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STUDY OF CERVICAL SPINE ALIGNMENT IN CERVICAL SPONDYLOSIS

Orthopaedics

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ABSTRACT

Introduction: The relationship between cervical spine alignment and spondylosis is debatable. This study will examine radiographic parameters linked with cervical spine alignment in healthy volunteers and cervical spondylosis patients to see if alignment affects the disease. **Methods:** A tertiary care hospital in New Delhi did an observational cross-sectional study to compare cervical spine sagittal alignment in cervical spondylosis and healthy individuals. A hundred cervical spondylosis patients and 100 healthy volunteers had lateral cervical spine radiographs with the neck neutral. Measurements and statistical analysis were made for the desired radiographic parameters. **Results:** The mean Occiput-C2 Angle, Cobbs angle, Saggital vertical alignment and C7 slope in healthy volunteers were 17.2 ± 9.7°, 11.7± 3.5°, 8.5± 2.6 mm, and 16.2± 2.8° respectively whereas in Cervical Spondylosis group it was 30.8 ± 7.1°, 12.4± 5.6°, 7± 3.7mm, and 18.2± 3.9° respectively. O-C2 angle and C7 slope were substantially higher in cervical Spondylosis patients. SVA was much greater in healthy people. **Conclusion:** The study presents normative cervical spine alignment data for Indians, which should be addressed while performing cervical spine procedures.

KEYWORDS

Cervical Spondylosis, spine alignment

INTRODUCTION

In orthopaedic outpatient departments, non-traumatic neck pain is common. In middle and later age, cervical spondylosis causes persistent neck pain.

Age-related anomalies in the functional spinal unit (two neighbouring vertebrae and the disc in between) are called cervical spondylosis. As discs degrade, their mechanical characteristics disappear. Facet joints are stressed and unstable, and uncovertebral joints become arthritic, causing neck pain and stiffness.

Patients usually report prolonged neck pain after postural steadiness and sporadic quiescence after 40. Neck pain often causes arm, forearm, and finger numbness and tingling. Radiation from neck to occiput, medial scapular pain, or low back pain with stiffness may occur. More severe disease causes myelopathy with neurological impairments, upper and lower limb paralysis, and bladder bowel involvement.

X-rays, computed tomography, magnetic resonance imaging, and myelography help diagnose the narrowing of one or more intervertebral spaces and bony spur formation at the disc's anterior and posterior margins, the disc osteophyte complex. Most changes occur in C5-C6 and C6-C7.[1]

Normative data on cervical spine alignment and its correlation with cervical spondylosis is scarce, and no study has been done in the Indian population. Thus, this study will examine radiographic characteristics linked with cervical spine alignment in healthy volunteers and cervical Spondylosis patients to see if alignment affects the condition.

METHOD AND MATERIAL

An observational cross-sectional study was conducted at a tertiary care hospital in New Delhi, after the Institutional Ethics Committee approval. History and radiography were used to assess orthopaedic OPD patients with neck discomfort over three months for cervical Spondylosis. The study included 100 cervical spondylosis patients over the age of 40 with informed consent. The study also included 100 age-matched people without neck pain following informed consent. Patients with previous spine surgery, spinal trauma within three months, and spine deformity were excluded from the study.

For an accurate cervical spine lateral X-ray, the patient stood upright and comfortable with their hands tied to 2 kg weights. Lateral cervical spine X-rays from the base of the skull to the upper chest with the patient gazing forward were obtained. For all exposures, the radiographic film had square horizontal and vertical margins and a 180 cm distance from the source. The films were scanned with a commercial optical scanner. A specialized computer program measured angles and lengths. The same three people saw the radiographic film to reduce interobserver bias.

Various cervical radiographic parameters measured:

1. **Occipital-C2 Angle:** An angle subtended by McGregor line of sight and a parallel line along the inferior endplate of C2 (Figure 1).

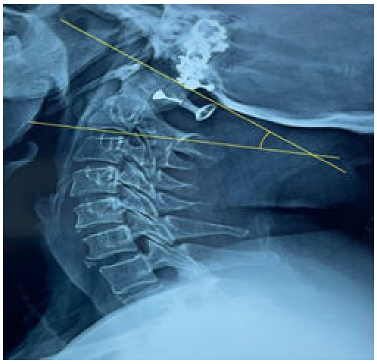

Figure 1: Occipital-C2 Angle

2. **C2-C7 Cobbs Angle:** Draw a line along the C2 vertebrae's inferior end plate and another parallel to the C7 vertebrae's inferior end plate, draw a perpendicular to them, and record the angle of the junction (Figure 2).

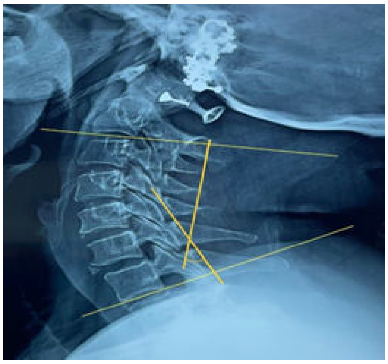

Figure 2: C2-C7 Cobbs Angle

3. **C7 Slope:** Measure the angle between a line parallel to the C7 vertebrae's inferior end plate and the horizontal (Figure 3).

Figure 3: C7 Slope

4. **Sagittal Vertical Alignment (SVA):** the vertical line between Dens's midpoint and C7 vertebrae's posterosuperior cortex (Figure 4).

Figure 4: Sagittal Vertical Alignment

All radiographic parameters were assessed three times and the average was calculated. The data was entered into Microsoft Excel for analysis and statistical evaluation was done using SPSS-21. The sample size was computed with 95% confidence and 80% power. The Kolmogorov-Smirnov test determined normality. Quantitative data was represented by mean (Standard deviation) or median (range), and Student t-test or Mann-Whitney U test were used to test the differences. Qualitative data was expressed in frequency percentage and tested by Chi-Square or Fischer's exact test. p-value below 0.05 was considered significant.

RESULTS

Two groups of hundred willing volunteers were studied.
Group A: Cervical Spondylosis patients.
Group B: Healthy age-matched persons.

Gender Distribution

The study included 116 (58%) men and 84 (42%) women. Group A included 62% men and 38% women, while Group B had 54% men and 46% women. Gender did not affect cervical spondylosis ($p > 0.05$).

Age Distribution

The study group A's mean age was 57.3±9.7 years, while group B's mean age was 59.3±9.7 years. Kolmogorov-Smirnov test showed non-normal distribution. Therefore, the median (IQR) and Mann Whitney test were utilized. Age did not significantly affect cervical spondylosis ($p > 0.05$).

Radiographic Parameters

The radiographic parameter median distribution in both groups was determined and shown in Table 1.

Cervical Spondylosis patients (Group A) exhibited considerably larger O-C2 angle and C7 slope compared to healthy volunteers ($p<0.05$), while healthy volunteers had higher SVA ($p<0.05$).

Table 1: Median distribution of radiographic parameters.

Variable	Patients of Cervical Spondylosis (Group A)		Healthy volunteers (Group B)		P value
	Median	Inter Quartile Range(IQR)	Median	Inter Quartile Range(IQR)	
O-C2 Angle	30	27,38.9	17.5	14.3,20	<0.001
C2-C7 Cobbs	12	8,15.4	12	9,15	0.585
C7 slope	18	16,20	16	14,18	<0.001
SVA	7	4.3,8	8	7,10	<0.001

DISCUSSION

Standard cervical spine alignment data can help in preoperative planning for patients undergoing cervical spine surgery, as their deviation from average values postoperatively can help the surgeon manage postoperative complications.[2] Current cervical spine surgery goals include restoring normal alignment, reducing discomfort, and increasing neurological function. The literature recommends horizontal gaze, C2-C7 Cobbs Angle (CL) less than 15 degrees, and SVA less than 40mm.[3,4]

Thus, preoperative radiographic evaluation and goal setting for postoperative alignment parameters are essential in cervical spine surgeries like ACDF, ACCF, and Occipito-cervical fusion. In fusion surgery, the dimensions of the bone graft and the cervical spine alignment may affect the outcome and require extensive follow-up studies, the start of which is still to establish normative data.

However, upright lateral cervical spine X-rays may not match intra-operative fluoroscopic pictures taken supine.

The 100 cervical Spondylosis patients in our study were 62% male and 38% female. The gender gap in healthcare access and our study's limited sample size may explain this representation. Several research have examined how age affects cervical spine alignment, but we found no statistical significance.

Our study indicated that patients with cervical Spondylosis had a median O-C2 angle of 30°, significantly higher ($p < 0.001$) than the healthy group (17.5°). Cervical Spondylosis and a greater O-C2 angle, may be caused by sub-axial cervical spine alterations. Sherekar et al. discovered that the mean O-C2 angle in 518 healthy Indian volunteers was 14.66±9.5° in males and 15.59±8.26° in females.[5] Spondylotic patients had a median C2-C7 angle of 12°, similar to healthy people. The cervical Spondylosis CL, thought to be hypo-lordotic or kyphotic, was remarkably identical to the healthy population. Thus, the question of whether CL is linked to cervical Spondylosis remains open. Asymptomatic patients have segmental kyphotic curves.[6] Lee et al. found hypo-lordotic cervical spines in 60.2% (109/131) of asymptomatic patients, including 40% with kyphosis.[7] The tiny sample size may explain this observation. According to Sherekar et al., the C2-C7 value in healthy Indians is 16.8 + 12.7" in males and 9.11+ 10.4° in females.[5] In our investigation, the spondylotic group showed a substantially higher C7 slope (18°) than the healthy population (16°). Changes in cervical alignment are more strongly associated with cervical spondylosis at the extremes of the cervical spine, with the C2-C7 cervical lordosis being almost identical to that of the healthy population, even though cervical Spondylosis alterations mostly affect the C5-C6 area. This shows that cervical spondylosis maintains the CL through Occipito-cervical and cervico-thoracic junction alignment alterations.

We chose the C7 slope over the Tl slope in our investigation because it is easier to measure on a plain radiograph and their equiprobability is well known.[8]

The healthy population had a considerably greater SVA (8mm) ($p < 0.001$) than the spondylotic group (7mm). SVA and parameter relationships need further study. Hey et al. found an 8.8mm SVA in healthy people.[9]

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Emphasising again, "normal" cervical position is still debated. Varied populations may have varied values due to factors like build, work, and exercise levels, and the results may not correlate well. As the first study in India to link cervical spine position to cervical spondylosis, it illuminates a large area of spine surgery research.

CONCLUSION

By examining the results and statistics, we found that cervical Spondylosis patients had considerably larger O-C2 angle and C7 slope than healthy volunteers. In contrast, healthy people had far greater SVA. No significant correlation was found between cervical Spondylosis and C2-C7 angle. This study also established Indian normative data for key radiographic parameters. The correlation between cervical spine alignment and age or sex in healthy volunteers was not significant. The mean Occiput-C2 Angle, Cobbs angle, Saggital vertical alignment and C7 slope in healthy volunteers were 17.2 ± 9.7°, 11.7± 3.5°, 8.5± 2.6 mm, and 16.2± 2.8° respectively whereas in Cervical Spondylosis group it was 30.8 ± 7.1°, 12.4± 5.6°, 7± 3.7mm, and 18.2± 3.9°.

Conflict Of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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