



ORIGINAL RESEARCH STUDY

Scapular dyskinesis among competitive swimmers



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ABSTRACT

Aim: To evaluate the prevalence of scapular dyskinesis (SD) in competitive swimmers during training sessions.

Methods: Repeated measurement observational study. 20 young competitive swimmers were filmed before, at midpoint and at the end of a training session, performing shoulder flexion and abduction. SD was examined separately by two assessors. Demographic and Quick Disabilities of the Arm, Shoulder, and Hand questionnaires were collected.

Results: SD was observed in 30% of the swimmers before training, in 70%, an hour later, and in 80%, upon completion of the training session. The difference between the baseline and mid-practice was close to significance (p -value = 0.055), and between mid-practice and end of practice was significant (p = 0.004). **Conclusions:** This study confirmed that the prevalence of SD increases throughout a training session in most swimmers. The main reason might be fatigue of the muscles which stabilize the scapula, therefore, when examining a sportsman's shoulder, it is important to examine the SD post-training or following simulation of the training session in the clinic.

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1. Introduction

Individuals who intensively and repetitively work with their upper extremities (swimmers, tennis players, gymnasts, etc. and manual laborers such as hairdressers, painters, etc.) frequently suffer from shoulder pain, impingement syndrome or rotator cuff tears. In swimmers, supraspinatus tendinopathy is the most common cause of shoulder pain (Heinlein and Cosgarea, 2010). Rotator cuff tears can cause pain inhibition followed by a decrease in muscle activation (Falla et al., 2007).

Among patients suffering from rotator cuff pathologies, 68% were observed with scapular dyskinesis (Warner et al., 1992). It is as yet unknown as to whether dyskinesis is a cause, effect or compensation for rotator cuff pathology (Kibler et al., 2013).

Prevalence of shoulder pain in swimmers can range between 40% and 91% depending on age, swimming style, perception of pain, changes in the training volume during the year, etc. (Madsen et al. (2011); McKenna et al., 2012). Heinlein and Cosgarea (2010) and Johnson et al. (2003) describe in detail shoulder biomechanics

during glide (catch), pull through and recovery phases of swimming. In the glide phase, when the forward hand enters the water, the upper trapezius elevates the shoulder, then protraction and upward rotation occurs due to the serratus anterior with retraction ensuing due to the rhomboids. These muscles hold and stabilize the scapula in place. The pull through phase occurs due to the latissimus dorsi, subscapularis and pectoralis major muscles that adduct, extend and internally rotate the humerus while the teres minor externally rotates it. In the recovery phase, the deltoid and supraspinatus are the main active muscles. The most prominent pathology is the weakness of the serratus anterior and the increased activity of the rhomboids during the pull through phase, resulting in a winging scapula and impingement of the biceps and supraspinatus tendons (Pink et al., 1991).

The alteration of normal kinematics of the shoulder is called scapular dyskinesis (Kibler et al., 2009), which is associated with shoulder pain and pathology (Kibler and McMullen, 2003). Various causes of scapular dyskinesis include bony posture or injury, joint instability or internal derangement, neurological and soft tissue alterations associated with inflexibility (Kibler et al., 2013). Scapular dyskinesis results in a winging or dysrhythmia of the scapula.

A winging scapula is defined as a prominence of the medial border or anterior tilt of the scapula (Kibler et al., 2013) which can be seen when there is a weakness or delayed activation of the

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serratus anterior or the lower trapezius muscles (Kibler, 1998; Kibler et al., 2013). An anterior tilt with protraction can be caused by a short pectoralis minor and a short head of the biceps brachii (Borstad and Ludewig, 2005).

Dysrhythmia is defined as the presence of one or more of the three following conditions: 1) a not smooth and continuous movement; 2) an excessive or premature elevation or protraction during elevation or lowering of the arms; 3) an excessively early downward rotation when lowering the arms (Kibler et al., 2013; McClure et al. (2009)).

Kibler et al. (2002) described three types of dyskinesia based on the three axes of scapular motion on the thorax (McClure et al., 2001; McQuade et al., 1998). The first type of dyskinesia is a prominence of the inferior medial border of the scapula occurring when the scapula abnormally rotates around the transverse axis. The second type is a prominence of the entire medial border occurring when the scapula abnormally rotates around the vertical axis. The third type is a prominence of the superior medial border.

Because sportsmen and manual laborers are usually physically fit, a regular examination in the clinic often does not detect scapular dyskinesia. However, as shown by Madsen et al.'s research (Madsen et al., 2011), dyskinesia in swimmers on occasion does not appear at the beginning of their workout, but at midpoint or even later. Madsen et al., 2011 in the only study on swimmers found dyskinesia in 82% of competitive pain-free swimmers at the end of their training session.

