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Original Article

Sagittal Alignment of the Spine in Standing Posture and the Association between Neck and Shoulder Pain in Younger Generation of India

Madan Singh Choudhary[1], Pawan kumar Goyal[2], Ajay Pant[3]
[1]Associate Profesor, [3]Professor & Head, Department of Orthopaedics, TMMCRC, Moradabad, UP, India.
[2]Specialist, Department of Orthopaedics, SMS Medical College & Hospital, Jaipur, Rajasthan, India.

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***Correspondence to:**
Dr. Madan S Choudhary
Associate Profesor,
Department of Orthopaedics,
TMMCRC,
Moradabad, UP, India.

ABSTRACT

Introduction: Pain from the shoulder and neck region now seems to occur more frequently. The Aim of this study was to investigate the relationship between chronic neck and shoulder pain and spinal alignment in younger individuals.

Methods: A total of 96 subjects agreed to participate in this study, in which 62 males and 34 were females. By the visual analogue scale (VAS), chronic neck and shoulder pain was measured, and the location of pain was identified. The sagittal alignment of the spine was assessed by the Spinal Mouse (Idiag, Volketswil, Switzerland) in a standing posture. Comparisons between two groups were performed by Student t-test. $p < 0.05$ were defined as statistically significant value.

Results: The mean value of the angle of thoracic kyphosis was 27.1 ± 3.9 in normal group and 32.1 ± 7.0 in pain group, The mean value of angle of lumber lordosis, Sacral/hip angle and angle of inclination was 29.1 ± 6.2, 17.9 ± 4.7, 3.4 ± 2.3 respectively in normal group. The mean value of lumber lordosis was 27.6 ± 4.9, Sacral and hip angle was 19.2 ± 4.8 and inclination was 2.9 ± 2.4 in pain group. The pain group showed significant increases in Thoracic kyphosis (TK) and Lumber lordosis (LL).

Conclusion: Thoracic kyphosis angles and lumbar lordosis angles in a standing posture were significantly larger in the pain group than in the normal group among the younger generation. Thoracic kyphosis (TK) showed significant difference between two groups who felt pain above the scapula and pain at the interscapular area.

KEYWORDS: Chronic Neck and Shoulder Pain, Sagittal Alignment of the Spine, Thoracic Kyphosis, Lumber Lordosis.

INTRODUCTION

One of the most common complaint of the patient seeking medical care is pain, and it has been recognized by the World Health Organization (WHO) as a problem of global importance.[1] These days there are common complain of Neck and shoulder pain in the clinical settings. Neck pain and shoulder pain are the conditions called "Katakori" in the Japanese. Pain from the shoulder and neck region now seems to occur more frequently.[2,3] The prevalence of shoulder-neck symptoms is highest in the 45–65 year age bracket, as well as among women, manual workers, and certain ethnic groups.[4] The pain is sometime assumed to be related to muscular tenderness rather than serious chronic disease. A characteristic of this disease is that both young and old individuals are affected; thus, something other than age must have a significant impact on its development. Takasawa et al. reported that the prevalence of neck and shoulder pain in the Japanese general population was 48.3% according to the data of medical checkups for the general population.[5] Yoshimura et al. surveyed the prevalence of motor system organs and reported that the prevalence of low back pain in the Japanese general population was 37.7 %.[6]

The sagittal alignment of the spine is thought to be one of the most important factors that influence disorders around the neck and shoulder.[7-11] The reciprocal curvature of the spine in sagittal alignment allows for efficient absorption of the loads applied to the spinal column and increases the efficiency of the spinal musculature.[12]

A slouched posture significantly reduces scapular upward rotation in arm elevation.[9,11,13,14] On the other hand, some researchers reported the association of body composition with musculoskeletal pain, and they demonstrated that a greater fat mass and an attenuated muscle mass as body composition factors are associated with musculoskeletal pain.[15-18]

However, there are no reports concerning the relationship between chronic neck and shoulder pain and spinal alignment in younger individuals. The purpose of this study was to investigate the relationship between chronic neck and shoulder pain and the sagittal alignment of the spine in a standing posture before the appearance of apparent degenerative change in spinal alignment.

