa Nassar**, Professor of Physical Medicine, Rheumatology and Rehabilitation Department, Faculty of Medicine – Ain Shams University, under her supervision, I had the honor to complete this work, I am deeply grateful to her for her professional advice, guidance and support.*

*I wish also to express my gratitude to **Prof. Dr. Neveen Ahmed Shaker**, Professor of Physical Medicine, Rheumatology and Rehabilitation Department, Faculty of Medicine – Ain Shams University, for her great efforts, kind advice, support and encouragement throughout the whole work.*

*I am also greatly indebted to **Prof. Dr. Heba Fawzy Elshishtawy**, Professor in Physical Medicine, Rheumatology and Rehabilitation Department, Faculty of Medicine – Ain Shams University, for her tremendous effort she has done, enthusiasm and help.*

*I would like to thank **Prof. Dr. Sahar Elgaafary**, Professor of Radiology Department, Faculty of Medicine, Ain Shams University for participating in fulfilling this work.*

*To my **little family**, my **colleagues**, my **patients** and to everyone who participated in one way or another in this work, I owe my thanks and appreciation.*

List of Abbreviations

SEMG	: Surface electromyography
NEMG	: Needle electromyography
FWEMG	: Fine wire electromyography
EMG	: Electromyography
SST	: Supraspinatus muscle
FC	: Full can movement
EC	: Empty can movement
SIS	: Shoulder Impingement Syndrome

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Introduction

A set of joints which consists of the: sternoclavicular joint, acromioclavicular joint, glenohumeral joint and scapulothoracic gliding plane, are called the shoulder joint (*Putza R.et al.,2000*)

Disturbance of any of these joints are likely to interfere with the smooth rhythm observed in movement of this complex. The overall ratio of scapulothoracic to glenohumeral movement of 1:2 is made possible by a clock work mechanism that involves movements at these two articulations with axial rotation of the clavicle that connects the shoulder girdle to the torso.

Stability of the scapulothoracic, glenohumeral joints and acromioclavicular joint rely not only on the intrinsic capsular ligaments, bony architecture ,musculature but also on extrinsic ligaments that need to be addressed in management of instability of these joints. (*Kumar ,2002*)

The rotator cuff muscles are: supraspinatus, infraspinatus, teres minor and subscapularis. The tendons of these muscles coalesce to form the rotator cuff. The muscles are inseparable at this level, except for subscapularis which separate and joined to the rest of the cuff via the rotator interval.

The rotator cuff provides dynamic stability by compressing within the concave glenoid fossa during upper extremity motion which is critical to normal functional activities (*Morag.et al.,2006*). Any pathologic condition of the rotator cuff may affect the ability of the rotator cuff to provide this compressive force, resulting in superior humeral head migration and potential impingement against the acromion (*Juul-Kristensen et al.,2000*)

Surface electromyography (SEMG) is the standard for recording compound muscle action potentials. SEMG has been used for decades as a technique for studying human motion (*Valle-Sole J et al 1995*), for recording EMG signals from multiple muscles in other clinical settings, and for monitoring response time in experimental circumstances. Indeed, because of the noninvasive and painless nature of the method, this should be considered a standard application of SEMG often superior to either needle electromyography (NEMG) or fine wire electromyography (FWEMG) .

Another important advantage to SEMG in this setting is that it allows prolonged recordings of muscle activity from multiple sites simultaneously. Surface electromyography (SEMG)may be used to classify movement disorders through measurement of frequency and amplitude of muscle activity and its relationship to separately record limb or trunkal movement or force.

SEMG is considered an acceptable tool for kinesiological analysis of movement disorders because it is a method for recording and quantifying clinically important muscle related activity with the least interference on the clinical picture (*Shahani et al.,1995*)

Researchers disagree about the optimal exercises to strengthen the supraspinatus muscle. In several EMG studies, investigators have attempted to quantify the amount of supraspinatus EMG activity during various exercises along with specific exercise positions in asymptomatic individuals (*Reinold et al.,2004*)

Jobe and Moyness in 1982 recommended empty can exercise to strengthen supraspinatus muscle during exercise . Reinold et al.in 2004 recommended full can exercise. Thus, controversy regarding the best exercise to strengthen the supraspinatus exists. It appears that the optimal exercise for the supraspinatus would elicit the greatest amount of

supraspinatus activity while minimizing the surrounding muscular activity, particularly the deltoid. However only one study compared the EMG activity of the supraspinatus and deltoid musculature during these exercises which have been published and this was done in asymptomatic individuals only.

Aim of the work

To conduct clinical and electrophysiological study in healthy controls and in patients suffering from supraspinatus tendinitis in order to:

1-Detect activity of supraspinatus during different movements.

2-Recommend best exercises for supraspinatus to be used in rehabilitation program for supraspinatus for better biomechanics of the shoulder.

Anatomy of the shoulder joint

The shoulder or pectoral girdle consists of articulations between the clavicle, scapula and the proximal end of the humerus. The glenohumeral articulation (shoulder joint) has the greatest range of motion of any joint in the body. The mobility of the shoulder joint is necessary for placement of the head to maximize manipulation.

The scapula is suspended on thoracic wall by muscles forming a “functional joint” called the scapulothoracic joint. These muscles act to stabilize and/ or to actively move the scapula. Active movement of the scapula help increase the range of motion of the shoulder joint.

