Original Article

Measurement of Lumbosacral Angle in Normal Radiographs: A Cross-Sectional Study

Syed Zohaib Gulzar Naqvi, Ahmed Ali, Aslam Siddiqui, Syed Danish Ali, Mujtaba Qureshi, Ikram Muhammad Aliuddin

ABSTRACT

OBJECTIVE: To determine the value of Lumbosacral angle in normal radiographs.
METHODOLOGY: The LSA has been measured in lateral lumbosacral spine radiographs taken in the recumbent position in 100 adult individuals visiting Orthopedics Outpatient Department, Baqai Medical University Hospital from 11 – 25 October 2019, with recent onset (less than 2 weeks) non traumatic low back pain without radiculopathy and radiographically vertebral abnormality. Simple randomized probability sampling technique was used.
RESULTS: Lumbosacral angle (LSA) of our population is 36± 8 degrees. Mean angle of adult male was 36 degrees, whereas mean angle in adult female was 33. degrees.
CONCLUSION: Present study established that there is no significant difference in LSA between two age groups and sex. Mean Lumbosacral angle in our study group is 36°. This is a milestone cross-sectional study for determining the variations of LSA in our spectrum of patients. In future, author aims to increase the spectrum of population and willing to do a multicenter study to determine LSA value on a larger scale.

KEYWORDS: Lordosis, Lumbosacral angle (LSA), Spino pelvic alignment (SPA).

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INTRODUCTION

Lumbar spine is normally curved anteriorly in sagittal plane which is known as the lumbar lordotic curve[1]. According to literature, this anterior convexity develops earlier in first year of life as nature manages the standing posture of child before initiating foremost steps. However, recent literature has shown 60% lumbosacral lordosis in human fetus's morphology suggesting its genetic origin[2]. This lordosis grows gradually with the development of spine till average age of 18 years[3]. Failure of children attaining erect posture results in lumbar lordosis and growth retardation may results in delay in onset of physiological lumbar lordosis[6]. To measure this physiological curve, several techniques have been introduced. These techniques include flexible rulers[7], radiography[8], goniometry[9], software methods[10], and inclinometers[11]. Radiographical analysis remains the gold standard[12].

The lumbosacral angle (LSA) is also called as the "sacral angle" or the "Ferguson's angle"[13]. The angle is measured by joining a line across the plane of the superior margin of the sacrum and a horizontal line. A study conducted in Southeast Nigeria found the mean LSA to be 44.5° [21], while another study from Nepal concluded that Nepalese population had a mean LSA of 33.48° [22]. Till today no data has been published to determine the normal values of these angles in Pakistani population, to determine abnormalities like hypo-/ hyper-lordosis. It is important to know the normal value of this angle to diagnose variations related to pathological conditions in patient with lower back pain. In all, current study is initial step and milestone study to determine the value of normal LSA and its variations in our part of the world. Authors suggest and determine to do study on larger multi centric study in future.

METHODOLOGY

The LSA was measured in lateral lumbosacral spine radiographs taken in the recumbent position in 100 adult individuals visiting Orthopedics Outpatient Department of Fatima Hospital, Baqai Medical University from 11 – 25 October 2019, with recent onset (less than 2 weeks) non traumatic lower backachenot associated with sensory or motor neuropathy and with no radiographic vertebral abnormality affecting the degree of normal lumbar lordosis. Simple randomized probability sampling technique was used. All patients between 20-80 years were included after taking informed consent. The data was grouped into two age groups: Group A (20-40 years) and Group B (41-80 years). Patient with less than 20 years, vertebral anomalies, radiculopathies and with history of trauma were excluded. The LSA formed between a line across the plane of the superior margin of S1 and a horizontal line, was measured by mounting each radiograph on a viewing screen with good illumination. The angle was measured in degrees using a goniometer. All measurements have

been taken by single qualified orthopedic surge onto avoid inter-observer variability. Variation of LSA between the two age groups and also between two sexes has been compared using chi-square test. The data has been analyzed by SPSS Statistics version 21 and $P<0.05$ was considered significant.

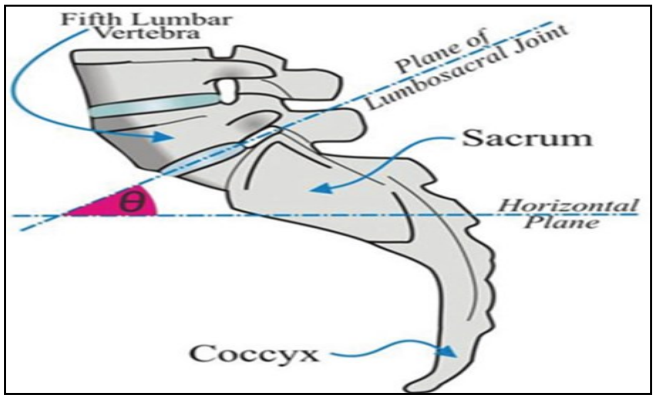
RESULTS

Lumbosacral angle (LSA) of our population is 36±8 degrees. Mean angle in Group A was 36.3 degrees and in Group B was 36.4 degrees respectively. Mean angle of adult male was 36 degrees, whereas mean angle in adult female was 33 degrees.

DISCUSSION

Lumbosacral angle (LSA) is one of the crucial radiographic angles which is commonly measured by the Ferguson's technique[14-17] (Figure I).
Great variations have been reported in literature in context of the value of LSA varying from population to population (Table I).
An ample variability in spino–pelvic alignment (SPA) and its influence on lumbar lordotic curve has been described by Roussouly P 2005[4] and recognition of changes in spinopelvic anatomy and alignment is crucial when treating patients with spine related problems. Furthermore the lumbosacral junction has been a demanding area of spine both anatomically and mechanically[5].