MATERIALS AND METHODS

A total of 96 subjects agreed to participate in this study, in which 62 were males and 34 females. The study comprises two groups: Group 1 were healthy individuals and the subjects of group 2 suffered from pain. Group 1 consists of 34 subjects in which 20 were male and 14 were female. Group 2 (Pain group) consist 62 subjects in which 22 were male and 40 were female. All were volunteers and did not meet the following exclusion criteria: limitation of passive range of motion in the shoulder, symptoms of cervical radiculopathy, and history of injury around the shoulder and spine detected prior to or during this study. This study was conducted prospectively at the general outpatient clinic of the Department of Orthopedics, in Teerthanker Mahaveer Medical College and Research Centre, Moradabad, UP, India. Written informed consent were taken from all the volunteers. The protocol for this study was approved by institutional ethical committee.

All participants were healthy adults between the age group of 20 to 30 years.

By the visual analogue scale (VAS), chronic neck and shoulder pain was measured, and the location of pain was identified. The sagittal alignment of the spine was assessed by the Spinal Mouse (Idiag, Volketswil, Switzerland) in a standing posture.

By visual analogue scale (VAS), score of pain were rated from 0 to 100 in all subjects, where 0 signify no pain and 100 indicating the worst possible pain. The Subjects were divided into two groups, normal group and pain group by VAS results. The VAS score of the normal group was 0, and other results were included in the pain group. Subjects with a VAS score of 0 confirmed that they had not felt pain for >1 month. The location of pain was classified in accordance with the JOA Katakori project.[19] In this report, the location was divided into the following four places: neck, above the scapula, interscapular area, and on the scapula Fig 1.

Fig 1: The location of neck and shoulder stiffness classified in accordance with the JOA Katakori project.[20] In this report, the location was divided into the following four places: 1: Neck, 2: Above the scapula, 3: Interscapular area, and 4: On the scapula.

Measures of sagittal spinal alignment were made using the Spinal Mouse For each person, sagittal spinal alignment and intersegmental angles were measured by a hand-held, computer- assisted electromechanical device that noninvasively measures. Many authors have reported the reliability of assessment of sagittal alignment of the spine with the use of the Spinal Mouse.[21,22] The subject was asked to attain a natural standing position. The Spinal Mouse was run paravertebrally along the spinal column from C7 to S3.

Raw Spinal Mouse measurement data were the superficial back length from C7 to S3 and the local angle of each point of this length relative to the plumb line. In this manner, 17 segments (Th1/2 to L5/S1) were evaluated; inclination of the spine, and the hip/sacral angle were calculated. Thoracic kyphosis angle (TK) and lumbar lordosis angle (LL) are measured by the accordance with Vialle et al., based on the graphic demonstration of the Spinal Mouse.[23] TK was reported as the angle between the cranial end plate of T4 and the caudal end plate of the transitional vertebra located at the junction of the thoracic kyphosis and lumbar lordosis. LL was the angle between the cranial end plate of the transitional vertebra and the cranial end plate of S1.[23] In this study; we drew the tangential line to upper thoracic line and the transitional line to measure TK, and drew the tangential line to the transitional line and L5/S1 to measure LL.

The following six angles were compared between the normal and pain groups and between genders: TK, LL, inclination, and hip/sacral angle. These six angles were also compared by gender and between groups and were divided by the result of VAS at each location of pain. The correlation between VAS and each angle was then assessed.

Statistical Analysis

Statistical analysis of results was performed using SPSS software. Comparisons between two groups were performed by Student t-test. $p < 0.05$ were defined as statistically significant value.

RESULTS

The study comprises two groups: Group 1 were healthy individuals and the subjects of group 2 suffered from pain. Group 1 consists of 34 subjects in which 20 were male and 14 were female. Group 2 (Pain group) consist 62 subjects in which 22 were male and 40 were female. The average age at the time of the investigation was 27.8 ± 6.7 years. There was no significant difference in age.

