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Research Article

To determine lumbar lordosis and thoracic kyphosis in thoraco lumbo pelvic alignment in chronic low back pain patients in Central Indian Population

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Abstract:

Background: Alterations in sagittal thoraco-lumbopelvic alignment are frequently linked to chronic low back pain (CLBP), a common disorder that greatly affects quality of life. The purpose of this research is to examine lumbar lordosis and thoracic kyphosis, two measures of thoraco-lumbopelvic alignment, in people living in Central India. **Aim:** To determine lumbar lordosis and thoracic kyphosis in thoraco lumbo pelvic alignment in chronic low back pain patients in Central Indian Population. **Materials & methods:** Patients with CLBP between the ages of 18 and 60 will be the focus of this cross-sectional study, which will run from 2021 through 2024. A minimum of 127 samples are needed to compute the sample size at a 95% confidence level. Those who have a history of low back pain, spinal deformity, hip or pelvic disease, or any condition that would prevent them from being exposed to radiation are eligible to participate in the study. To determine TLP alignment, the study will use a mix of radiographic imaging and clinical evaluation methods, such as photogrammetry and spinal assessment tools, with the goal of minimizing radiation exposure and ensuring ethical compliance. **Results:** Males comprised 56% (n=111) and females comprised 44% (n=87) of the total sample population, out of 198 incorporated. In contrast, the control group was composed of 52% males (n=103) and 48% females (n=95). 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 highlights the impact of lumbar lordosis and thoracic kyphosis on thoraco-lumbo-pelvic alignment in Central Indian patients with cervical back pain (CLBP). It emphasizes the importance of assessing sagittal spinal curves for optimal diagnosis and treatment planning.

Key words: Chronic low back pain; lumbar lordosis; pelvic tilt; thoraco-lumbo alignment; Ethnic populations.

Introduction:

Chronic low back pain (CLBP) is a prevalent condition that significantly impacts the quality of life and functional capabilities of affected individuals. It is often linked to abnormalities in the alignment of the thoraco-lumbo-pelvic (TLP) region, a biomechanical unit that plays a pivotal role in maintaining upright posture and ensuring efficient locomotion [1-5]. Lumbar lordosis and thoracic kyphosis, as key components of spinal curvature, are critical determinants of spinal alignment and mechanical stability. Variations in these curvatures are frequently implicated in the

pathophysiology of CLBP, necessitating a thorough understanding of their interrelationships within the TLP alignment framework [6-8].

The Central Indian population represents a unique demographic with potentially distinct spinal morphometric characteristics influenced by genetic, environmental, and lifestyle factors [2]. Studies on spinal alignment in specific regional populations are essential to establish normative data and identify deviations associated with pathological conditions [3,4]. While significant research has been conducted on thoraco-lumbo-pelvic alignment in Western and Asian populations, there is limited data pertaining to the Central Indian demographic [5]. This gap highlights the need for region-specific investigations to better understand the variations in lumbar lordosis and thoracic kyphosis and their correlation with CLBP. The aim of the present study was to determine lumbar lordosis and thoracic kyphosis in thoraco lumbo pelvic alignment in chronic low back pain patients in Central Indian Population.

Materials & methods: The present investigation was initiated after the Institutional Ethics Committee granted permission. Cross-sectional research design Duration of study: 2021 to 2024. Random Purposive Sampling. Study location: The Department of Radiology and the Orthopedics out-patient department for standing lateral X-rays. Calculation of the sample size: The sample size is determined at a 95% confidence level, based on the assumption that the prevalence of chronic low lumbar pain is 30% of patients, as indicated in the reference study. A minimum of 127 samples is necessary to achieve a sample size with a relatively allowable error of 15% of prevalence. Inclusion criteria: Predominant low back pain for a minimum of three consecutive months and an age between 18 and 60 years. Spinal 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 dysfunction, and contraindication for radiographic exposure (e.g., pregnancy, tumor). Methodology of investigation: A combination of clinical assessment instruments and radiographic imaging will be employed to measure TLP alignment: Photogrammetry: Digital photography will be employed to conduct postural assessments, which will evaluate shoulder alignment, pelvis tilt, and spinal curvature. Spinal Assessment Tools: Instruments such as the Spinal Mouse or inclinometers are used to measure spinal angles and mobility. Radiographic Imaging: In order to guarantee minimal radiation exposure and ethical compliance, a subset of participants may be subjected to X-rays to obtain precise measurements of spinal alignment.

Statistical analysis:

For the statistical analysis, IBM SPSS version 28 was utilized. To compare the means of the variables between the groups, unpaired tests were employed. We tested for correlation using the Chi-square test and ran multiple regression and analysis of variance. For statistical purposes, a P value below 0.05 was deemed significant.

