Muscle adaptation and postural deviation in office workers with different subtypes of scapular dyskinesis

S Wangbunkhong*, M Vongsirinavarat and P Sakulsriprasert

Faculty of Physical Therapy, Mahidol University, Nakhon Pathom 73170, Thailand

sukhon.wang@gmail.com

Abstract

The upper extremity tasks require the energy originated from proximal to distal continuity as a kinetic chain of movement. The scapula is very important for this chain because of its connection of the limb to the torso. Dysfunction of scapula or scapular dyskinesis then could lead to tissue injury and pain developed in upper quarter region. The faulty scapular alignment is related to changes of surrounding muscle properties to be in shortened or elongated length.These might be associated with neck, shoulder and scapular pain because altered force loading and transferring. Scapular dyskinesis can be classified into four subtypes depended on the position and motion of the scapula bone. However, the relationship between subtypes of scapular dyskinesis and axioscapular muscle adaptations along with postural of upper quarter deviations is still unclear. The purpose of this study is to identify axioscapular muscle adaptations and postural deviations in symptomatic office workers with different subtypes of scapular dyskinesis.

The participants were symptomatic office workers with different subtypes of scapular dyskinesis. They were evaluated the subtypes of scapular dyskinesis corresponded with flexibility of pectoralis minor, upper trapezius and levator scapulae using muscle length tests. The performances of serratus anterior, upper trapezius, middle trapezius, lower trapezius and rhomboids were also examined using manual muscle test. The postural deviations of cervical, shoulder and thoracic were also investigated using postural analysis methods.

The results showed high incidence of axioscapular muscle adaptations including of decreased flexibility of pectoralis minor, upper trapezius and levator scapulae in all subtypes as well as decreased performance of serratus anterior, middle trapezius, lower trapezius and rhomboids. The high incidence of postural deviations including forward head, rounded shoulder and thoracic hyper-kyphosis were also found in all subtypes of scapular dyskinesis.

In conclusion, this study showed the relationship between subtypes of scapular dyskinesis and the changes of surrounding structures. These should be considered for proper management in symptomatic individuals with scapular dyskinesis.

Keywords: Scapular dyskinesis, Axioscapular muscle, Office worker, Posture

Introduction

The work characteristics of the office workers are related to prolonged static sitting and typing positions. These prolonged low level muscle contractions is related to increased muscle pressure that blocked blood circulation resulting in insufficient oxygen [1]. This leads to muscle damage and trigger point formation. Repetitive movements in typing task also increase mechanical loading in working muscles that increase local temperature to working tissue resulting in tissue damage. The release of inflammatory mediators stimulates the nociceptors which sending signals to pain pathway [2]. The chronic overloading in contractile and non-contractile tissues around neck, shoulder and scapular areas in office workers could lead to upper quarter musculoskeletal adaptation. The muscle imbalance is then developed and causing altered scapular position and movement called scapular dyskinesis. According to Kibler's concept [3], Scapular dyskinesis is classified into 4 different types of position and motion abnormalities. Type I is the inferior medial scapular angle prominent associated with excessive anterior tilting of the scapula bone. Type II is the entire medial border prominence associated with excessive scapular internal rotation. Type III is excessive superior border elevation. Type IV is normal symmetrical scapular motion.

There are clinical comments regarding the scapular dyskinesis related to shoulder pain in the overhead activities. Moreover, the studies extend to investigate the relationship between scapular dyskinesis and cervical symptom. Previous studies has found the reorganization of the surrounding muscles after neck pain [4]. The key group that might be related with scapular dyskinesis and work-related pain in office workers is the axioscapular muscles. These muscles attach between the scapula to the axis of the body consisted of serratus anterior, pectoralis minor, rhomboids, levator scapulae and three parts of trapezius. The important role of these muscles are controlling mobility and stability of neck, shoulder, and scapula to be in the optimal positions in the different tasks [5]. Therefore, changes of the alignment of either scapula, shoulder or cervical spine can potentially influence the biomechanics of each other by altering tensions of the axioscapular muscles. On the other hand, changes of axioscapular muscles activities and properties might influence the alignment of either scapula, shoulder or cervical spine [6].

However, there were few studies presenting the incidence of axioscapular muscle adaptation along with upper quarter alignment deviation in individuals with each subtype of scapular dyskinesis. Therefore, this study aimed to investigate the patterns of axioscapular muscle adaptation and postural deviation of cervical, shoulder and thoracic in office workers with different subtypes of scapular dyskinesis. Hypothesis of the study was there were musculoskeletal and biomechanical changes of axioscpular muscle along with postural deviation in office workers with subtypes of scapular dyskinesis.

Materials and Methods

This study was a cross-sectional design, examining the muscle adaptations and postural deviation in office workers with different subtypes of scapular dyskinesis. Office workers in this study were defined as people who worked with video display units or video display terminals using keyboard or mouse, voluntarily participated in the study. Each participant signed an informed consent prior to participation. This study obtained the ethical approval from Mahidol University Central Institutional Review Board, protocol number MU-CIRB 2016/166.1410.