Table 1 showed each angle between normal and pain group. The mean value of the angle of thoracic kyphosis was 27.1 ± 3.9 in normal group and 32.1 ± 7.0 in pain group, The mean value of angle of lumber lardosis, Sacral/hip angle and angle of inclination was 29.1 ± 6.2, 17.9 ± 4.7, 3.4 ± 2.3 respectively in normal group. The mean value of lumber lardosis was 27.6 ± 4.9, Sacral and hip angle was 19.2 ± 4.8 and inclination was 2.9 ± 2.4 in pain group.(Fig 2) The pain group showed significant increases in Thoracic kyphosis (TK) and Lumber lordosis (LL). TK and LL show the angles of thoracic kyphosis and lumber lordosis which measured in accordance with Vialle et al.[23] There was no statistically significant difference in lumber lardosis sacral/hip angle and inclination in normal and pain group.

Table 1: Angles between normal and pain group.

	Normal Group (n=34) (Group 1)	Pain Group (n=62) (Group 2)	*p* value
Thoracic kyphosis	27.1 ± 3.9	32.1 ± 7.0	0.0002
Lumber lordosis.	28.2 ± 2.8	27.6 ± 4.9	0.51
Sacral/hip angle	17.1 ± 9.1	19.2 ± 4.8	0.14
Inclination	2.7 ± 3.9	2.9 ± 2.4	0.75

Table 2: Angles between genders.

	Female (n=54)	Male (n=42)	*p* value
Thoracic kyphosis	30.4 ± 6.9	29.3 ± 5.3	0.39
Lumber lordosis.	29.1 ± 6.2	27.3 ± 4.1	0.10
Sacral/hip angle	17.9 ± 4.7	18.1 ± 5.2	0.37
Inclination	3.4 ± 2.3	3.9 ± 2.1	0.27

Table 3: Angles between normal and neck pain group

Neck Pain	Normal Group (n=34) (Group 1)	Pain Group (n=38) (Group 2)	*p* value
Thoracic kyphosis	27.1 ± 3.9	30.8 ± 6.9	0.007
Lumber lordosis.	28.2 ± 2.8	29.4 ± 2.1	0.04
Sacral/hip angle	17.1 ± 9.1	17.5 ± 5.9	0.82
Inclination	2.7 ± 3.9	4.0 ± 2.6	0.09

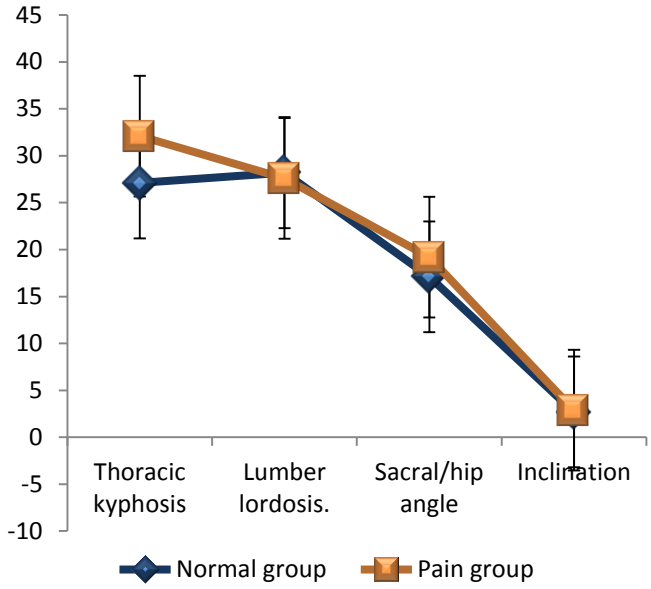

Fig 2: Angles between normal and pain group.