Results:

Males comprised 56% (n=111) and females comprised 44% (n=87) of the total sample population, out of 198 incorporated. In contrast, the control group was composed of 52% males (n=103) and 48% females (n=95).

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 LL with a mean of 41.5 in the CLBP group of patients. Cho et al., [9] observed a mean of 48.3 in their low-back pain patients. Whereas Yukawa et al., [10] observed in their back pain patients a mean of 49.7. LL is a key parameter in sagittal thoraco-lumbopelvic alignment and significantly impacts CLBP. Reduced LL is frequently observed in CLBP patients and is associated with increased pelvic retroversion and pelvic tilt as compensatory mechanisms to maintain sagittal balance [11]. Excessive or hypo-lordosis alters the load distribution across spinal structures, leading to mechanical stress, disc degeneration, and facet joint dysfunction [12]. Studies in specific populations, such as Central Indians, underscore regional variations in LL norms, influencing diagnostic thresholds and treatment strategies for CLBP [10].

The present study observed TK with a mean of 38.4 in the CLBP group. Cho et al.,[9] in their study observed TK with a mean of 28.6 in low back pain patients, whereas Yukawa et al., [10] observed in their study with a mean of 36.0 in their back pain patients. TK significantly influences sagittal thoraco-lumbopelvic alignment and is closely associated with CLBP [13]. Increased or exaggerated TK can disrupt spinal balance, leading to compensatory adjustments such as reduced lumbar lordosis and increased pelvic retroversion, exacerbating mechanical strain on the lower back [14]. Conversely, flattened TK may impair the spine's shock-absorbing capacity, further contributing to pain [15]. Regional studies, including Central Indian populations, highlight variability in TK angles, suggesting the importance of population-specific norms in the evaluation and management of CLBP [16]. Tailored interventions are essential for restoring sagittal alignment

The thoraco-lumbo-pelvic alignment in populations varies due to genetic, cultural, and environmental factors. Studies have reported significant differences in spinal parameters such as PI, SS, LL, and TK among different ethnic groups [17,18]. The Central Indian population, characterized by unique anthropometric traits, shows variations in pelvic morphology and spinal curvature compared to Western and East Asian cohorts. These differences necessitate population-specific normative data for spinal alignment to better understand patho-mechanics in CLBP patients.

Alterations in the thoraco-lumbo-pelvic alignment have been strongly associated with the development and persistence of CLBP. Excessive thoracic kyphosis or reduced lumbar lordosis increases biomechanical stress on the lumbar spine, contributing to disc degeneration and facet joint arthropathy [15,16]. Furthermore, PT and pelvic rotation can compensate for sagittal misalignment but may lead to muscular fatigue and secondary pain syndromes [16].

The Indore region of Central India, where sedentary lifestyle patterns are common, might predispose individuals to poor postural habits and weak core musculature, exacerbating thoraco-lumbo-pelvic misalignment. These factors align with findings by a study [12-16], who noted that individuals with sedentary occupations in India are at a higher risk for lumbar spine pathologies due to poor ergonomics. The present findings reinforce the importance of incorporating ergonomic interventions and tailored physiotherapy protocols addressing regional lifestyle factors.

Conclusion:

The study emphasizes the substantial influence of lumbar lordosis and thoracic kyphosis on the thoraco-lumbo-pelvic alignment of CLBP patients in the Central Indian population. The results underscore the significant correlation between CLBP and deviations in sagittal alignment, particularly reduced lumbar lordosis or exaggerated thoracic kyphosis. This emphasizes the significance of assessing sagittal spinal curves during clinical assessments and treatment planning. The necessity of population-specific reference values for optimal diagnosis and management is further supported by regional morphometric variations. The research aims to alleviate pain and restore alignment in CLBP patients, thereby establishing a foundation for personalized therapeutic strategies.

Conflict of interest:

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

References:

1. Li J, Liu L. Comparison of short-segment versus long-segment fixation for the treatment of thoracolumbar burst fracture: a meta-analysis. Int J Clin Exp Med. 2017 Jan 1;10(10):1750-62. *DOI:* 10.1097/MD.0000000000008770
2. Patil KA, Prashanth KM, Ramalingaiah A. Detection of osteoporosis in lumbar spine [L1-L4] trabecular bone: a review article. International Journal of Research in Orthopaedics. 2021 Jul;7(872):10-8203.
3. Newman M, Newman R, Hughes T, Vadher K, Barker KL. Is the timed loaded standing test a valid measure of back muscle endurance in people with vertebral osteoporosis?. Osteoporosis International. 2018 Apr;29:893-905. https://doi.org/10.1007/s00198-017-4358-8.
4. Tinelli M, Töpfer F, Kreinest M, Matschke S, Grützner PA, Suda AJ. Minimally invasive reduction and percutaneous posterior fixation of one-level traumatic thoraco-lumbar and lumbar spine fractures. European Journal of Orthopaedic Surgery & Traumatology. 2018 Dec;28:1581-7. https://doi.org/10.1007/s00590-018-2224-9.
5. Pereira-Duarte M, Dionne A, Joncas J, Parent S, Labelle H, Barchi S, Mac-Thiong JM. A classification algorithm for prioritizing surgery in Pediatric patients with idiopathic scoliosis when Long Surgical delays are expected. European Spine Journal. 2024 Oct;33(10):3792-7. https://doi.org/10.1007/s00586-024-08405-4.
6. Kumar DS, Ampar N, Lim LW. Accuracy and reliability of spinal navigation: An analysis of over 1000 pedicle screws. Journal of orthopaedics. 2020 Mar 1;18:197-203. https://doi.org/10.1016/j.jor.2019.10.002
7. Buttermann G. Anterior Spinal Fusion for Thoraco-Lumbar Idiopathic Scoliosis Comparing Less Invasive Concave versus Traditional Convex Approach: A Pilot Study. Journal of Clinical Medicine. 2024 Aug;13(15). doi: 10.3390/jcm13154383
8. Ding BT, Kaliya-Perumal AK, Oh JY, Yu CS. Prospective evaluation of the time required for insertion of 380 lumbar and sacral pedicle screws using navigation with an intraoperative 3-dimensional imaging system. International Journal of Spine Surgery. 2020 Jun 1;14(3):368-74. DOI: https://doi.org/10.14444/7048

9. Bhosale S, Pinto D, Srivastava S, Purohit S, Gautham S, Marathe N. Measurement of spinopelvic parameters in healthy adults of Indian origin–A cross sectional study. Journal of Clinical Orthopaedics and Trauma. 2020 Sep 1;11(5):883-8.
10. Singh R, Yadav SK, Sood S, Yadav RK, Rohilla R. Spino-pelvic radiological parameters in normal Indian population. SICOT-J. 2018;4. doi: 10.1051/sicotj/2016003
11. Cho Y. Evaluation of global sagittal balance in Koreans adults. Journal of Korean Neurosurgical Society. 2017 Sep 1;60(5):560-6.
12. Yukawa Y, Kato F, Suda K, Yamagata M, Ueta T, Yoshida M. Normative data for parameters of sagittal spinal alignment in healthy subjects: an analysis of gender specific differences and changes with aging in 626 asymptomatic individuals. European Spine Journal. 2018 Feb;27:426-32. https://doi.org/10.1007/s00586-016-4807-7
13. Malka M, Sardar ZM, Czerwonka N, Coury JR, Reyes JL, Le Huec JC, Bourret S, Hasegawa K, Wong HK, Liu G, Hey HW. The Thoracolumbar Inflection Point in a Population of Asymptomatic Volunteers: A Multi-Ethnic Alignment Normative Study Cohort Study. Global Spine Journal. 2023 Aug 3:21925682231193619.
14. Diebo BG, Henry J, Lafage V, Berjano P. Sagittal deformities of the spine: factors influencing the outcomes and complications. European Spine Journal. 2015 Jan;24:3-15. https://doi.org/10.1007/s00586-014-3653-8
15. Asai Y, Tsutsui S, Oka H, Yoshimura N, Hashizume H, Yamada H, Akune T, Muraki S, Matsudaira K, Kawaguchi H, Nakamura K. Sagittal spino-pelvic alignment in adults: The Wakayama Spine Study. PloS one. 2017 Jun 6;12(6):e0178697. https://doi.org/10.1371/journal.pone.0178697
16. Takemitsu Y, Atsuta Y, Kamo Y, Iwahara T, Sugawara O, Harada Y, Miyatake Y. Operative treatment of lumbar degenerative kyphosis. InLumbar Fusion and Stabilization 2023 (pp. 150-159). Tokyo: Springer Japan. https://doi.org/10.1007/978-4-431-68234-9_17
17. Mahdavi SB, Riahi R, Vahdatpour B, Kelishadi R. Association between sedentary behavior and low back pain; A systematic review and meta-analysis. Health promotion perspectives. 2021;11(4):393. doi: 10.34172/hpp.2021.50
18. Shinde SB, Manpreet B, Bhore PR. Effect of spinal extension exercises on mechanical low back pain in work from home IT professionals in India. International Journal of Occupational Safety and Health. 2022 Mar 13;12(2):75-80. DOI: https://doi.org/10.3126/ijosh.v12i2.39022