

Sagittal plane mal-alignment in lumbar spinal radiographs in a tertiary hospital

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Abstract

Background: Plane radiograph of the spine is still the primary or first line investigation in patients with a variety of symptoms including back pain in a resource limited setting like ours.

Methods: A crosssectional study of radiographs of patients who were referred to Radiology Department of Jos University Teaching Hospital for lumbo-sacral radiography between July 2013 and April 2014 was carried out.

Results: Two hundred and forty two lumbo-sacral radiographs were assessed comprising 166 (68.6%) females and 76 (31.4%) males with a mean age of 48±15 years. Overall 15 (6.2%) patients were found with mal-alignment in the sagittal plane consisting 10 females and 5 males with a female to male ratio of 2:1. Anterolisthesis occurred in 11(4.5%) and retrolisthesis in 4

(1.7%). First degree slip dominated in 9/15 (60%) of the patients with listhesis, while second degree slip was found in 6 (40%). Most of the observed vertebral subluxation (7; 46.7%) occurred at the L4/L5 intervertebral disc space.

Conclusions: Mal-alignment in the sagittal plane in lumbar spine radiographs in our locality demonstrates comparable pattern and localization with that seen elsewhere.

Keywords: Lumbar Spine, Radiographs, Listhesis, Mal-alignment

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Introduction

Plane radiographic investigation of the spine is often requested for a variety of conditions. It is done to rule out skeletal features as a cause of the back pain and other symptoms. The normal lumbar spine assumes a lordosis from infancy as is well demonstrated on a lateral view radiograph. Anatomical lines drawn along the anterior margins of the vertebral bodies (anterior spinal line), their posterior margins (posterior spinal line) the junction of the laminae and the spinous processes (spinolaminar line) and the tips of the spinous processes extending from the cervical spine down to the sacrum describe the axial relationship of the vertebral bodies, the spinal canal and the spinous processes in the sagittal plane.¹ These lines normally maintain continuity in describing the gentle lordotic curve in the lumbar section. A 'step deformity' and loss of alignment indicative of subluxation is seen when there is a slip of one vertebral body relative to another. These abnormalities in the sagittal plane seen on lateral radiographs of the lumbar spine include an anterior slip of a cephalad vertebra body over the immediate caudal vertebra (anterolisthesis), or a posterior slip of a cephalad vertebra over the immediate caudal vertebra (retrolisthesis).²

Traditionally, 'Meyerding classification' is used to

grade the degree of vertebral subluxation, which is based on the amount of anterior subluxation of the cephalad vertebra in reference to the caudad vertebra. The grading is a percentage relative to the sagittal diameter of the inferior vertebral body: Grade I=0% to 25%, Grade II=25% to 50%, Grade III=50% to 75%, Grade IV=75% to 100%, Grade V=Greater than 100% referred to as spondyloptosis.³

Listhesis is broadly considered to have two main etiologies, spondylolytic and degenerative.⁴ Spondylolytic spondylolisthesis is distinguished by chronic fracture of the pars interarticularis and is observed primarily during childhood and adolescence. The pars interarticularis is the part of the vertebral neural arch that lies between the superior and inferior articular facets. Degenerative spondylolisthesis refers to anterior slip without an associated defect or disruption in the vertebral ring.

The objective of this study is to determine the prevalence of these mal-alignments in the sagittal plane in patients who have undergone plane radiographic investigations of the lumbar spine for varying indications.

Materials and Methods

A prospective study was carried out employing successive technically adequate lateral view lumbar spine radiographs of individuals taken over a 10 month period (July 2013-April 2014) in the Radiology department of the Jos University Teaching Hospital. All investigations were carried out with a GE MS-18S (150Kv) conventional X-ray machine complimented with GE RDM5-47/S0 (5.5Kw; 50-60Hz) automatic processor. Lumbar spine radiographs were obtained using same

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standardized protocol. The patients were placed on their left side in the lateral position with legs flexed and both arms raised to the head which is supported on a pillow. The long axis of the spine was set parallel to the table and the midaxillary (coronal) plane of the body was aligned to the table midline. Images were obtained from T12 to S1, with the centering point 10cm from the spinous process of L2 and the direction of the central ray is vertical at 90 degrees to the film.

The radiographs were all carefully assessed and data recorded including the presence, location and degree of mal-alignments in the sagittal plane. Mal-alignment meant the presence of anterior or posterior vertebral slip or listhesis. Listhesis was defined as present when the subluxation was 3 mm or more. Magnitude of listhesis was obtained by measuring the slip distance against the width of the caudad vertebral body. Usable data were obtained from 242 patients, who had lateral radiographs for various reasons. The data was analyzed using the Epi-Info 2005 version 3.4.3 statistical software (CDC, Atlanta, GA). Results were presented as simple descriptive statistics.

Results

A total of 242 lateral radiographs were assessed during the study period comprising 166 (68.6%) females and 76 (31.4%) males. The patients whose lumbar spinal radiographs were investigated aged between 13years and 98years with a mean age of 47 ± 15 years. Overall 15 (6.2%) patients were found with mal-alignment in the sagittal plane: 10 females and 5 males with a female to male ratio of 2:1. Eleven (4.5%) of these were found with anterolisthesis while 4 (1.7%) had retrolisthesis. Out of those with radiographically diagnosed anterolisthesis, 8 (72.7%) were females and 3 (27.3%) were males. There were 2 (50%) females with retrolisthesis and 2 (50%) males with same assessment.

First degree slip dominated in 9 (60%) of the patients with listhesis, while second degree slip was found in the remaining 6 (40%). Only 1 of the 4 discovered retrolisthesis had a second degree subluxation. Most of the observed vertebral subluxation (7; 46.7%) occurred at the L4/L5 intervertebral disc space. 5 (33.3%) were located at the L5/S1 disc space while the remaining 3 were found at L1/L2, L2/L4, L3/L4 disc spaces respectively. 14 of the patients with sagittal plane mal-alignment of the lumbar spine were 50 years and above, the remaining one patient being 21 years old.

