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Association between head postural alteration and Acromio-humeral distance in young athletes

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Changes in upper body posture and concomitant imbalance of the muscle system have been proposed as one of the etiological mechanisms leading to sub-acromial impingement syndrome. Although clinicians commonly assess posture and devise rehabilitation programs to correct posture, there is little evidence to support this practice.To explore the association between head postural alteration and acromio-humeral distance (AHD). A total of thirty overhead activity athletes' male subjects of age between 15-25 years, and normal BMI between 18.5 to 24.9 kg/m^2 participated in the current study. Fifteen healthy control participants with normal upper limb clinical assessment (group I) and fifteen patients with sub-acromial impingement syndrome (group II). Ultrasound measurements of AHD and cranio-vertebral angle (CVA) measurement using a lateral radiograph x-ray were taken for each participant. The statistical analysis revealed that there was a significant difference in CVA, and AHD between both groups, and P value was <0.001. Moreover, there was a statistically significant relationship between CVA and AHD (r=0.541, n=30, p=0.002). The regression equation was: AHD = 2.629+0.121 CVA. It can be concluded that the acromio-humeral distance is significantly correlated to the cranio-vertebral angle between the sub-acromial impingement patients and normal subjects. Our findings provide a scientific basis for muscle training in overhead activity athletes such as volleyball, basketball and swimmers players.

Keywords: Head postural alteration, cranio-vertebral angle, acromio-humeral distance, sub-acromial impingement syndrome, young athletic players

INTRODUCTION

Sub-acromial Impingement Syndrome (SAIS) is one of the most common causes of shoulder pain affecting manual and sedentary workers as well as athletes. Individuals with SAIS present with pain during overhead movements and arm elevation within the painful arc, leading to considerable functional incapacity. The underlying etiology of SAIS is multifactorial with symptoms triggered by both extrinsic and intrinsic factors including inflammation of the sub-acromial bursa, rotator cuff tendon degeneration, weak or rotator cuff and scapular musculature dysfunction (muscle imbalances), aberrant activation patterns of shoulder girdle muscles, and postural dysfunction of the spinal column and scapula (De

Witte PB, et al. 2011). It is common in athletes who frequently observe altered patterns of activation, scapular dyskinesia, and muscle imbalances involving major postural muscles (upper, middle, lower trapezius, and serratus anterior) (Cools AM, et al. 2007).

Standard posture is characterized as if the gravity line passes through the external auditory tissue, the cervical spine bodies, and the acromion and anterior of thoracic spine (Kendall FP, et al. 2005). Normally, the cervical spine is lordotic. Protraction movement is a result of extension of the upper cervical spine and flexion of the lower cervical spine, whereas retraction movement results from flexion of the upper cervical spine and extension of the lower cervical spine. If the cervical spine is held in protracted position for prolonged duration, it can lead to alterations in head posture ultimately leading to poor posture known as forward head posture (FHP), which is a deviation from neutral posture (Thigpen CA, et al. 2010).

Alteration in alignment of the head, neck, shoulders and thoracic spine has been suggested as one of the key underlying factors in association with SAIS. Previous authors have suggested that increased thoracic kyphosis together with a forward shoulder posture results in the narrowing of sub-acromial space and prompts tendon inflammation/tendon degeneration and upper limb movement dysfunction due to mechanical compression (Ratcliffe E, et al. 2014)**.** The evaluation of the upper body position has been given considerable attention to facilitate the development of enhanced SAIS management strategies (Borstad JD,2006).

Postural alterations can occur independently within thoracic and cervical spine, shoulder, and scapula. Common postural alterations within the sagittal plane include increased forward head posture (FHP), forward shoulder posture, and thoracic spine kyphosis. These aberrant alignments are suggested to influence scapular kinematics and produce dysfunctional postural adjustments with effect on the pressure and dimensions of the sub-acromial space **(**Ludewig PM, Cook TM., 2000)

Neer was the first to use the term sub-acromial impingement syndrome. Neer's model involving acromial irritation of the sub-acromial tissues has been embraced by physical therapists, who have suggested that an alteration in upper body posture, known as a forward head posture (FHP), is associated with the impingement process due to changes in the position of the scapula, an increase in the thoracic kyphosis angle, and a concomitant imbalance of the surrounding muscles. These changes are thought to produce a compressive impingement under the acromion, creating a mechanical block to elevation of the humerus and irritation of the sub-acromial tissues (Sahrmann SA, 2002)

The magnetic resonance imaging, computed tomography, X-rays, and ultrasound can measure the sub-acromial space (SAS) or acromio-humeral distance (AHD) (Kalra N, et al. 2010). Ultrasonography has been found to be a non-invasive, radiation free technique, and has high validity compared to X-rays (Azzoni R, et al. 2004). A recent systematic review found ultrasound to be the best method of AHD measurement because of the good evidence for its reliability, in contrast to radiographic methods (McCreesh et al.2013).