I. Bony component of the shoulder girdle:

A) The humerus:

The humerus is the largest and longest bone of the upper extremity, with its proximal portion consisting of the halfspheroid articulating surface or head, greater tuberosity, bicipital groove, lesser tuberosity, and proximal humeral shaft.

The greater tuberosity has 3 facets into which the tendons of the supraspinatus, infraspinatus, and teres minor insert. The lesser tuberosity is the site of insertion of the subscapularis, completing the rotator cuff. The facets provide for a continual ring insertion of the rotator cuff from posteriorinferior to anterior-inferior on the neck of the humerus. This insertion is interrupted only by the bicipital groove, through which the long head of the biceps brachii passes laterally and distally from its origin on the superior lip of the glenoid. . (*Kronberg et al., 1990*)

The surgical neck of the humerus is located just distal to the tuberosities at the level of the metaphyseal flare.

B) The scapula:

The scapula is a large, thin, triangular bone lying on the posterolateral aspect of the thorax, overlying ribs 2 through 7, that serves mainly as a site of muscle attachment. The superior process, or spine, separates the supraspinatus muscle from the infraspinatus and extends superiorly and laterally to form the base of the acromion. The spine functions as part of the insertion of the trapezius muscle, as well as the origin of the posterior deltoid muscle. The acromion serves as a lever arm for function of the deltoid and articulates with the distal end of the clavicle, forming the acromioclavicular joint. The acromion forms a portion of the roof of the space for the rotator cuff, and variations in acromial shape can affect contact and wear on the cuff (impingement). (*Jobe et al., 1987*)

Tendinitis and bursitis are the result of impingement of the humeral head and overlying rotator cuff against the coracoacromial arch, which is composed of the acromion, coracoacromial ligament, and coracoid process. The coracoid process projects anteriorly and laterally from the upper border of the head of the scapula. The superior surface serves as the origin of the 2 coracoclavicular ligaments that are torn, along with the acromioclavicular ligament, in acromioclavicular (AC) joint separations.

The coracoid tip serves as the origin of the coracobrachialis muscle and the short head of the biceps brachii, as well as the insertion of the pectoralis minor muscle. The coracohumeral and coracoacromial ligaments originate on the coracoid as well. The scapular notch lies just medial to the base of the coracoid and is spanned by the transverse scapular ligament. The suprascapular nerve passes beneath the ligament to innervate the supraspinatus and infraspinatus muscles. (*Ticker et al., 1998*)

The glenoid fossa, or cavity, represents the bony articulating surface for the humerus. Its articular surface is only one third to one

fourth that of the humeral head , and hence, provides only a small contribution to glenohumeral stability.

C)The clavicle:

The clavicle serves as the sole bony strut connecting the trunk to the shoulder girdle via the sternoclavicular joint medially and the acromioclavicular joint laterally. It has a double curve along its long axis and is subcutaneous in its full extent. The flat outer third serves as an attachment point for muscles and ligaments, whereas the tubular medial third accepts axial loading. (*Ljunggren et al., 1998*) .It serves as a site for muscle attachments, a barrier to protect underlying neurovascular structures, and a strut to stabilize the shoulder complex and prevent it from displacing medially with activation of the pectoralis and other axiohumeral muscles. Additionally, the clavicle prevents inferior migration of the shoulder girdle through the strong coracoclavicular ligaments. (*Bigliani et al., 1987*)

II. Joint articulation:

A)Glenohumeral joint:

The glenohumeral joint is suited for extreme mobility with its mismatched large humeral head and small glenoid articular surface.

Glenoid Labrum. The glenoid labrum is a dense, fibrous structure, which is triangular on cross-section. Located at the glenoid margin, the labrum serves to extend the conforming articular surfaces, thereby increasing contact surface area and adding to stability. (*Cooper et al., 1992*)

Joint Capsule. The surface area of the capsule is approximately twice that of the humeral head, allowing for extensive range of motion. The capsule is truncated in shape, and the inferior portion, or axillary

pouch, is redundant. The capsule tightens or "winds up" in various extremes of position. (*Arnoczy et al., 1990*)

Ligaments. The coracohumeral ligament is a thick band of capsular tissue originating from the base of the lateral coracoids and inserting into the lesser and greater tuberosities. This ligament is taut with the arm in the adducted position and constrains the humeral head on the glenoid. (*Warner et al., 1992*)

The superior glenohumeral ligament extends from the anterosuperior edge of the glenoid to the top of the lesser tuberosity. It parallels the course of the coracohumeral ligament, and these 2 structures are considered similar in function. Together they constitute the rotator interval region between the anterior border of the supraspinatus and the superior border of the subscapularis. (*Boardman et al., 1996*)

The middle glenohumeral ligament is the most variable of the 3 glenohumeral ligaments, being absent in 8% to 30% of patients. It originates from the supraglenoid tubercle, superior labrum, or scapular neck and inserts on the medial aspect of the lesser tuberosity. Its function is to limit anterior translation of the humeral head in the lower ranges of abduction (60 to 90°) and inferior translation in the adducted position at the side.

The inferior glenohumeral ligament is the thickest and most consistent of the three glenohumeral ligaments. It is often described as a complex containing an anterior band, axillary pouch, and posterior band. The anterior band extends from the anteroinferior labrum and glenoid lip to the lesser tuberosity of the humerus and is the thickest portion and the primary stabilizer against anterior translation of the humeral head in the throwing position of abduction and external rotation. (*Arnoczy et al., 1990*)