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Assessment of Scapular Position in Office Workers with Non-Specific Low Back Pain - A Case Control Study

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ABSTRACT

Background – Low back pain (LBP) has prevalence of about 76% in individuals involved in sitting occupations. Office workers adapt to poor body posture due to prolong sitting position, which may lead to musculoskeletal disorders, discomfort or pain with a bad effect on the quality of life. LBP subjects have weak lumbar extensors which causes decreased spinal extension mobility leading to compensatory kyphosis posture/forward bending posture, causing alterations in muscle activation of thoracic muscles with inappropriate scapular positioning. Studies till date have assessed scapular position in NSLBP subjects only at rest position. So it was necessary to assess the scapula during dynamic movements in NSLBP office workers as it reveals abnormal non-smooth and premature scapular movement changes that may occur in LBP subjects due to kinetic chain alterations.

Objectives–To assess scapular position both at static and during dynamic movements in office workers with NSLBP.

Methodology– The case control study was conducted including 70 subjects (case group-35, control group-35) aged between 18-57yrs, and were allocated into the groups based on NPRS. The static scapular position of each subject in both the groups was assessed by using lennie test & dynamic scapular assessment was done by using scapular dyskinesis test.

Results– The age, gender, BMI were normally distributed in case & control groups. The lennie test variables (sup. Angle, R.S, inf.angle) of right & left side scapula of case group showed significant differences of p<0.001 with control group. The scapular dyskinesis test results showed significant differences of p<0.001 during flexion and abduction between case & control groups.

Conclusion– The results of lennie test and scapular dyskinesis tests of showed significant differences between lennie test & scapular dyskinesis test between case & control group. So, our study concludes that the LBP subjects will be prone to alterations in scapular position both at rest & during dynamic movements.

KEY WORDS – Non-specific low back pain, office workers, scapular dyskinesis

I. INTRODUCTION

Non-specific low back pain (NSLBP) is defined as low back pain not attributable to recognizable, known specific pathology (e.g., infection, tumor, osteoporosis, fracture, structural deformity, inflammatory disorder, radicular syndrome, or cauda-equina syndrome etc.)(1). It is seen because of heavy physical exertion such as weight lifting, repetitive movement and frequent static posture. LBP prevalence has been found to range from 6.2% to 92% with increase of prevalence with age and female preponderance (2). Previous studies concluded that 76% of individuals with sitting occupation will experience low back pain (3).

Gradually, the prevalence of Low Back pain (LBP) has increased among office workers in general (4). In the present days, individuals spend extended periods in a seated position at work. They adapt to poor body posture due to prolonged sitting position. Such working conditions cause musculoskeletal disorders that can lead to discomfort or pain with a bad effect on the quality of life (5). Low back pain subjects have weak lumbar extensors leading to kyphotic posture and alterations in scapular positioning.

Scapula must co-ordinate the demands of humeral positioning and energy transfer while providing a stable platform for muscle attachments. Thus, for normal shoulder movement to occur there must be stability at both pelvis and scapula, as abnormalities in pelvis or hip motion can lead to kinetic chain alterations (6).

SCAPULA NORMAL ALIGNMENT: The vertebral border of the scapula is parallel to the spine and is positioned approximately 3 inches from the midline of the thorax. It is situated on the thorax between the T2 and T7 thoracic vertebrae. The scapula is flat against the thorax and is rotated 30 degrees anterior to the frontal plane.

SCAPULAR MAL-ALIGNMENT: 1) downwardly rotated: -The inferior angle of the scapula is medial to the root of the spine of the scapula. 2) Depressed: - The superior border of the scapula is positioned lower than the T2 and T7 vertebral landmarks 3) Elevated: - The elevation of the superior angle of the scapula, but not the acromion (levator scapula muscle is short). The elevation of the entire scapula, including the acromion (upper trapezius muscle is short) . 4) Adducted: -The vertebral border of the scapula is less than 3 inches from the midline of the thorax. 5) Abducted: -The vertebral border of the scapula is more than 3 inches from the midline of the thorax . 6) Tilted or tipped: -The inferior angle protrudes away from the rib cage. This alignment is associated with shortness of the pectoralis minor muscle & biceps brachii muscle.7) Depressed and tilted: - The scapula is depressed, but the scapula is also anteriorly tilted.8) Abducted and tilted: -This alignment is the combination of both abduction and tilted. 9) Winged: - The vertebral border protrudes posteriorly from the thorax. Scapula should not wing during arm movement, either during the flexion/abduction phase or during the return from flexion/abduction phase . 10) Upwardly rotated: -The root of the spine of the scapula is medial to the inferior angle (7)

During shoulder flexion the scapula often stops its movement at 140o. The rest of the motion occurs almost at the glenohumeral joint (GH). The movement of the inferior angle beyond the midline or the protrusion of the scapula laterally beyond the thorax indicates excessive scapular abduction. The scapula should slightly depress, posteriorly tilt, and adduct to complete the motion of 180o. The presence of a kyphosis or shortness of the pectoralis minor muscle can impede this depression.

Minimal movement of the spine should occur during full abduction or flexion of the shoulder. If the thoracic spine is kyphotic, the scapula will be tilted anteriorly by the convexity of the ribs, thus limiting the apparent range of shoulder flexion. Decreasing the degree of the thoracic kyphosis improves the range of shoulder flexion (8).

In chronic non-specific low back pain subjects, there is weakness of spinal extensor muscles, which causes decreased spinal extension mobility. Due to which, the subject adapts to compensatory kyphotic posture or forward bending posture, causing alterations in muscle activation of thoracic muscles with inappropriate scapular positioning (9).

In the subjects with the classic forward head, increased thoracic kyphosis, the scapula rotates forward and downward. Additional consequences of forward head posture are shortening of sternocleidomastoid muscles, upper trapezius and levator scapulae muscles that results in elevated scapula (10).

In previous studies they measured the movements of scapula in each subject performing humeral elevation in an upright seated posture and in a slouched seated posture. They concluded that increased thoracic kyphosis alters the kinematics of scapula during humeral elevation (increase of anterior tilt of scapula). Some authors proposed that increased thoracic flexion(kyphosis) alters the scapulohumeral relationship leading to shoulder complex muscle weakness and limited GH joint range of motion and thus may result in shoulder impingement pathology (11,12).

In some cases, over activity or tight latissimus dorsi anteriorly rotate the pelvis which causes overextension of lumbar spine leads to pain in thoraco-lumbar junction. Latissimus dorsi inserts beneath the trapezius. This fibre overlapping in cross roads of forces, the traction of scapula, via descending part of trapezius passes here and these fibers of thoraco-lumbar fascia which perpetuate the traction of trapezius transmit forces towards contralateral gluteus. Latissimus dorsi muscle stiffness increases the scapular upward rotation & posterior tilt Lower trapezius, one of main primary stabilizers of spine, most prone to weakness and inhibition of it causes over activity of serratus anterior and upper trapezius muscles which draws scapula laterally and upwardly which leads to destabilization of axis of rotation (maintained by lower trapezius), so force couple gets affected leading to alteration in force transmission in patients with low back pain(13,14).

NEED OF THE STUDY: In static scapular assessment one cannot observe the rhythm and premature movement of scapula during arm elevation (flexion & abduction), so dynamic scapular assessment helps to observe abnormal non-smooth and premature scapular movement changes that may occur in LBP subjects due to kinetic chain alterations. Therefore this study aimed to assess the scapular position both at rest and during dynamic movements in NSLBP office workers, which can be helpful to plan a treatment protocol while treating scapular mal-alignment and to prevent further shoulder pathologies in NSLBP office workers and vice versa.

II. METHODOLOGY

Subjects were included on the basis of inclusion and exclusion criteria. All subjects were asked to sign the written consent form stating acceptance to participate in the study. Subjects with LBP and absence of LBP were selected on the basis

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of NPRS. Then Scapular position in NSLBP office workers and in non-low back pain office workers was assessed.

TEST PROCEDURE: - Firstly, scapular position at rest position in office workers with NSLBP was assessed by Lennie test, subjects were asked to expose the area which was going to be assessed i.e. posterior upper thorax area exposed with shoes off. The subject stood in a relaxed position, arms by his/her side. Then the examiner had drawn a spinal midline i.e. straight line from C7 spinous process to midpoint between the posterior superior iliac spines. Red skin markings were made on the right scapula for superior angle, root of spine, inferior angle. Blue skin markings were made on the left scapula for superior angle, root of spine, inferior angle. Red skin markings in correspondence to three markings on right scapula were made over the spinal midline using metric ruler. Blue markings in correspondence to three markings on left scapula were made over the spinal midline using metric ruler. All the markings were done using the marker pens (14, 15).For assessment of scapular position at rest in healthy office workers, same procedure was followed(Fig 1.1).

To assess the scapular position during dynamic movement by Scapular dyskinesis test (SDT), subjects were asked to stand in a relaxed position with arms at the sides, elbows straight, and shoulder in neutral rotation. The participants were instructed to raise both arms above his or her head simultaneously as much as possible in a 2-s period, and then lower the arms for 2 s. The participants performed one series of 8–10 cycles (at least eight and maximum of ten) of flexion, abduction and lowering of the arms with weighted loads based on their body mass. Participants who weighed <68.1 kg and 68.1 kg used 1.5-kg and 2.5-kg dumbbells, respectively. The tester was supposed to stand 2mtrs behind the participants with freedom to move during the test to observe the scapula from any point in the posterior frontal and sagittal planes.

The tester defined the alterations in scapular position on basis of Scapular dyskinesis test (SDT) classification. This SDT classification expresses the degree of alterations in scapular position in three ways i.e. obvious, subtle, and normal.

1.Obvious- Apparent prominence of any portion of the medial border or inferior angle or dysrhythmia, or excessive or premature movement of the scapula during elevation or lowering of the arm
2.Subtle - Questionable evidence of abnormality, inconsistently present.
3.Normal - Absence of projection of the scapula, and upper and lower rotations are smooth and continuous during elevation and lowering of the arm, respectively (16). (Fig 1.2&1.3).

Fig 1.1 Lennies test

Fig 1.2 SDT Flexion

Fig 1.3 SDT Abduction

III. RESULTS

Present study included 2 groups with 70 subjects (case group-35, control group-35), and subjects were allocated into the groups on basis of NPRS. Then the scapular alignment at rest was assessed by using Lennie test at three levels (Superior angle of scapula, root of spine, inferior angle) and the dynamic scapular assessment was done by using scapular dyskinesis test during flexion and abduction movements. The data including demographics and all parameters were recorded on a data collection form and then converted into tabular form. All statistical analysis was performed using the Statistical Package for Social Sciences (SPSSTM) version 20 for Windows and MS-Excel (version 2007) software system.

Descriptive analysis was calculated including means, standard deviation and 95% CI for all tests and measures. Then it was subjected for normality testing and found to be normally distributed in Kolmogorov-Smirnov and Shapiro-Wilk test.

Table 5.1

Age				
Group	N	Mean	Std. Deviation	T
Cases	35	36.686	11.430	.042
Controls	35	36.800	11.512	p=0.967 ns

Table 5.2 describes the gender distribution of (males-27 & females-8) in each group with males constituting 77.1% and females 22.9% in each group. The total no.of males in this study resulted in 54 and females -16.

Gender		Group		Total
		Cases	Controls	
Male	Count %	27 77.1%	27 77.1%	54 77.1%
Female	Count %	8 22.9%	8 22.9%	16 22.9%
Total	Count %within Group	35 100.0%	35 100.0%	70 100.0%

Table 5.4:- Descriptive analysis of BMI

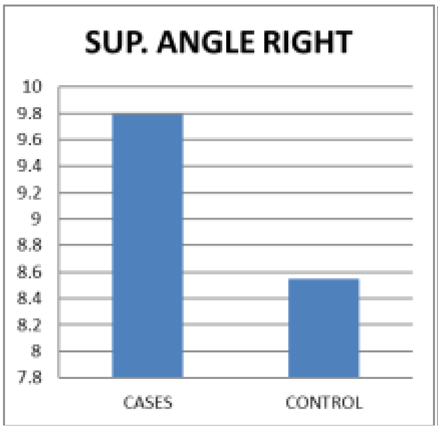
BMI				
Group	N	Mean	Std. Deviation	T
Cases	35	26.120	2.407	.362
Controls	35	25.914	2.344	p=0.718 ns

Table 5.5: Descriptive analysis of NPRS

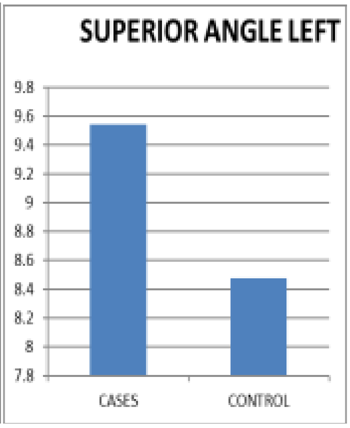
NPRS			
Group	N	Mean	Std. Deviation
Cases	35	4.657	1.211

The comparison between lennie test variables (superior angle of scapula, root of spine of scapula and inferior angle of scapula of case group and control group(both right and left sides)were done by using independent t-test and resulted in very high significant value of $p<0.001$.

Graph 1& Graph 1.2 shows significant differences between superior angle of right side scapula of case & control groups & significant differences between left side scapula superior angle of both groups.

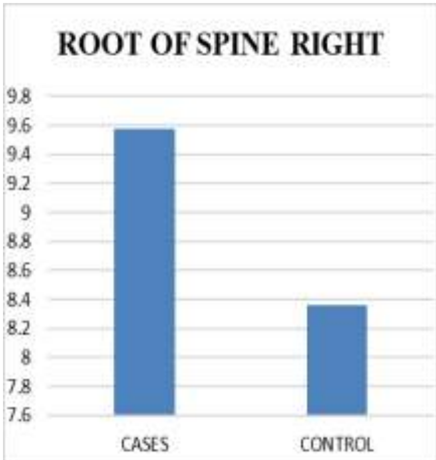


Graph 1

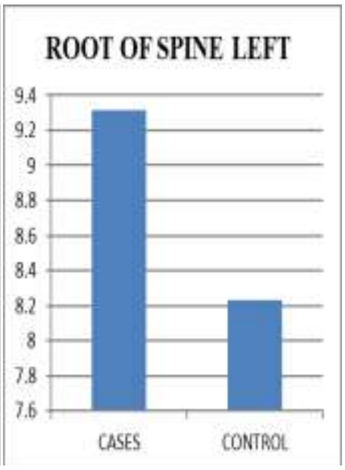


Graph 1.2

Graph 1.3&1.4 shows significant differences in Right scapula root of spine measurements between both case & control groups & significant differences in left side root of spine measurements in between both groups

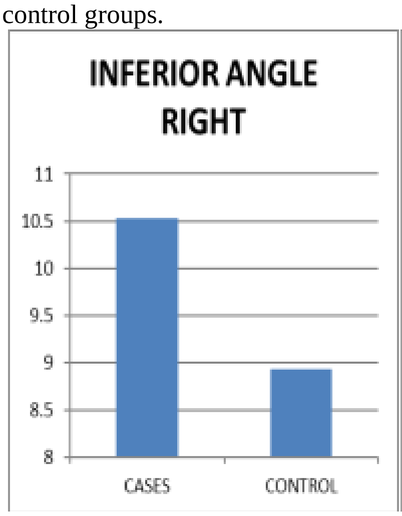


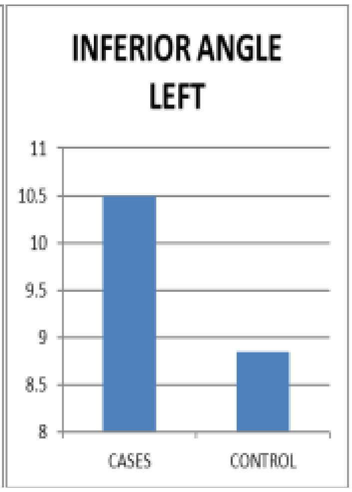
Graph 1.3



Graph 1.4

Graph 1.5 &1.6 shows significant differences of right scapula inferior angle and left scapula inferior angle between both case & control groups.





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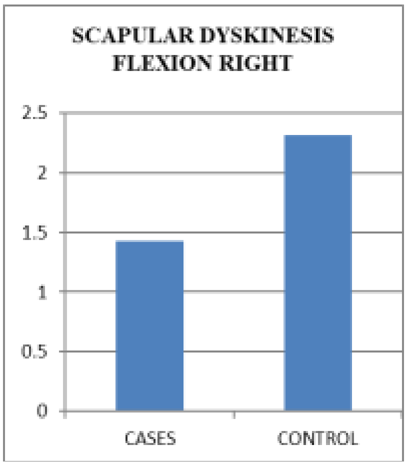
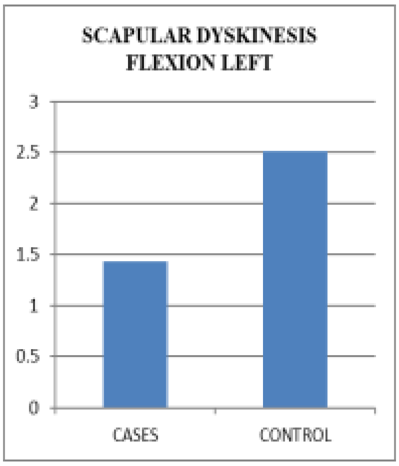
The comparison between SDT variables of case and control group was done by using Mann Whitney U test (Z) and showed very high significant value of p<0.001.

Graph 1.7&1.8 show significant differences in case & control group both on right and left side scapula alignment during flexion movement.

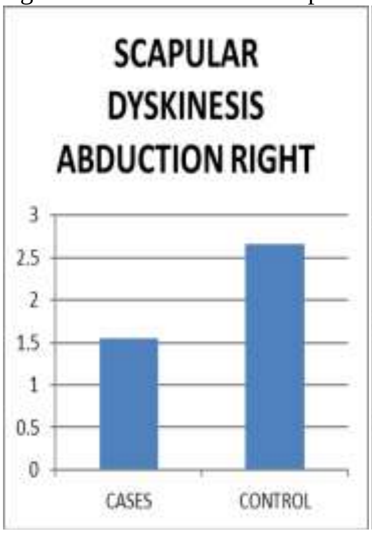


Graph 1.7

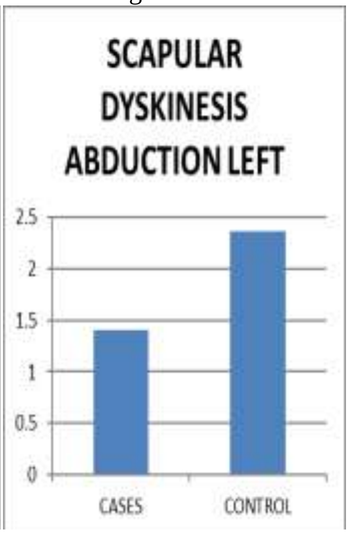


Graph 1.8

Graph 1.9 &1.10 show significant differences in scapular abduction right & left between case & control group.



Graph 1.9



Graph 1.10

IV. DISCUSSION

The purpose of this study was to assess whether there is any effect of LBP on scapula alignment in office workers with NSLBP. Our study included 70 subjects divided into two group's case (with LBP) & control group (without LBP) based on NPRS. The static scapular alignment of bilateral scapula in both case & control group was assessed by using lennie test at three levels (superior angle, root of spine, inferior angle of scapula).

The dynamic scapular alignment of both sides in case & control groups was assessed by using scapular dyskinesis test. The results of SDT were coded as obvious-1, subtle-2,Normal-3.

In present study, while performing lennie test, we got significant differences between case & control group's scapular alignment (Superior angle, root of spine, inferior angle). In line with our study, a study by Rania R. Mohamed et al (2021) revealed that the subjects with chronic LBP have bilateral increased EMG activities of latissimus dorsi muscle and decreased EMG activities of gluteus maximus muscle compared to healthy subjects & this latissimus dorsi muscle's increased activity lead to a difference in the scapular position in patients with chronic LBP.

In our study, we also assessed scapular alignment during dynamic movements (Flexion & abduction). We observed obvious differences during scapula flexion and abduction in scapular dyskinesis test, between case & control group. These results correlate with the results of study by Taghizadeh et al (2017) which stated that the increased latissimus dorsi muscle activation attached to the lower tip of the scapula affects the scapula's upward rotation position. It pulls the inferior tip of the scapula superiorly and laterally during arm elevation (increased upward rotation), which inserts into the humerus. Our study results are also consistent with the study results of Rania R. Mohamed et al (2021) that males with chronic LBP had a bilateral increased scapular upward rotation compared to healthy subjects in different shoulder abduction positions. Since the latissimus dorsi is attached to the inferior border of the scapula, its stiffness affects scapular motion. The latissimus dorsi stiffness increases the upward scapular rotation and posterior tilt; however, scapular internal scapular rotation decreased during humeral elevation.

Office workers spend extended periods in sitting position at work. So, prevalence of LBP has increased gradually in office workers. In chronic NSLBP office workers, there is weakness of lumbar extensors muscles leading to lacking of spinal extensor mobility causing the individual adapt to compensatory kyphotic posture resulting in alterations in muscle activation of thoracic muscles with improper scapular positioning.

V. CONCLUSION

Present study showed significant differences in scapular alignment both at rest & during dynamic movements between case & control groups. So, we conclude that the CLBP subjects will be having altered scapular kinetics both at rest & during dynamic movements. Based on findings of our study we recommend maintaining good posture while sitting in the offices to prevent future pain and musculoskeletal dysfunctions.

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