



Radiographic Versus Inclinatoric Method in Measuring Spinal Posture

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ABSTRACT

Background: Low back pain (LBP) is associated with abnormal spinal posture (lumbar hypo-/hyper-lordosis). Radiographic method (X-ray) is costly and risky. Therefore, testing the validity of safer and cheaper methods such as inclinometer is needed due to lack of research.

Purpose: to test the validity of inclinometric method compared to radiographic one in measuring lumbar curvature.

Methods: This diagnostic accuracy study included thirty-one patients of both genders complained from LBP with mean age of 40.4 years. They were categorized into two groups; group A included 18 patients whom lumbar lordotic angle (LLA) was measured with inclinometer and group B included 13 patients whom LLA was measured by Cobb's angle (on plain X-ray sagittal views).

Results: There was no significant differences between LLA measured by radiographic and inclinometric methods (MD=5, P-value= 0.082).

Conclusion: Measuring LLA with inclinometer is valid compared to radiographic method in patients with LBP. Inclinometer is cheap, usable, and accessible in both research and clinical setting.

Keywords: Cobb's angle; sagittal radiographs; Inclinometer; Backache; Lumbar lordotic angle.

Introduction

Low back pain (LBP) is discomfort/pain/stiffness located between lower rib and lower gluteal fold with/out lower limb pain that affects more than 18% of the population (Lionel, 2014), causing significant disability and impaired life quality (Klemenc-Ketis, 2011).

Posture involves balance between activities of many musculature that maintain upright position and function (Levangie and Norkin, 2005). Normally, lumbar curvature is lordotic with an angle between 18-30 and 45-72 degrees; below and above these values are considered hypo- and hyper-lordosis, respectively and does not differ with aging after 15 years of age (Issahaku et al., 2023; Gnanasigamani & Ramalingam, 2024).

Abnormal posture is associated with or a risk factor for LBP and not only gives bad appearance but also decreases the speed and range of the motion (Jung et al., 2020; Kripa & Kaur, 2021). Furthermore, abnormal lumbar curvature increases the amplitude of center of pressure displacement; i.e. impairs postural control (Żurawski et al., 2020). Therefore, assessment and follow up of postural alignment or spinal curvature is important for prevention of LBP and for its management.

Several previous studies assessed the reliability of postural assessment tools for the lumbar spine such as radiographic method (x-rays) and inclinometer among others and found good reliability (with about 4 degrees of error for inclinometer) and validity (Takatalo et al., 2020; Zanguie et al., 2023). However, the evidence is little with no studies was found to assess the validity of inclinometer compared with x-rays in measuring lumbar lordosis (Zanguie et al., 2023). Moreover, radiographic method is the gold standard for assessment of posture. But its cost and risk of radiation exposure decrease its usage which encourages use of other alternatives as inclinometer (RAi & VeqAR, 2022).

Positive results of this study may provide physiotherapists and other practitioners with an cheap, usable, accessible and objective tool for postural assessment. Moreover, it will protect the patients from repetitive exposure to x-ray radiation.