There is insufficient evidence to support the role of aberrant posture in SAIS pathogenesis, possibly due to the multifactorial nature of SAIS and lack of consistency between the study methodologies. In view of conflicting findings, further research is needed to recognize aberrant postural adaptations in patients with SAIS in order to facilitate the implementation of targeted treatment based on assessment (Ratcliffe E, et al. 2014).

Most researchers used common methods in SAIS patients for quantitative evaluation of static upper body posture. The results were contradicted. Several researchers identified asymptomatic and symptomatic patients with postural differences (Timmons MK, et al. 2012).

Given these variations in upper body posture among asymptomatic and Symptomatic subjects, it is not possible to determine whether these altered Postures-have an etiological association with SAIS or are induced by underlying pathology (Lewis JS et al. 2005). The purpose of this study was to compare head postural alteration variables between the SAIS patients and asymptomatic healthy controls. The null hypothesis for this investigation was that Ho: There is no association between head postural alteration and acromio-humeral distance.

MATERIALS AND METHODS

Subject

The current study was conducted at Deraya University, Minia, Egypt. Before data collection, each participant signed consent form that approved by Research Ethical Committee, Faculty of Physical Therapy, Cairo University (No: P.T.REC/012/002365). A total of 30 overhead activity athletes' male subjects (volleyball, basketball and swimmers players) including 15 healthy control participants (group I) with normal upper limb clinical assessment and no history of upper extremity painful condition or surgery. Other 15 participants with sub-acromial impingement syndrome (group II). All participants have normal BMI between 18.5 to 24.9 kg/m2. Their age ranged between 15 to 25 years. All patients of group (II) have persistent shoulder pain for at least 12 weeks and at least three positive tests (Neer Impingement Sign, Hawkins and Kennedy impingement test, and Painful arc of Shoulder movement test).

Neer impingement Sign was performed with the patient in sitting. The clavicle and scapula were stabilized with one hand and passively flexes the patient's internally rotated arm with the other hand. The purpose was to compress the sub-acromial contents under the acromion. Reproduction of pain indicates a positive test (Calis M. et al. 2000).

Hawkins and Kennedy impingement test. Was performed with the patient either sitting or standing. Flexes the arm to 90° and then internally rotates the shoulder. This procedure was done at varying degrees of horizontal adduction. Reproduction of pain indicates a positive test (Pisan M. et al. 2000).

Painful arc of shoulder movement test. The patient actively abducted the arm. The presence of a painful arc of movement between 60° and 120° suggests sub-acromial pathology. This test is recommended in research studies (Gartsman GM., 2000).

Participant who receiving treatment during last 3 months, or with rotator cuff tear, instability, osteoarthritis, hypermobility syndrome, systemic disease affecting function of neck, upper extremity, and or with history of cervical pain over the past 12 months, or upper limb surgery were excluded.

Instruments

* Ultrasonographic measurements for each participant's AHD were scanned by using a Mindray DP-10 Power Portable USG System as in figure (1).

*Lateral radiograph x-ray was used for measuring the Cranio-vertebral angle of each participant in both groups.

Figure1: Mindray DP-10 Power Portable USG System

Procedures

The AHD measurement

First, the AHD measurements were taken while the participant of group (I) and group (II) in sitting position. The head was in a neutral position, arm in 0◦ of flexion, elbow was in full extension and forearm was in neutral position. The transducer was placed on the lateral surface of the shoulder along the longitudinal axis of the humerus and the AHD was scanned in the longitudinal view and was measured from the infero-lateral edge of acromion to the apex of the greater tubercle as in figure (2). Three measurements were taken and the mean value was recorded.

Figure2: Scanned acromio-humeral distance

Cranio-vertebral angle measurement

The cranio-vertebral angle was measured while the participant is standing using a lateral radiograph x-ray. The cranio-vertebral angle can be visualized from a person's side: Draw a horizontal line that goes through the C7 spinous process, which is the back of the vertebra at the bottom of the neck. Draw a second line from the C7 spinous process up to the tragus, which is the pointed part in front of the earhole. Where these two lines join together at the C7 vertebra forms the cranio-vertebral angle.