In competitive swimmers, muscle fatigue can occur due to repetitive overhead activity. On average, a competitive swimmer completes 8–10 strokes per 25 m, swims 60,000–80,000 m per week with each shoulder rotating 30,000 times a week (Heinlein and Cosgarea, 2010). Muscle fatigue can cause a decrease in muscle strength and balance resulting in uncontrolled scapular movements (McQuade et al., 1998). Dyskinesia can result in different injuries and dysfunctions, particularly shoulder impingement, which can occur if there is excessive protraction (Ludewig and Cook, 2000; Lukaszewicz et al., 1999). Detection of such late dyskinesia may be important in prevention and treatment of shoulder pain and injuries in athletes and manual laborers.

Our aim was to evaluate the prevalence of scapular dyskinesia in competitive swimmers found during their training sessions. We hypothesized that as the training session progresses, scapular dyskinesia will occur.

2. Methods

2.1. Design

Repeated measurement observational study.

2.2. Sample

Convenience sample of 20 competitive swimmers (of all strokes and distances) was recruited.

Inclusion criteria: at least six training sessions a week, minimum of 1½ hours per training session.

Exclusion criteria: None.

The study was observational, with no intervention and was approved by the swimmers' coach. All participants received an explanation of the aims and procedures of the study and signed an informed consent form. The study was approved by the Institutional Review Board (IRB) of the Recanati School for Community Health Professions, Faculty of Health Sciences, Ben-Gurion University of the Negev.

2.3. Setting

The study was conducted at “Ganey Omer” and “Cafri Omer” swimming pools, Omer, Israel.

2.4. Instrumentation and procedures

A digital video camera was used to record the tests. The distance between participant and camera varied to allow clear depiction of shoulder blades as well as waist, head and elbows (McClure et al., 2009). The observation method has good validity and interrater reliability as shown in previous studies (McClure et al., 2009; Tate et al., 2009).

This study was based on Madsen et al.'s study (Madsen et al., 2011). All participants were asked to fill out a demographic questionnaire. Data on upper limb symptoms (health-related quality of life) were evaluated using the Quick Disabilities of the Arm, Shoulder and Hand questionnaire (Quick DASH) including the optional sports module, which has been found to be valid for detecting upper limb disability. The Quick DASH, reliable in English, (Mintken et al., 2009), was adapted to Hebrew (Ziv, 2006). Shoulder pain experienced during the previous week's training sessions were also collected via the visual analogic scale (VAS).

Swimmers were evaluated while wearing their swimsuits, but the scapular region was clearly seen at the time of examination and on the tape. The test was conducted three times: the first evaluation was performed before the beginning of the training session; the second, after 60 min; and the last one at the end of the session (at a consistent time of one and a half hours). The testers performed full range arm flexion and abduction (in the forearm mid-position). The athletes were asked to perform three repetitions of each movement while videotaped from the back.

2.5. Outcome measures

The main outcome measure of this study was the prevalence of scapular dyskinesia at three time intervals during the training session. If scapular winging or dysrhythmia was seen unilaterally or bilaterally, the test was defined as “positive”, meaning that the swimmer had exhibited signs of scapular dyskinesia. If not, it was defined as “negative” normal scapular kinematics. Two assessors, both senior year physical therapy students from Ben Gurion University were trained to evaluate scapular dyskinesia by observing videotaped examples of normal and abnormal scapular movement (McClure et al., 2009). Assessors separately observed the video records and categorized the scapular dyskinesia as present or absent. If the two assessors agreed, then dyskinesia of the scapula was diagnosed. When a disagreement arose, the outcome was resolved after repeated evaluation and discussion. Agreement between raters after first independent evaluation of tapes was 65% (39 cases), 21 (35%) cases were reevaluated separately and an agreement was reached on another 9 (15%) cases, the rest 12 (20%) cases required additional reevaluation and discussion.

2.6. Statistical analysis

All statistical analyses were performed using the SPSS 17.0 for Windows (SPSS, Chicago, IL, USA). Statistical analyses were conducted at a 95% confidence level. A p-value < 0.05 was considered significant.

Descriptive statistics were used to characterize the sample. Shoulder dyskinesia was presented as prevalence. The chi-square test was used to compare the prevalence of shoulder dyskinesia between baseline and mid-practice evaluations.

Shapiro-Wilk tests were used to test VAS, Quick-DASH and

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