ANALYSIS OF SERRATUS ANTERIOR ON SHOULDER INSTABILITY
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Shoulder disorders are the third most common musculoskeletal condition in sports, but little is understood about the mechanisms that can cause it. The Serratus Anterior (SA) is the main stabilizer of scapula and deficits in its activity and recruitment affects scapular stability. The purpose is to systematically review about SA muscle activity in subjects with disorders related to the shoulder. The search was performed in Pubmed and Virtual Health Library, using key words: serratus anterior, scapulothoracic muscle activity and recruitment timing. A total of 18 articles were found. Disorders related to the shoulder display numerous variations in SA muscle activity. Future research may contribute to the understanding of SA activation pattern and the shoulder stabilization.

KEY WORDS: symmetry, shoulder, coaching.

INTRODUCTION: Although recently it has been shown that shoulder disorders are the third most common musculoskeletal condition in sports (Worsley et al., 2013), little is understood about the mechanisms and major muscle patterns that can cause these disorders during tasks of the upper limbs. The abnormal cinemetic standard caused by change in the activation of serratus anterior (SA) and upper trapezius (UT) are evidenced as the responsibilities to generate shoulder instability during arm lifting, also reducing the subacromial space or nearing the undersurface tendon to the glenoid labrum, allowing inadequate space for the rotator cuff tendons and other subacromial structures (Phadke, Camargo, Ludewig, 2009; Alizadehkhaiyat, Hawkes, Kemp, Frostick, 2015; Lin, Hanten, Olson, Roddey, Soto-Quijano et al. 2005). The SA is the main stabilizer of the scapula (Helgadottir, Kristjansson, Einarsson, Karduna, Jonsson, 2011) and to a scapular-humeral rhythm healthy it is of paramount importance (Ludewig, Cook, Nawoczenski, 1996; Phadke, Camargo, Ludewig, 2009; Struyf et al. 2014; Alizadehkhaiyat et al. 2015), because there must be a complete interaction between the humerus and scapula to achieve large upper limb degrees of motion (Ludewig, Cook, Nawoczenski, 1996; Struyf et al. 2014). However, if this interaction does not occur, there is risk of structures involved in the shoulder complex, what can lead to development of injuries and pathologies (Phadke, Camargo, Ludewig, 2009; Alizadehkhaiyat et al. 2015, Lin et al. 2005), mainly in athletes. Therefore, the objective of this review is to compare the pattern of SA muscle activation in disorders involving the shoulder complex.

METHODS: The instructional guidelines PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) were followed (Struyf et al. 2014). The eligibility criteria adopted in accordance with the PICO (patient, intervention, comparison and outcome) methodology and the keywords selected from these combinations (Struyf et al. 2014) were: Shoulder pain, Shoulder Impingement Syndrome, Frozen Shoulder, Shoulder Bursitis, Shoulder instability, Glenohumeral instability, Shoulder Dislocation, Massive Rotator Cuff Tear, Cervical Disorders, electromyography, healthy subjects, asymptomatic subjects, pain free shoulder, scapulothoracic, scapular, serratus anterior muscle, muscle recruitment, muscle activity, muscle activation. Afterwards, the remaining articles were screened on abstract and the remaining articles have been through selection by methodological quality analysis proposed by CENTRAL COUNSELING INSTITUTION website: https://www.guidelinecentral.com/library/quality-measures/. This search was applied to
RESULTS: A total of 18 articles were included in the systematic review. Articles regarding nerves injuries or studies handling a treatment outcome, about the validity, reliability or standardization of techniques were excluded. The methodological quality of the articles was assessed using appropriate risk of bias criteria for case-control studies. The results demonstrate that from the 18 articles selected, in 11 an abnormal activity of the SA was found (Diederichsen, Norregaard, Dyhr-Poulsen, Winther, Tufekovic et al. 2009; Hawkes, Alizadehkhaiyat et al. 2012; Helgadottir et al. 2011; Hundza & Zehr, 2007; Lin et al. 2005; Lin, Lim, Soto-Quijano, Hanten, Olson et al. 2006; Lin, Hsieh, Cheng, Chen, Lai, 2011; Ludewig and Cook, 2000; Mcmahon, Jobe, Pink, Brault, Perry, 1996; Padke & Ludewig, 2013; Wadsworth and Bullock-Saxton 1997) and 7 have shown equal activity between patients and controls (Bandholm, Rasmussen, Aagaard, Jensen, Diederichsen, 2006; Cools, Witvrouw, Declercq, Vanderstraeten, Cambier, 2004; Faria, Teixeira-Salmela, Goulart, Moraes, 2008; Lopes, Timmons, Grover, Ciconelli, Michener, 2015; Moraes, Faria, Teixeira-Salmela, 2008; Roy, Moffet, Mcfadyen, 2008; Santos, Belangero, Almeida, 2007). In 7 studies it was found a lower muscle activity of SA during tasks of upper limb between patients and controls (Diederichsen et al. 2009; Hawkes et al. 2012; Lin et al. 2005; Lin et al. 2006; Lin et al. 2011; Ludewig & Cook 2000; Mcmahon et al. 1996), other 2 studies found a delay in SA activation (Helgadottir et al. 2011; Wadsworth and Bullock-Saxton 1997), 1 study showing increased activity (Hundza & Zehr, 2007) and 1 that demonstrates an anticipation disabling muscle during lowering arm phase (Padke & Ludewig, 2013). In contrast, 5 studies found no significant difference in muscle activation between patients and controls (Bandholm et al. 2006; Cools et al. 2004; Faria et al. 2008; Lopes et al. 2015; Roy et al. 2008), and other 3 who found no significant difference related to the previous SA activation time between patients and controls (Santos et al. 2007; Roy et al. 2008; Moraes et al. 2008).