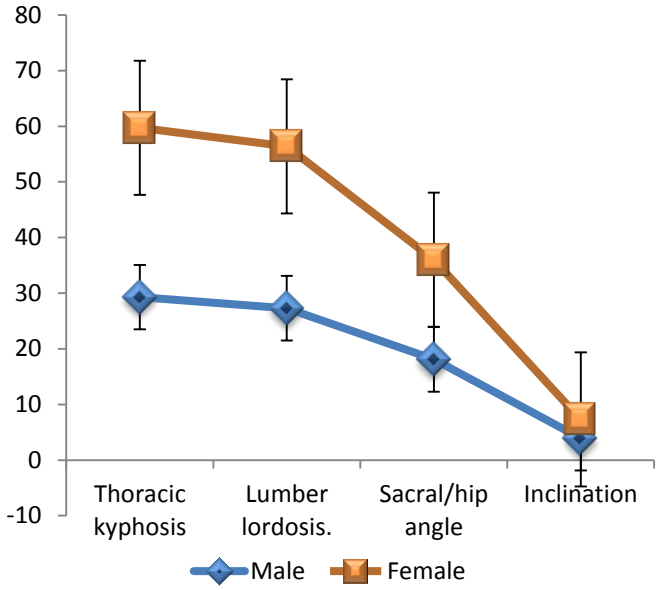

Fig 3: Angles between genders.

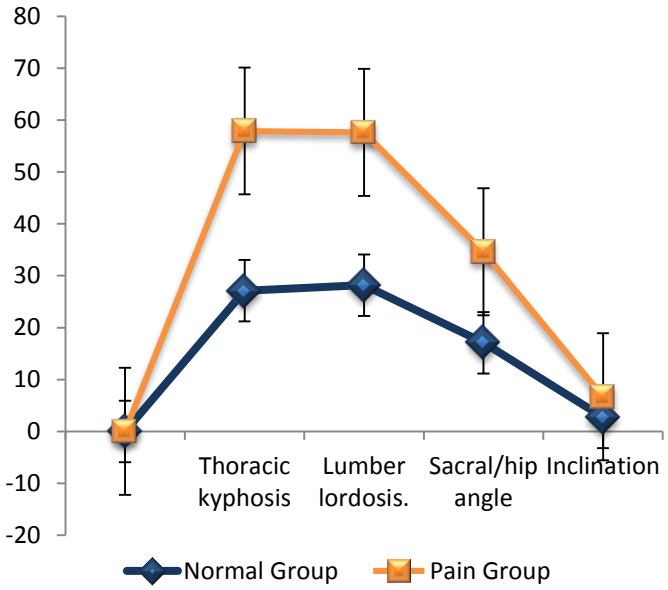

Fig 4: Angles between normal and neck pain group

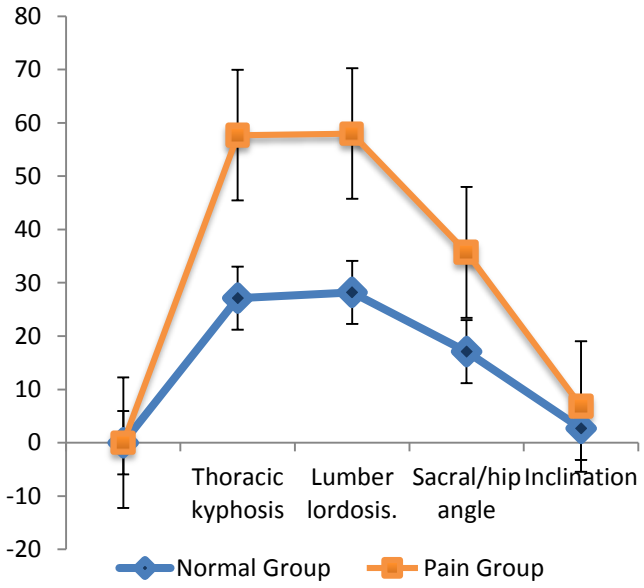

Fig 5: Angles between normal and pain above the scapula.

Table 2, Fig 3 shows the angle between male and females. There was no significant difference in any angle between genders. There was a significant difference in Thoracic kyphosis (TK) (p = 0.0074), and lumber lordosis (LL) (p=0.0421) between normal group and subjects who felt pain in the neck. The mean value of Sacral/hip angle was 17.1± 9.1 in normal group and 17.5 ± 5.9 in pain group. The mean value of angle of inclination was 2.7 ± 3.9 in normal group and 4.0 ± 2.6 in pain group.

There was a no significant difference in Sacral/hip angle and inclination between two groups. (Table 3, Fig 4) In terms of location of pain, 38 subjects felt pain in the neck (3 on the dominant side, 5 on the nondominant side, and 30 on both sides).

Table 4, Fig 5 showed each angle between the subjects who felt pain above the scapula and subjects without pain. There was a significant difference in Thoracic kyphosis (TK) (p = 0.03). There was no significant difference in lumber lordosis, Sacral/hip angle and inclination between two groups. total of 53 subjects felt pain above the scapula (4 on the dominant side, 7 on nondominant side, and 42 on the both sides).

Table 5, Fig 6 showed each angle between the subjects who felt pain at the interscapula and subjects without pain. There was a significant difference in Thoracic kyphosis (TK) (p = 0.01).

There was no significant difference in lumber lordosis, Sacral/hip angle and inclination between two groups. total of 21 subjects felt pain in the interscapular area (1 on the dominant side, 3 on the nondominant side, and 17 on both sides).

Table 4: Angles between normal and pain above the scapula.

Pain above scapula	Normal Group (n=34) (Group 1)	Pain Group (n=53) (Group 2)	*p* value
Thoracic kyphosis	27.1 ± 3.9	30.6 ± 7.9	0.03
Lumber lordosis.	28.2 ± 2.8	29.8 ± 8.5	0.80
Sacral/hip angle	17.1 ± 9.1	18.6 ± 5.1	0.49
Inclination	2.7 ± 3.9	4.1 ± 2.7	0.15

Table 5: Angles between normal and pain at the interscapula.

Pain at the inter-scapula	Normal Group (n=34) (Group 1)	Pain Group (n=21) (Group 2)	*p* value (*β* value)
Thoracic kyphosis	27.1 ± 3.9	31.3 ± 9.7	0.01
Lumber Lardosis	28.2 ± 2.8	28.8 ± 7.8	0.66
Sacral/hip angle	17.1 ± 9.1	19.1 ± 9.1	0.32
Inclination	2.7 ± 3.9	3.7 ± 2.9	0.17

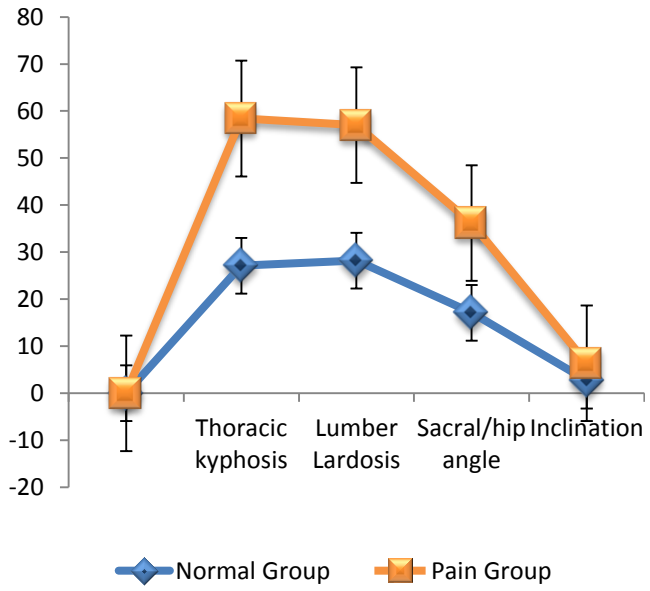

Fig 6: Angles between normal and pain at the interscapula

DISCUSSION

In the present study we found the mean value of the angle of thoracic kyphosis was 27.1 ± 3.9 in normal group and 32.1 ± 7.0 in pain group, The mean value of angle of lumber lordosis, Sacral/hip angle and angle of inclination was 29.1 ± 6.2, 17.9 ± 4.7, 3.4 ± 2.3 respectively in normal group. The mean value of lumber lordosis was 27.6 ± 4.9,Sacral and hip angle was 19.2 ± 4.8 and inclination was 2.9 ± 2.4 in pain group. The pain group showed significant increases in Thoracic kyphosis (TK) and Lumber lordosis (LL). There was no statistically significant difference in lumber lordosis sacral/hip angle and inclination in normal and pain group. There was no significant difference in any angle between genders. There was a significant difference in Thoracic kyphosis (TK) (p = 0.0074), and lumber lordosis (LL) (p=0.0421) between normal group and subjects who felt pain in the neck but no significant difference in Sacral/hip angle and inclination between two groups. Thoracic kyphosis (TK) showed significant difference between two groups who felt pain above the scapula and pain at the interscapular area.

Regarding neck and shoulder pain in the Japanese population, some associated factors apart from body composition have been previously demonstrated, specifically gender, psychological stress and some types of musculoskeletal pain, to be associated with neck and shoulder pain in Japanese subjects.[24,25] Furthermore, the association between neck and shoulder pain and sagittal spinal alignment has also been reported.[20]

Many papers have reported a relationship between posture and pain and pain around the neck and shoulders.[8,10,11,14,26] However, previous papers have assessed the alignment including in old generation, or have not reported in detail on the location of pain around the neck and shoulders. Ours was the first report to examine the relationship between sagittal spinal alignment and chronic neck and shoulder pain and to classify the location of the pain in younger individuals.

The upper trapezius is an agonist muscle for upward rotation of the scapula, and the levator scapula is an antagonist. Thus, both the levator scapula and upper trapezius could not relax because both muscles pull each other in a forward head position. Both muscles' insertions are located where the subjects felt pain. These biomechanical reports were consistent with our results. Thus, an increase in thoracic kyphosis easily induces chronic neck and shoulder pain. These results suggest that posture correction, especially correction of thoracic kyphosis, is an effective therapy to improve chronic neck and shoulder pain. We need the further study of investing whether the posture correction improves chronic neck and shoulder pain or not.

As we wanted to examine the persistence of neck-shoulder pain, which could be of importance to daily activities and work, we had to make clear and rather restrictive diagnostic criteria to separate them from more diffuse conditions. Shoulder and neck symptoms have

been linked to jobs with highly repetitive work, static work, and work above shoulder level.[27-31] However, mechanical exposure explains only part of these complaints.

Regarding the evaluation of spinal alignment, the SpinalMouse has been reported to be a useful and reliable tool in many papers.[32,33] Particularly in health checkups, the SpinalMouse has proven to be very useful for measuring spinal alignment, considering its cost and the limited time available to perform such measurements.[34] Therefore, we employed the SpinalMouse system to evaluate spinal alignment in this study.

The mobility of the thoracic spine was significantly restricted compared with the mobility of the cervical and lumbar spine. Pain decreases the mobility of the thoracic spine and scapula. Lumbar lordosis compensates for thoracic kyphosis to maintain the posture. Therefore, it is easy for lumbar lordosis to be influenced by pain, and lumbar lordosis thus significantly increased in the pain group.

CONCLUSION

In conclusion; the pain group showed significant increases in Thoracic kyphosis (TK) and Lumber lordosis (LL). There was no statistically significant difference in lumber lordosis sacral/hip angle and inclination in normal and pain group.

There was no significant difference in any angle between genders. Thoracic kyphosis angles and lumbar lordosis angles in a standing posture were significantly larger in the pain group than in the normal group among the younger generation. Thoracic kyphosis (TK) showed significant difference between two groups who felt pain above the scapula and pain at the interscapular area.

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