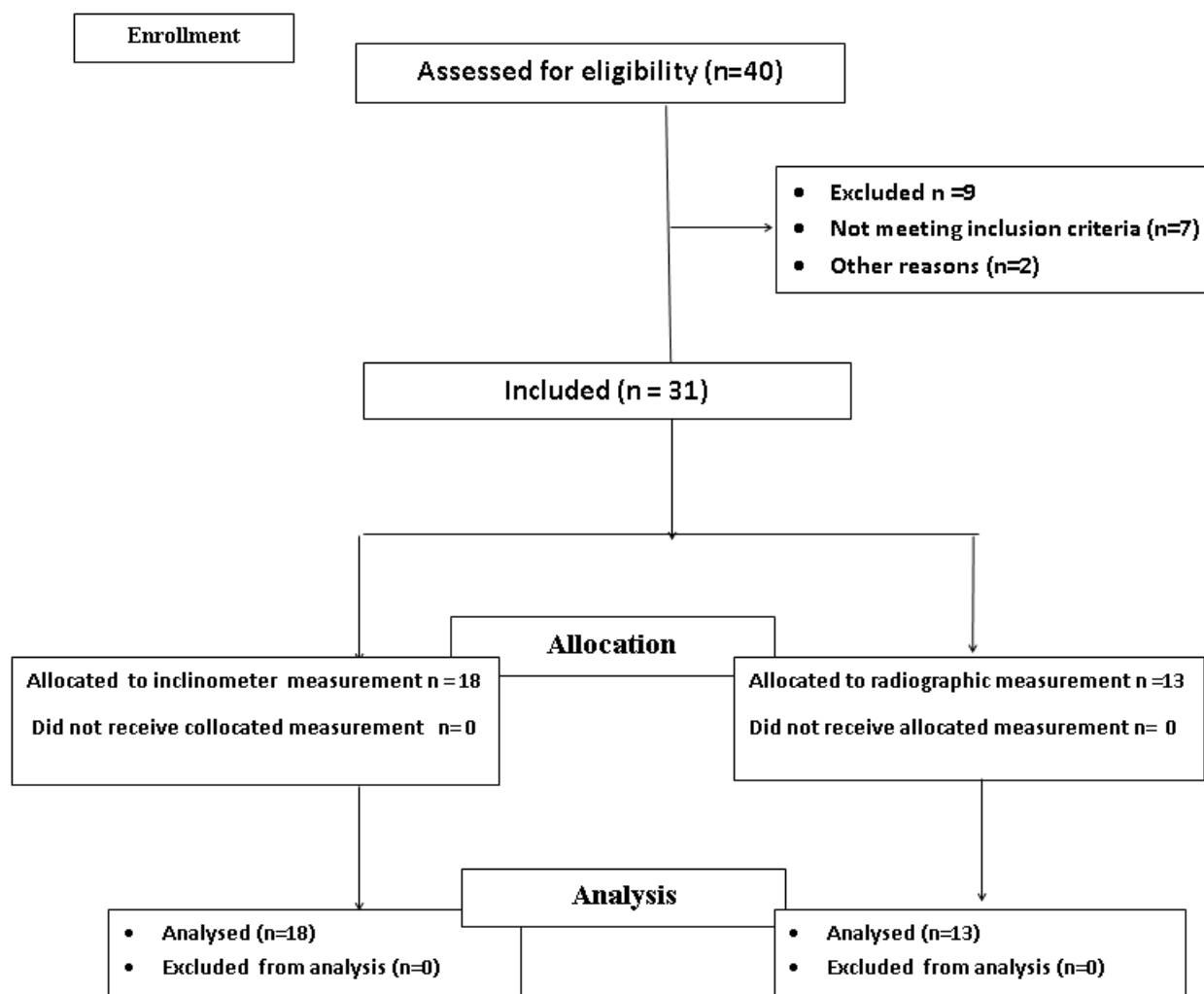
Therefore, the objective of this study is to investigate the validity of inclinometric method compared to radiographic method in measuring lumbar lordotic angle.

Methodology

Patients:

This diagnostic accuracy (validity study) included 31 male and female patients with LBP with mean age of 40.4 years. They were divided into two groups; group A (patients of this group [n=18] were assessed for LLA using inclinometer) and group B (patients of this group [n=13] were assessed for LLA using Cobb's angle from sagittal plain radiographs) shown in flow chart for study participants figure (1). Patients were recruited from Cairo University Hospital. The informed consent was signed by the patients after explaining the aim and procedures of the study. The study was approved by ethical committee, faculty of physiotherapy, Benha university under the registration number No:PT,BU, EC,9

Patients were allowed to participate if their age ranged from 21-63 years and had LBP. Patients were not allowed to participate if they had structural, inflammatory, infectious, metabolic, congenital, traumatic spinal disorders and spinal or lower limb surgery.