Data analyses:

The measurements available for analysis were: cranio-vertebral angle, and acromio-humeral distance. Data were analyzed using the SPSS, Version 16. Descriptive statistics were computed for each study variable. Pearson correlation was done to examine the relationship between cranio-vertebral angle (CVA) and acromio-humeral distance (AHD).

RESULTS

The demographic data was compared between both groups (Group I: Control group and Group II: Sub-acromial impingement syndrome group), Unpaired T-test was used to compare age and Body Mass Index (BMI) and revealed no significance difference was found between both groups. Concerning age, the mean value in group (I) was 18.33 years (± 0.723) while in group (II) was 19.46 years (± 0.833) and P value was 0.644. By comparing BMI, the mean value in group (I) was 24 kg/ m^2 (±0.876) while in group (II) was 22.95 kg/ m^2 (±1.16) and P value was 0.902.

Unpaired T-test was used to compare cranio-vertebral angle (CVA) between both groups. The mean value in group (I) was 57.46 degrees (± 6.6) while in group (II) was 49 degrees (± 5). Comparison showed significant difference and P value was <0.001. Fig: (3)

Concerning acromio-humeral distance (AHD), unpaired T-test was used to compare AHD between both groups. The mean value in group (I) was 10.49 mm (± 0.9) while in group (II) was 7.67 mm (± 0.55). Comparison showed significant difference and P value was <0.001. Fig: (4).

To examine the relationship between cranio-vertebral angle (CVA) and acromio-humeral distance (AHD), Pearson correlation was done and revealed that there was a statistically significant relationship (r=0.541, n=30, p=0.002). Figure (5) show the relationship between cranio-vertebral angle (CVA) and acromio-humeral distance (AHD). Linear regression also was carried out to test the strength of relationship. The regression model was statistically significant to predict acromio-humeral distance (AHD), P value was 0.002. (R Square = 0.292). The regression equation was: AHD = 2.629+0.121 CVA as in figure (5).

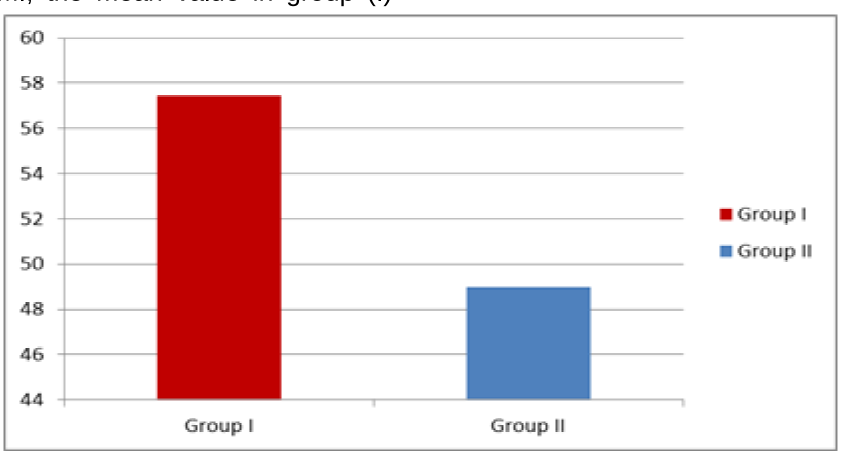

Figure 3: Comparison of cranio-vertebral angle (CVA) between both groups

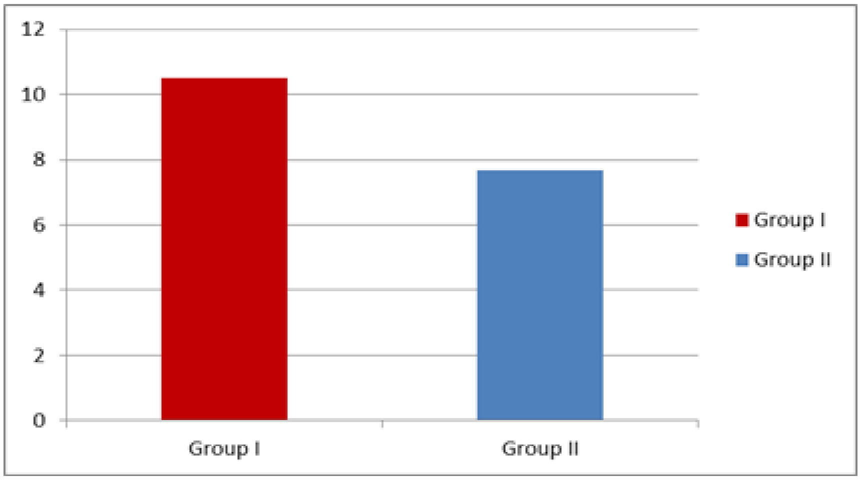

Figure 4: Comparison of acromio-humeral distance (AHD) between groups.