The inclusion criteria including; age between 20 - 55 years, BMI < 30 kg/m^2, presence of neck, shoulder, and scapula symptoms within 3 months, pain intensity equal or more than 3/10, using computer at least 4 hours in any working day for at least 1 year. The subjects were excluded from the study if he or she had history of neck or shoulder fracture, history of neck or shoulder surgery, history of trauma of upper quadrant within 6 months, cervical or shoulder pathology, fibromyalgia, systemic diseases and soft tissue disorders, obvious structural scoliosis, central nervous system disorders, congenital thoracic deformities, participating in intensive exercise program or physical therapy program for neck and shoulder within 6 weeks.

Each participant was asked to perform 5 repetitions of active bilateral shoulder flexion and abduction with and without weight (1.4 kg for BW < 68.1 kg and 2.3 kg for BW > 68.1 kg) in both hands. The testing began with arms at the sides of the body. They were asked to elevate upper limbs while keeping thumbs upwards and then returned to neutral. Each cycle of elevation and return to the starting position lasted 6 seconds (3 seconds per phase) [7]. The examiner stood behind the participant and recorded video to evaluate the presence of aberrant mobility of the scapula and classified scapular dyskinesis into subtypes according to Kibler's concept.

The evaluation of axioscapular muscle adaptation included muscle flexibility and performance. The testing procedure of individual muscles was as follows [8-9].

The performance of axioscapular muscles was assessed by manual muscle testing with break-test technique. Manual resistance was applied after the targeted muscle had been placed at the end range position. The participants were asked to hold the part at that position and not allowed the examiner to break the hold position with manual resistance. The muscle was considered weak if the participant could not hold the initial position for 5 seconds. The tested muscle consisted of serratus anterior, upper trapezius, middle trapezius, lower trapezius and rhomboids.

The flexibility of axioscapular muscles was assessed by muscle length test. The passive elongated muscle in the opposite direction of its action was performed while evaluating the end-feel or resistance at the end of movement. The muscle was considered short if there was altered the normal end-feel. The tested muscle consisted of pectoralis minor, levator scapulae and upper trapezius.

The postural alignments of neck and shoulder were defined by paralleling with a plumb line reference. The participant was asked to stand in relaxed position at the marked point in front of grid line then captured the picture and uploaded into kinovea software program. The forward head and rounded shoulder were considered from the cervical and shoulder angles. The cervical angle less than 50° was considered forward head posture. The shoulder angle less than 52° was considered round shoulder posture. [10,11]. The thoracic kyphosis was determined by flexible ruler and considered thoracic hyper-kyphosis from the thoracic angle more than 45° [12].

All data were analyzed by using SPSS for windows version 22. The descriptive statistics were used to summarize demographic data and subtypes of scapular dyskinesis. The Chi-squire statistics were used to explore relationship between types of scapular dyskinesis and postural alignment deviation, performance of axioscapular muscles, the length of axioscapular muscles.

Results and Discussion

The characteristics of subjects

There were 99 office workers participated including 87 females and 12 males. The age was ranging from 23 to 55 years, body mass index from 16.20 to 29.90 kg/m^2 and pain scale were reported from 3 to 9. All data were tested for normal distribution using Kolmogorov-Smirnov Goodness of Fit test. The data were normal distributed. Table 1 shows means and standard deviations of demographic characteristics of all participants. In term of job characteristics, most participants were using computer more than 10 years, at least 4-8 hours per day, for 3-5 days per week.

Table 1 The characteristics of participants (n=99).

Characteristics	Mean ± SD
Age (years)	35.50 ± 9.37
Body mass index (kg/m^2)	21.67 ± 3.16
Pain scale	5.23 ± 1.48

The performance of axioscapular muscles

Table 2 shows percentages of axioscapular muscles weakness in subtype of scapular dyskinesis. The results showed high percentages of muscle weakness in serratus anterior, rhomboids, middle and lower trapezius in all subtypes of scapular dyskinesis. There were significant differences among subtypes of scapular dyskinesis of rhomboids (χ^2 (4, N = 248) = 30.75, $p < 0.01$) and upper trapezius (χ^2 (3, N = 51) = 9.00, $p = 0.03$) performance. The serratus anterior, rhomboids, middle trapezius, and lower trapezius play important roles to stabilize the scapula in static resting position and dynamic movement position. The main functions were facilitating upward rotation, posterior tilt and retraction of the scapula during shoulder elevation. The altered performance of these muscles caused the scapular dysfunction by the alteration of scapular muscles force-couple. They contribute to create scapula, shoulder and neck muscle imbalances because these muscles act as the bridge between neck, shoulder and scapular areas. Thus, the changed performance of these muscles could lead to neck, shoulder and scapular pain or discomfort from muscle imbalance and movement impairment [13,14].

Table 2 Percentages of axioscapular muscles weakness in subtype of scapular dyskinesis.