FIGURE I: SCHEMATIC DIAGRAM MEASUREMENT OF LSA ON LATERAL LUMBOSACRAL X-RAY



Association of age, posture and sex in variation of degrees of lumbar lordosis is unclear. Literature clearly showed that birth defects, degenerative diseases, trauma and inflammatory conditions affect the degrees of lumbar lordosis. However to reduce bias, adult population has been included in the current study with no spinal deformity and pathology. We utilized radiographic methods for measurement as radiographic method of measuring LSA is gold standard and reliable[15,16]. All the readings have been observed by single orthopedic surgeon so as to avoid inter-observer discrepancy.
Most of the previous studies included male population

TABLE I: COMPARISON OF MEAN LSA IN DIFFERENT STUDIES

Author, year of Publication	Study type	Gender	Mean LSA (in degree)
Mitchel, 1934	Not mentioned	Male	41°
Splithoff, 1953	Prospective (recumbent)	Male	42°
Hellems and keat,1971	Retrospective (erect)	Male	41°
Madufora et al, 2012	Prospective (recumbent)	Male	36°
Okpala study, 2014	Retrospective (recumbent)	Both	44.5°
Umesh, 2018	Prospective , CT based	Both	33.4°
Current study	Prospective recumbent)	Both	36°

in their studies; current study is a landmark study enrolling both the genders (Figure II), hence we were also able to compare the value of LSA in male and female population; however these values were not statistically significant (p= 0.78).

FIGURE II: SHOWED FREQUENCY OF MALE AND FEMALE IN NUMBERS AND MEAN LSA

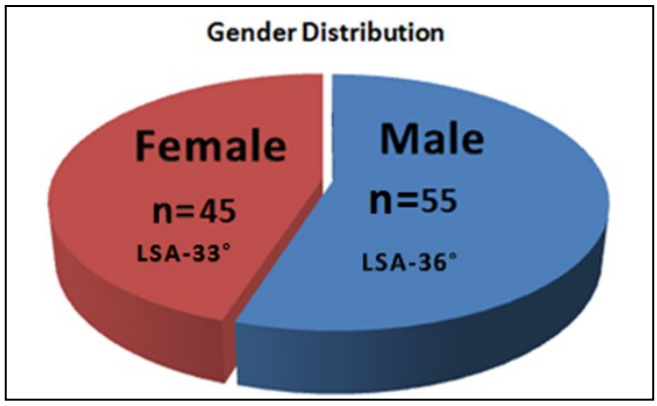
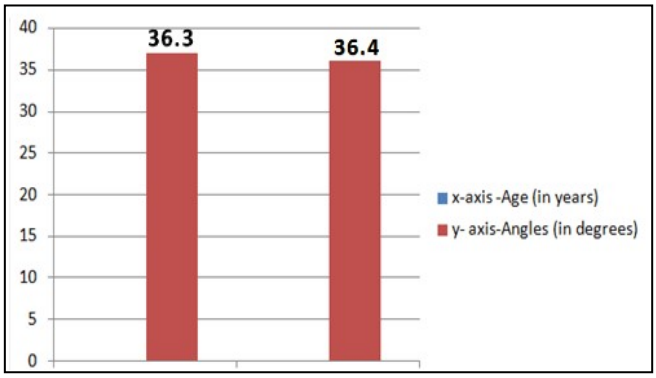


FIGURE III: SHOWING GRAPHICAL REPRESENTATION OF LSA BETWEEN AGE GROUPS



Group A (age ≤40) Group B (age >40)

Our study has shown that the LSA of our population is

36°+/- 8°. Prospective study by Splithoff CA 1953[18] recorded the values of LSA 40-44° in 100 subjects of their population. A study by Mitchell GA 1934[20] reported an average LSA of 41° in 28 individuals. A retrospective study of 274 Nigerian population showed mean LSA of 44.5° [21]. A prospective study using 100 radiographs of adult individuals by Maduforo C *et al* [27]. reported LSA value of 36.0 (9.4°). It further concluded that lumbosacral angle does not increase significantly after the age 36–40 years. We also found that there is no significant difference of LSA in individuals less than 40 years than those with more than 40 age group (Figure III).

Our male population LSA (36°) is 3° lower than Troyanovich SJ 1997[23] and Hellems H 1971[24] studies done with erect posture and 7° less from Splithoff CA 1953[18] and Okpala Fo 2014[21] studies done in recumbent position.

Study by Khanal UP 2018[22] recorded mean LSA of 33.4° on computed tomography, 3° lesser than our population. His study showed statistically significant difference in LSA value among male and female gender, however our values of LSA among both the genders are not comparable. Furthermore, instability has not been observed in individuals having LSA greater than 34°, which is in contrast to Ferguson AB 1934[17] finding.

The strength of the current study is that it's a cross-sectional study with standardized radiographic evaluation by a single experienced orthopedic surgeon hence the probability of inter-observer discrepancy is far less. Secondly, current study involves both genders to determine difference of LSA between the two.

CONCLUSION

Present study established that there is no significant difference in LSA between two age groups and sex. Mean Lumbosacral angle in our study group is 36°. This is a milestone cross-sectional study for determining the variations of LSA in our spectrum of patients. In future, author aims to increase the spectrum of population and willing to do a multicenter study to determine LSA value on a larger scale.

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AUTHOR CONTRIBUTIONS

Naqvi SZG: Idea, Design, Analysis, Writing
Ali A: Writing, Literature Review
Siddiqui A: Supervision, Writing
Ali SD: Writing, Literature review
Qureshi M: Data Collection, Literature review
Aliuddin AM: Literature review

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