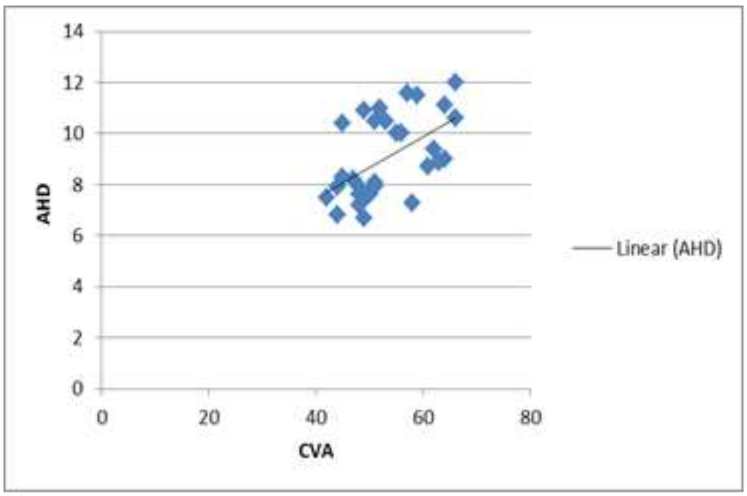

Figure 5: Relationship between CVA and AHD.

DISCUSSION

The results of the present study identified head postural alteration (FHP) in patients with SAIS. This result was matched with Omid et al. study (2017) who identified multiple postural alterations in female patients with SAIS, including greater FHP, and FSP compared to only greater FSP in male patients.

Increased FHP and FSP altered scapular positioning. The scapula provides a stable base for efficient function of the rotator cuff and other muscles crossing the gleno-humeral joint in individuals with good upper body posture (Thigpen CA, et al. 2010).

In addition, altered scapular kinematics and muscle activation patterns reported by motion analysis and EMG studies in asymptomatic patients with increased FHP and FSP suggested a subsequent mechanical impact on sub-acromial space (Thigpen CA et al. 2010).

Persistent FHP results in shortening of the posterior neck extensors, tightening of the anterior neck and shoulder muscles with subsequent effects on normal scapular position and kinematics (Im B. et al. 2016). Abnormal scapular orientations can then alter the activation of the stabilizing muscles such as levator scapulae and upper trapezius muscles as well as the mobilizing muscles such as pectoralis minor. Continuous FSP causes adaptive shortening and tightness of the anterior musculature such as the pectoralis minor resulting in increased scapular anterior tilt, internal rotation, and downward rotation. These scapular patterns associated with FSP would depress the acromion, restrict clearance of sub-acromial space, and increase the pressure on sub-acromial soft tissues leading to painful shoulder elevation, restricted motion, weakness, and functional disability (Lewis JS, et al. 2005).

It is also possible that excessive scapular protraction combined with postural abnormalities i.e. increased FSP and FHP could restrict scapular upward rotation during shoulder abduction in the range of 60°-90° and reduces sub-acromial space clearance.

This comes in agreement with Lewis JS. et al. 2005 who find that the forward head or ‘‘slouched’’ posture has been associated with an increased thoracic kyphosis, forward shoulder posture, and a scapula that is protracted, elevated, anteriorly tilted, and downwardly rotated. This combination of postures has been associated with a reduction in gleno-humeral movement and SIS.

Other researchers have reported opposing results. In a study of 60 controls and 60 SAIS patients, Lewis et al. (2005) reported no relationships between various postural components including FHP and FSP. They assessed FSP using goniometric scapular posture markers in patients with SAIS and asymptomatic participants in conjunction with electrical movement study of shoulder kinematics and found no association between SAIS and FSP. This was due to large individual variations and challenged the hypothesis that posture and resultant muscle imbalance play an etiologic role in the pathogenesis of SAIS (McClure et al., 2006).

CONCLUSION

Earlier understanding of the crucial elements influencing the relationship between dysfunctional posture and SAIS has not been rigorously examined. While studies of asymptomatic subjects established the likelihood of a connection between SAIS and posture; studies involving SAIS patients have largely failed to clarify this relationship. SAIS patients in the current study exhibited abnormal FHP as compared to controls. There is a significant difference in cranio-vertebral angle (CVA) and acromio-humeral distance (AHD) between the patients with sub-acromial impingement syndrome and normal subjects. The acromio-humeral distance (AHD) is significantly correlated to the cranio-vertebral angle (CVA). Randomized controlled trials of rehabilitation interventions addressing defined postural alterations are needed to support their integration into prevention and intervention programs. Future research needs to determine the benefits of treating muscle imbalances and changes in posture in the conditions where it is thought as an etiological factor.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

AUTHOR CONTRIBUTIONS

ESM developed the idea. MME and ESM developed research design, scientific Writing. MME and AA performed the practical part. BSL reviewed statistical design and conducted the statistical analysis and wrote the results section. MIM reviewed the manuscript. All authors read and approved the final version.

REFERENCES

Azzoni R, Cabiza P, Parrini M, 2004. Sonographic evaluation of sub-acromial space. Ultrasonics; 42:683-687

Borstad JD, 2006. Resting position variables at the shoulder: evidence to support a posture-impairment association. Phys Ther; 86:549-557.

Calis M, Akgun K, Birtane M, Karacan I, Calis H, Tuzun F, 2000. Diagnostic values of clinical diagnostic tests in subacromial impingement syndrome. Ann Rheum Dis; 59:44-47.

Cools AM, Declercq GA, Cambier DC, et al., 2007. Trapezius activity and intramuscular balance during isokinetic exercise in overhead athletes with impingement symptoms. Scand J Med Sci Sports; 17:25-33.

De Witte PB, Nagels J van, Arkel ER, et al.,2011. Study protocol sub-acromial impingement syndrome: the identification of pathophysiologic mechanisms. BMC Musculoskeletal Disord; 12:1-12.

Gartsman GM, 2000. Mini-symposium: rotator cuff partial thickness tears evaluation and treatment. Curr Orthop; 14:167-172.

Im B., Kim Y., Chung Y., et al., 2016. Effects of scapular stabilization exercise on neck posture and muscle activation in individuals with neck pain and forward head posture. J Phys Ther Sci; 28:951-955.

Kendall FP, McCreary EK, Provance PG, Rodgers M, Romani W, 2005. Muscles Testing and Function, With Posture and Pain. 5th ed. Lippincott Williams & Wilkins; Philadelphia, PA.

Kalra N., Seitz AL, Boardman ND, et al, 2010. Effect of posture on acromio- humeral distance with arm elevation in subjects with and without rotator cuff disease using ultrasonography. J Orthop Sports Phys The; 40(10):633-640.

Lewis JS, Green A., Wright C, 2005. Sub-acromial impingement syndrome: the role of posture and muscle imbalance. J Shoulder Elbow Surg; 14:385-392.

Lewis JS, Wright C, Green A, 2005. Subacromial impingement syndrome: the effect of changing posture on shoulder range of movement. J Orthop Sports Phys Ther; 35:72-87.

Ludewig PM, Cook TM, 2000. Alterations in shoulder kinematics and associated muscle activity in people with symptoms of shoulder impingement. Phys Ther; 80:276-291.

McCreesh KM, Crotty JM, Lewis JS, 2013. Acromio-humeral distance Measurement in rotator cuff tendinopathy: Is there a reliable, clinically applicable method? Br J Sports Med, July 2.

McClure PW., Michener LA., Karduna AR, 2006. Shoulder function and 3-dimensional scapular kinematics in people with and without shoulder impingement syndrome. Phys Ther; 86:1075-1090.

Omid A, Roebuck MM, Makki AT, Frostick SP, 2017. postural alterations in patients with subacromial impingement syndrome. Int J Sports Phys Ther. Dec;12(7):1111-1120.

Ratcliffe E., Pickering S., McLean S., et al.,2014. Is there a relationship between subacromial impingement syndrome and scapular orientation? A systematic review. Br J Sports Med; 48:1251-1256.

Sahrmann SA, 2002. Diagnosis and Treatment of Movement Impairment Syndrome. London, UK: Mosby.

Thigpen CA, Padua DA, Michener LA, 2010. Head and shoulder posture affect scapular mechanics and muscle activity in overhead tasks. J Electromyogr Kinesiol; 20(4):701-709.

Timmons MK, Thigpen CA, Seitz AL, et al.,2012. Scapular kinematics and sub-acromial impingement syndrome: a meta-analysis. J Sport Rehabil; 21:354-370.

Pisan M., Gerber C, 2000 Mini-symposium: rotator cuff (i) clinical examination of the rotator cuff. Curr Orthop; 14:155-160.