DISCUSSION: According to results of the survey data we found that in most cases there is a modified muscle activity of the SA in time contraction or intensity of contraction (Diederichsen et al. 2009; Hawkes et al. 2012; Lin et al. 2005; Lin et al. 2006; Lin et al. 2011; Ludewig and Cook, 2000; Mcmahon et al. 1996; Hundza & Zehr, 2007; Helgadottir et al. 2011; Wadsworth and Bullock-Saxton 1997; Padke & Ludewig, 2013), this result is in agreement with our hypothesis. In contrast, some studies show no change between patients and controls (Bandholm et al. 2006; Cools et al. 2004; Faria et al. 2008; Lopes et al. 2015; Roy et al. 2008; Santos et al. 2007; Moraes et al. 2008), which means that there is still doubt about the role of the SA as the main stabilization muscle of shoulder complex during upper limb tasks. However, in some cases that they do not show a significant difference between patients and controls (Bandholm et al. 2006; Cools et al. 2004; Faria et al. 2008; Lopes et al. 2015; Roy et al. 2008; Santos et al. 2007; Moraes et al. 2008), the controls also had some type of dysfunction or pathology only by asymptomatic way (Moraes et al. 2008; Lopes et al. 2015) and controls asymptomatic may exhibit the same patterns of activation that patients with symptoms, as already exhibit the dysfunction or disease, but compared to normal individuals this intensity pattern and muscle activation time may be different in SA. The SA is the main stabilizer of scapula (Helgadottir et al. 2011) and scapular-humeral rhythm healthy is very important for shoulder complex and for a lower risk of injury to structures involved, specially among the subacromial space (Ludewig, Cook, Nawoczenski, 1996; Phadke, Camargo, Ludewig, 2009; Struyf et al. 2014; Alizadehkhaiyat et al. 2015). In low back pain was found a delay in transversus abdominis and because this, the spine stays unstable and it increased the injury risk (Hodges & Richardson, 1997). We believe that in shoulder complex the SA also have a delay and because this the shoulder stays unstable and with risk of injuries. However,
future studies need to be done to understand if this relationship exists and the real role of SA in disorders related to shoulder, while there is a tendency to abnormal activity of SA, but there still no consensus.

CONCLUSION: Although the results of this systematic review have shown a tendency to abnormal activity of SA in upper limb tasks in individuals with disorders in the shoulder complex, we can’t reach a consensus on the real role of the SA as the main muscle shoulder complex stabilizer. However, it is clear the importance of a proper muscle pattern for upper limb tasks. Therefore, we believe that future research on pathologies and dysfunctions in shoulder complex and their relationship with SA can play a major role in demonstrating more clearly the perception and the tools for adequate planning in the rehabilitation of these patients, mainly in athletes that are more affected for it.

REFERENCES:


