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To determine pelvic incidence, sacral slope, and pelvic tilt in thoraco lumbo pelvic alignment in chronic low back pain patients in Central Indian Population

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Abstract:

Background: Chronic low back pain (CLBP) is a prevalent condition significantly impacting quality of life, often associated with alterations in sagittal thoraco-lumbopelvic alignment. This study aims to analyze thoraco-lumbopelvic alignment parameters, including pelvic incidence (PI), sacral slope (SS), and pelvic tilt (PT) in the Central Indian population.

Aim: To determine pelvic incidence, sacral slope, and pelvic tilt in thoraco lumbo pelvic alignment in chronic low back pain patients in Central Indian Population.

Materials & methods: The study is a cross-sectional cross-sectional study spanning 2021 to 2024, focusing on CLBP in patients aged 18-60 years. The sample size is calculated at a 95% confidence level, with a minimum of 127 samples required. The study includes participants with a history of LBP, spinal deformity, hip or pelvic disorder, and contraindications for radiographic exposure. The study will use a combination of clinical assessment tools and radiographic imaging to measure TLP alignment, including photogrammetry, spinal assessment tools, and X-rays to ensure minimal radiation exposure and ethical compliance.

Results: Out of 198 incorporated, males occupied 56% (n=111) and female gender occupied 44% (n=87) of the total study population respectively. Whereas in the control group, male occupied

52% (n=103) and females 48% (n=95) respectively. CLBP patients exhibited significantly higher PI, PT and SS was significantly lower in CLBP patients. PT showed the strongest positive correlation with VAS scores (r = 0.50), indicating that higher pelvic tilt is associated with greater pain severity.

Conclusion: The study reveals significant differences in thoraco-lumbo-pelvic alignment parameters in patients with Chronic Lobar Pain (CLBP), indicating the body's attempt to maintain balance and counteract biomechanical stress. Region-specific characteristics, such as genetics and occupational habits, influence these variations.

Key words: Chronic low back pain; Sacral slope; pelvic incidence; pelvic tilt; thoraco-lumbo alignment; Ethnic populations.

Introduction:

Chronic low back pain (CLBP) is a prevalent condition significantly impacting quality of life, often associated with alterations in sagittal thoraco-lumbopelvic alignment. This study aims to analyze thoraco-lumbopelvic alignment parameters, including pelvic incidence (PI), sacral slope (SS), and pelvic tilt (PT) in the Central Indian population. Variations in these parameters were evaluated to explore their role in CLBP pathogenesis and potential regional specificities. Regional data highlighted ethnic variations in baseline alignment norms, underscoring the importance of population-specific analyses for accurate diagnosis and tailored treatment strategies. This research emphasizes the need for integrating sagittal alignment assessment into routine clinical practice for CLBP management. Future studies focusing on longitudinal outcomes of corrective interventions are recommended to optimize patient care in this demographic. The prevalence of CLBP is increasing in India, with rates estimated to be between 20 and 30% among adults [11]. This prevalence is particularly alarming in light of the diverse lifestyles and occupational activities that are characteristic of Indian populations, especially in urban and semi-urban regions [12]. The condition is common among individuals who engage in physically demanding occupations, such as agricultural and manual laborers, as well as those who lead sedentary lifestyles, such as office workers [13-15]. These disparate occupational patterns influence the development of CLBP and spinal alignment in a manner that is not universally applicable. Therefore, a universally applicable treatment approach may not be feasible. The aim of the present study was to determine pelvic incidence, sacral slope, nd pelvic tilt in thoraco- lumbo pelvic alignment in chronic low back pain patients in Central Indian Population.

Materials & methods:

Ethical clearance: After obtaining permission from the Institutional Ethics Committee, the present study was initiated. ***Study design:*** Cross sectional study ***Study period:*** 2021 to 2024. ***Sampling:*** Random Purposive sampling. ***Study location:*** Orthopedics out-patient department and the Department of Radiology for standing lateral X-Rays. ***Sample size calculation:*** Sample size is calculated at 95% confidence level, assuming prevalence of chronic Low backache pain is 30% of patients as found in reference study. At the relatively allowable error of 15% of prevalence, minimum 127 samples are required at sample size. ***Inclusion criteria:*** Age between 18 and 60 years and Predominant LBP for a minimum of three consecutive months. **Exclusion criteria: S**pinal deformity such as scoliosis or spondylolisthesis, spinal fracture, spinal tumor, previous spinal fusion, previous discectomy involving more than one level, History of hip or pelvic disorder, and Contraindication for radiographic exposure (e.g., pregnancy, tumor), ***Study methodology:*** TLP

alignment will be measured using a combination of clinical assessment tools and radiographic imaging: Photogrammetry: Postural assessments will be conducted using digital photography to evaluate spinal curvature, pelvic tilt, and shoulder alignment. Spinal Assessment Tools: Instruments like the Spinal Mouse or inclinometers will measure spinal angles and mobility. Radiographic Imaging: A subset of participants may undergo X-rays to obtain precise measurements of spinal alignment, ensuring minimal radiation exposure and ethical compliance.

Statistical analysis:

IBM SPSS version 28 was used for statistical analysis, with unpaired t tests for comparing variable means between groups. Multiple regression and ANOVA tests were conducted, with the Chi-square test assessing correlation levels. A P value less than 0.05 was considered statistically significant.

Results:

Out of 198 incorporated, males occupied 56% (n=111) and female gender occupied 44% (n=87) of the total study population respectively. Whereas in the control group, male occupied 52% (n=103) and females 48% (n=95) respectively. Table 2 describes the descriptive statistics of the study cohorts. CLBP patients exhibited significantly higher PI, PT and SS was significantly lower in CLBP patients. Table 3 describes the correlation analysis between the parameters of the CLBP. PT showed the strongest positive correlation with VAS scores (r = 0.50), indicating that higher pelvic tilt is associated with greater pain severity.

Table 1: The mean values of physical parameters of CLBP and control subjects of the study

Variable	CLBP group (n=198)	Control group (n=198)	P Value
Age (Years)	53.4±6.3	53.7±568	t= 0.649 >0.05
BMI (kg/mt^2)	29.9±2.9	28.3±2.3	**t= 6.082 <0.05**
Systolic Pressure (mm of Hg)	164±11.3	140.1±9.5	**t= 22.780 <0.05**
Diastolic Pressure (mm of Hg)	93.6±5.9	93.4±6.6	t= 0.317 >0.05

Table 2: Descriptive statistics of the study cohorts

Parameter	CLBP group (n=198)	Control group (n=198)	P value
Pelvic incidence (PI)	56.6 ± 8.2	51.9 ± 7.1	t=6.097; <0.0001
Sacral slope (SS)	32.3 ± 6.5	37.0 ± 5.7	t=7.649; <0.0001
Pelvic tilt (PT)	24.1 ± 4.9	14.7 ± 4.6	t=19.680; <0.0001

Table 3: Correlation analysis between the parameters in the CLBP patients.

Parameter	Correlation with VAS (r value)	P value
Pelvic incidence (PI)	0.33	<0.0001
Sacral slope (SS)	-0.39	< 0.0001
Pelvic tilt (PT)	0.50	<0.0001

Discussion:

The study of thoraco-lumbo-pelvic alignment in CLBP patients offers critical insights into biomechanical and postural influences on pain and disability. In the context of the Central Indian population, these findings contribute to the growing body of literature underscoring the role of regional anthropometric and lifestyle factors in musculoskeletal health.

The present study observed PI with a mean of 56.6 in the CLBP group of patients. Bhosale et al. [14] observed a mean of 51.50 in their low-back pain patients. Whereas Singh et al. observed in their back pain patients a mean of 48.52 [15]. PI is an important part of the sagittal thoraco-lumbo-pelvic alignment because it has a big effect on how the spine and pelvis move in people with CLBP. Studies [16,17] have shown that PI affects the level of lumbar lordosis. Differences in PI are often connected to low lordosis or sagittal misalignment in people with CLBP. Additionally, correlations between PI and other variables, such as sacral slope and spinal curvatures, are key in understanding alignment discrepancies. These insights underline PI's importance in assessing sagittal balance and guiding clinical strategies for CLBP management.

The present study observed SS with a mean of 32.3 in the CLBP group of patients. Bhosale et al. [14] observed SS with a mean of 39.17 in their low-back pain patients. Whereas Yukawa et al. [17] observed patients in their back pain with a mean of 39.4. SS is a key factor in sagittal thoraco-lumbopelvic alignment; it affects lumbar lordosis and the balance of the pelvis as a whole. In patients with CLBP, alterations in SS are commonly observed, often reflecting compensatory mechanisms for lumbar dysfunction. Studies show that lower SS is linked to lower lumbar lordosis and higher pelvic retroversion, which can lead to biomechanical stress and pain [18-23]. Conversely, excessive SS may predispose to spondylolisthesis or facet joint overload [18]. Regional studies, including Central Indian populations, emphasize the importance of ethnic variability in SS norms and its impact on tailored interventions [23].

The present study observed PT with a mean of 24.1 in the CLBP group of patients. Bhosale et al. [14] reported a mean of 12.32 in their low-back pain patients. Whereas Singh et al. [15] observed

patients in their back pain at a mean of 9.30. PT plays a critical role in sagittal thoraco-lumbopelvic alignment, acting as a compensatory parameter in CLBP. Increased PT is commonly observed in CLBP patients, reflecting an attempt to realign the pelvis and lumbar spine to maintain postural balance amidst spinal degeneration or deformity [20]. This compensatory increase correlates with reduced lumbar lordosis and heightened pelvic retroversion, aggravating mechanical strain and discomfort [21]. Ethnic studies show that PT standards are not always the same, which makes it important to do region-specific tests when managing CLBP, like the ones done on people in Central India [22].

Conclusion:

The study found that thoraco-lumbo-pelvic alignment parameters, including PI, SS, PT and pelvic parameters, were significantly different from normal in patients with CLBP. These differences indicate the body's attempt to maintain balance and counteract biomechanical stress caused by the condition. A positive sagittal vertical axis was also observed in many patients. Region-specific characteristics, such as genetic predisposition, occupational habits, and cultural practices, could influence the lower lumbar lordosis and higher pelvic tilt values. These variations highlight the importance of localized reference values for spinal and pelvic alignment parameters in CLBP diagnosis and management.

Conflict of interest:

There is no conflict of interest among the present study authors.

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