Fig(1):Flow chart for study participants

Procedures:

Measuring LLA using inclinometer:the fifth lumbar (L1), twelfth thoracic (T12), first and second sacral (S1,2) spinous processes were identified and marked on all patients of group A while standing. Then, the higher end of the device was located at L1 and T12 and the score was recorded, then the lower end was put at the S1,2 and the value was recorded. LLA is the difference between these two scores (22).

Measuring LLA using sagittal radiographs (Cobb's angle):all patients who previously (within < 3 months) underwent sagittal radiographs of lumbosacral spine from quiet standing for clinical examination by request of the orthopedist were included in group B. New radiographs were not asked from the patients and we used only the already done one for an ethical issue; not to impose the patients to the risk of radiation.

On these radiographs, two lines (from superior and inferior surfaces of L1 and L5, respectively) were drawn on these radiographs with help of Kinovea software (v.3.1) that also measure the Cobb's angle at the meeting point of the two lines (or the equivalent angle). Kinovea has excellent reliability for measuring lumbar lordosis (ICC 0.87-0.91) (Sharifnezhad et al., 2021). The accuracy of radiographic methods of lumbar curve evaluation is high, with reliability values of 0.98 (Vrtovec et al., 2009).

Statistical analysis

Differences between both groups in all variables (except gender distribution was tested with Chi-square test) were tested using independent t-test. Alpha was set at 0.05. Statistical Package for the Social Sciences (v. 24) software was used for analysis.

Results

Table (1) shows demographic data of patients of both groups. There were non-significant differences in demographics between both groups ($P\text{-value} > 0.05$).

Table (1) Demographics of the patients.

Demographics	Group A	Group B	P-value
Age, Mean (SD)	37.8 (11.7)	43.9 (10.2)	0.32
BMI, Mean (SD)	25.7(2.2)	27 (2)	0.07
Gender (count)			
Male	8	5	0.74
Female	10	8	

Group A: inclinometer method; Group B: radiographic method; SD: standard deviation

Table 2 shows means (standard deviations) of lumbar lordotic angle using both methods (inclinometric and radiographic). Difference in mean scores of LLA between both groups was insignificant ($MD=5$, $P\text{-value} = 0.082$).

Table (2): Means and standard deviations of lumbar lordotic angle for both groups:

Variable	Group A	Group B	MD	SED	t	P-value	95% CI (Lower, Upper)
Lumbar lordotic angle, Mean (SD)	41.4 (7.4)	36.4 (8.14)	5.06	2.8	1.79	0.082	(-0.7, 10.8)

SD: Standard deviation; Group A: Inclinatoric method; Group B: Radiographic method; MD: Mean difference; SED: Standard error of difference; T: independent t test value; P: probability; CI: Confidence interval.

Discussion

This study tested the validity of inclinometric method compared to radiographic method in measuring lumbar lordotic angle in LBP patients. It showed non-significant difference between both methods ($MD=5$, $p > 0.05$). This means that inclinometer is safe and inexpensive alternative to x-rays in measuring lumbar lordosis.

Interesting finding of the current study is that the included LBP patients had LLA of 39 degrees on average which was within the normal reported ranges (30-45 degrees), but tended slightly toward hyper-lordosis (Gnanasigamani & Ramalingam, 2024). This was in line with Kripa & Kaur (2021) who said that posture is not the primary factor for LBP.

In addition, this study found that inclinometer tends to overestimate the LLA by 5 degrees. This result supported the work of Zanguie et al. (2023) who found that inclinometer had 4 degrees of measurement error.

Authors of this study, based on the positive findings of the current study, recommend using inclinometer in measuring spinal posture (in particular lumbar lordotic angle) in patients with lumbar pathology (especially low back pain) as it was safe, cheap, usable, accessible, and valid compared to plain radiographs.

This study is limited by including small sample and most of the participants were from female gender. This to be considered in future studies.

Conclusion

Measuring spinal posture (LLA) with inclinometer is valid compared to radiographic method in patients with LBP. Inclinometer is cheap, usable, and accessible postural assessment tool in both research and clinical setting.

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