Type / Muscle	Serratus anterior	Upper trapezius	Middle trapezius	Lower trapezius	Rhomboids
Type I (n=21)	100.00 (n=21/21)	0.00 (0/21)	90.45 (19/21)	100.00 (21/21)	23.80 (5/21)
Type II (n=126)	92.86 (n=117/126)	9.52 (12/126)	96.83 (122/126)	98.41(124/126)	46.03 (58/126)
Type III (n=9)	100.00 (9/9)	22.22 (2/9)	100.00 (9/9)	100.00 (9/9)	77.89 (7/9)
Type IV (n=20)	90.00 (18/20)	10.00 (2/20)	90.00 (18/20)	100.00 (2020)	45.00 (9/20)
Mixed type (n=22)	83.36 (19/22)	9.09 (2/22)	100.00 (22/22)	95.45 (21/22)	54.45 (12/22)

The flexibility of axioscapular muscles

Table 3 shows percentages of axioscapular muscles tightness in subtypes of scapular dyskinesis.The results showed that all participants with all subtypes of scapular dyskinesis presented with pectoralis minor tightness. Moreover, high percentage of levator scapulae and upper trapezius tightness were also found. There were not statistically significant different of all tested muscles in all subtypes of scapular dyskinesis (pectoralis minor: χ^2 (4, N = 500) = 0.00, $p = 1.00$, levator scapulae: χ^2 (4, N = 443) = 2.84, $p = 0.59$, upper trapezius: χ^2 (4, N = 498) = 0.03, $p = 1.00$). Tightness of these muscles contributed to decreased scapular upward rotation, scapular posterior tilt, and increased scapular elevation which related with decrease of subacromial space width that endangers subacromial structures during arm movements. Non-specific neck pain might also be affected because upper trapezius and levator scapulae attach to the cervical spine and support functional control of neck [15].

Table 3 Percentages of axioscapular muscles tightness in subtype of scapular dyskinesis**.**

Type / Muscle	Levator scapulae	Pectoralis minor	Upper trapezius
Type I (n=21)	95.24 (n=20/21)	100.00 (n=21/21)	100.00 (n=21/21)
Type II (n=126)	92.86 (n=117/126)	100.00 (n=126/126)	97.62 (n=123/126)
Type III (n=9)	88.89 (n=8/9)	100.00 (n=9/9)	100.00 (n=9/9)
Type IV (n=20)	75.00 (n=15/20)	100.00 (n=20/20)	100.00 (n=20/20)
Mixed type (n=22)	90.90 (n=20/22)	100.00 (n=22/22)	100.00 (n=22/22)

The postural alignment deviations

Table 4 shows the percentages of forward head, rounded shoulder and thoracic hyper-kyphosis in subtypes of scapular dyskinesis. The results showed that all participants in all subtypes presented with rounded shoulder on both sides. The high incidences of forward head and thoracic hyper-kyphosis also found in all subtypes. There were significant differences among subtypes of scapular dyskinesis of forward head posture in participants; χ^2 (4, N = 252) = 19.11, p = 0.01. The difference in proportion of rounded shoulder and thoracic kyphosis in participants with different types of scapular dyskinesis was not statistically significant, (round shoulder; χ^2 (4, N = 500) = 0.00, p = 1.00, thoracic kyphosis: χ^2 (4, N = 272) = 4.03, p = 0.40).

The faulty upper quarter posture is related to changes of axioscapular muscle working from shortened or elongated position. In the long term, these changes are associated with dysfunction in the upper quarter of the body contributed to movement impairment of upper quarter kinetics chain which leading to changing of stress loading to cervical, shoulder and scapular structures [16-17].

Table 4 Percentages of postural alignment deviation in subtype of scapular dyskinesis.

Type / Muscle	Forward head	Rounded shoulder	Thoracic hyper-kyphosis
Type I (n=21)	42.86 (n=9/21)	100.00 (n=21/21)	61.90 (n=13/21)
Type II (n=126)	41.27 (n=52/126)	100.00 (n=126/126)	55.56 (n=70/126)
Type III (n=9)	77.77 (n=7/9)	100.00 (n=9/9)	55.56 (n=5/9)
Type IV (n=20)	55.00 (n=11/20)	100.00 (n=20/20)	55.00 (n=11/20)
Mixed type (n=22)	45.46 (n=10/22)	100.00 (n=22/22)	40.90 (n=9/22)

Conclusions

Participants with neck, shoulder and scapular pain with all subtypes of scapular dyskinesis had similar patterns of deviated alignments of upper quarter consisted of forward head, rounded shoulder and thoracic hyper-kyphosis. The axioscapular muscle adaptations including decreased flexibility of pectoralis minor, upper trapezius and levator scapulae were also observed, along with decreased performance of middle trapezius, lower trapezius, serratus anterior and rhomboids. These findings should be considered for proper management in rehabilitation program in individuals with symptomatic neck, shoulder, and scapular pain with scapular dyskinesis.

Ethic Committee No.

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