The average age of the males with mal-alignment was 55 years while that for females was 61 years. The most common indication for plain x-ray investigation of the lumbar spine was low back pain and the most common finding was spondylotic changes.

Discussion

The study was embarked upon to determine the prevalence of vertebral mal-alignments in the sagittal plane which are sometimes seen on lateral radiographs

of the lumbar spine in individuals who have undergone x-ray investigation for various indications including low back pain in our locality.

Low back pain (LBP) is an almost inevitable symptom in the middle aged and elderly individuals worldwide, more so in a society like ours that lacks a culture of exercise. The middle age is often associated with onset of degenerative disease affecting the spinal column often presenting as back pain.⁵ The epidemiology of our study population is therefore skewed toward the mid and older age groups and LBP is expectedly the leading indication for referrals to the Radiology department for plane radiography of the lumbar spine. This study further asserts this. LBP constituted 91.8% of the indications for plane X-ray of the spine, followed by parasthesia and suspected vertebral metastasis from cancer of the prostate, each constituting 2.5% and 2% respectively. The mean age of our study population is 47.8 years with standard deviation of 15.5 years. This compares well with that observed in other studies where symptomatology revolves on LBP.^{6,7}

We found an overall prevalence of 6.2% for listhesis in our environment with 4.5% being forward slip and only 1.7% being backward slip of one vertebra over the next distal vertebra. This is consistent with research findings on the subject in other places. Igbinedion and Akhigbe⁸ while studying the correlations of radiographic findings in patients with low back pain found a prevalence of 13.4% for spondylolisthesis. They observed that spondylolisthesis was not as common as osteophytosis (vertebral marginal bony outgrowths) in patients with LBP. Osteophyte formation is indicative of spondylosis which is the most common finding from our study. Uduma et al⁶ studied 249 radiographs of the lumbar spine and discovered a prevalence of 9.24% for spondylolisthesis.

The number of the females in our cohort was more than that of the males. This is an inadvertent occurrence based on our consecutive recruitment methods. Our finding of more females with sagittal mal-alignment (10/15) concurs with the trend of over riding incidence of spondylolisthesis among females seen in other studies.^{8,9,10} This disproportionate sex ratio perhaps reflects the better health seeking behavior of women compared to the men.¹¹ Differences in sex hormone profiles might also play a part and future studies on correlation of listhesis and sex hormone profiles will therefore be interesting.

Degenerative changes of the lumbar spine occur most frequently in the L4/L5 disc space seconded by the L5/S1 disc space.^{2,10} Our finding also confirm this in our environment with 46.7% of listhesis occurring at the L4/L5 intervertebral disc space and 33.3% present at the L5/S1 disc space. In the study by Igbinedion and Akhigbe⁸, it was observed that 75.2% of spondylolisthesis occurred at the L4/L5 and L5/S1 disc spaces. These disc spaces are the point of maximal force

of transmission of the weight of the upper part of the body to the pelvic girdle. Zukotynski et al¹² proposed a linkage to vulnerability to micro-trauma from repetitive flexion, extension, rotational forces or increased loading on lower lumbar vertebrae as a reason for this.

Spondylolisthesis can be further categorized into type I – congenital (dysplastic); type II – isthmic; type III – degenerative; type IV – traumatic; type V – pathologic and iatrogenic.^{10,15} Isthmic spondylolisthesis is believed to arise from biomechanical stress associated with high risk activities like gymnastics, rowing, tennis, weightlifting, wrestling and footballs and hence found more in young athletes while degenerative spondylolisthesis is associated with chronic disc degeneration and facet incompetence leading to segmental instability and slippage found in middle age and elderly individuals. It has predilection for females and is reportedly more common in African American women than their white counterparts.^{14,15} Age related facet arthritis and consequent remodeling leads to the facets assuming a more sagittal orientation, allowing a slip to occur.¹⁶ The only patient with trauma related vertebral subluxation in our study was a 21 year old young man. This patient was found with a retrolisthesis. While it would appear that trauma is important in the aetiology of retrolisthesis, this could probably only be significantly proved with a larger cohort and a recruitment method that involves direct contact with the patients to provide for such data. We relied on the clinical information on the patient's request or referral form which may have been inadequately filled. In agreement with other studies,^{6,8,15,17} our study also reveals that first degree spondylolisthesis was commonest. The pathological basis in the commoner occurring degenerative spondylolisthesis supports this. It would appear that a measurable degree of force as seen in trauma will be needed to overcome the stabilizing effects of the surrounding ligaments like anterior and posterior longitudinal ligaments and cause up to one-half of the sagittal width of the superior vertebra to slide or sublux over the inferior vertebra, even in the presence of degenerative disc disease. Constitutional make up and subtle anatomical differences in individuals must however be taken into consideration. In this study 60% patients had first degree listhesis while 40% had second degree listhesis, one of which was associated with trauma. We did not find any Grade 3 or Grade 4 listhesis.

The limitations of this study include our dependence on the request forms for extraction of the information on biodata of the patients and the indications for spinal radiographs. Further studies on the subject should be on a larger cohort and incorporate contact with the patients in order to properly evaluate events of symptomatology. However, this study has established a reference on the prevalence of vertebral subluxation in the lumbar spine in plane radiographs in our environment as well as its localization and sex distribution.

In conclusion, our findings on sagittal mal-alignment in the lumbar spine is comparable with what

has been discovered on the subject in other localities, showing the usual female gender preponderance, L4/L5 localization and predominance of Grade 1 anterolisthesis.

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