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PELVIC INCIDENCE MEASUREMENT ON X-RAY IN PATIENTS HAVING LOWER BACK PAIN AND IT'S CORRELATION WITH LUMBER SPINAL INSTABILITY

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ABSTRACT **Purpose:** Many factors such as lumbar instability and spinopelvic alignment are associated with low back pain. Our purpose was to analyze the pelvic incidence - one of spinopelvic alignment parameters- and spine instability correlations in patients with chronic low back pain.

Methods: 500 patients suffering from chronic low back pain entered this case control study. Lateral spine radiography was taken from patients. pelvic incidence and L3, L4 and L5's vertebral body width were measured for all patients, and lumbar instability was evaluated in 3 different levels: L5-S1, L4-L5 and L3-L4.

Results: 350 patients having lumbar instability formed group A and 150 patients without lumbar spine instability allocated to group B. Average age, mean weight, height, body mass index and mean vertebral width of both groups did not differ meaningfully. Pelvic incidence's mean amounts set to 47.61 in group A and 56.6 in group B without any significant difference; but pelvic incidence was significantly lower in patients with lumbar instability of L5-S1 origin (P=0.01).

Conclusions: Overall, pelvic incidence did not differ between two groups. However, separate evaluation of each level revealed lumbar instability of L5-S1 segment to be associated with lower pelvic incidence.

KEYWORDS : Lumbar Vertebrae, Postural Balance, Low Back Pain, Spine, Pelvic incidence

INTRODUCTION

Low back pain is a major health problem that mostly affects adults. Despite great efforts to identify the causes of this pain, they are still unknown. Several observations have been concerning the effect of multiple factors on low back pain. Postural changes are one of the main risk factors of low back pain [1]The term low back pain refers to pain of variable duration in an area of the anatomy afflicted so often that it has become a paradigm of responses to external and internal stimuli .Low back pain may be classified by duration as acute if pain lasting <6 weeks, sub chronic if pain is lasting for 6-12 weeks, or chronic if pain is lasting for more than 12 weeks [2]. Low back pain is a leading cause of disability. It occurs in similar proportions in all cultures, interferes with the quality of life and work performance, and was the most common reason for medical consultations. Globally, about 40% of people have low back pain at some point in their lives, with estimates as high as 80% of people in the developed world[3].

World Statistical Review in 2012 reported a rate of 9.6% among males and 8.7% among females. Another 2012 World Statistical Review found a higher rate in females than males, which the reviewers felt was possibly due to greater rates of pains due to osteoporosis of bones, during menstruation, and pregnancy among women. An estimated 70% of women experience back pain during pregnancy. [4]

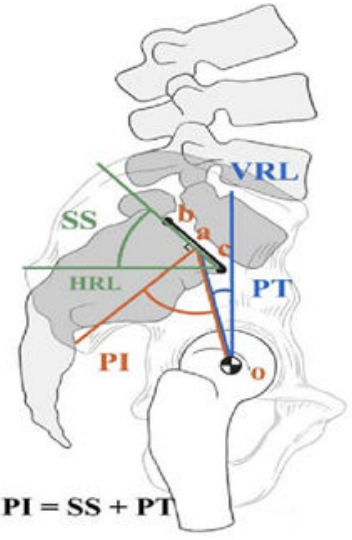
Causes of low back pain

Degenerative (most common) Instability (fracture, spondylolisthesis) Organic (Tumour, infection) Nerve compression/irritation (PID, root compression) Rule out psychogenic cause (insurance claim, problem with employer etc)

The pelvic incidence (PI) is measured as an angle formed by two vectors: 1) The line joining the bicoxo-femoral axis to the center of the sacral end plate and 2) A line perpendicular to the sacral endplate. Morphologically, the line joining the bicoxofemoral axis and the center of sacrum represents the pelvic thickness in the sagittal plane (SPT)[5]. This vector represents the line of transmission of the body weight from the pelvis to the lower limbs and anatomically, it passes through the strongest parts of the pelvis: postero-superior acetabular wall and the sciatic buttress

The pelvic incidence is a fixed morphological parameter, whose value remains more or less constant throughout adult life[6]. It is an algebraic sum of two dynamic angles: the pelvic tilt and the sacral slope[7]. The pelvic tilt represents the inclination of the innominate bones with respect to the frontal plane and the sacral slope determines the sacral tilt with respect to the horizontal plane.

Postural changes are one of the main risk factors of low back pain. Many studies have emphasized the importance of sagittal spine–pelvic angle in maintaining proper and balanced posture in normal people. Thus, in patient having back pain there is some changes in sagittal-spine angle in x-ray lumbosacral spine with bilateral head of femur in standing view . Pelvic parameter



Figure(1):-Mathematical relationship between pelvic incidence (PI), sacral slope (SS), and pelvic tilt (PT). HRL, Horizontal reference line; VRL, vertical reference line.

1.Sacral Slope (SS)
2.Pelvic incidence (PI)
3. Pelvic tilt (PT)

MATERIALS AND METHODS

This hospital based prospective study has been conducted in the Department of Orthopaedic, Govt Medical College and Associated group of hospitals, Kota during the September 2018- December 2019.

Selection of Cases

The study design was non-experimental, and study type was observational.

INCLUSION CRITERIA:

1. Patients who have lower back pain of subacute/ Chronic variety.
2. Both males and females.
3. Age 20 to 70 Years irrespective of profession.

EXCLUSION CRITERIA:

1. Patients with age < 20 year
2. Operated spine or pelvic injury.
3. Affected with disease of spine e.g. Ankylosing spondylitis, congenital /Developmental kyphosis, Scoliosis, Poliomyelitis
4. Injury of hip and knee leading to restricted movements at hip &knee joints.
5. Pregnancy/ Post partum.

Procedure

After taking proper informed consent and detail history of the patient to exclude the patients according to exclusion criteria. Patients with low back pain were approached, and 1000 samples were taken, in that 500 were test subjects according to the inclusion and exclusion criteria, the procedure was explained, and consent was taken to participate in the study. Institutional Ethical Committee approval was obtained before starting of the study. After obtaining x-ray of lumbosacral spine with sacrococcygeal spine lateral view in standing position with knee in full extension with both hands over opposite side supraclavicular fossae of subjects. Case were taken to get true lateral view of lumbosacral spine with pelvis & both hip joints clearly visible so as to identify and measure various measurements. All the cases were subjected for radiograph of lumbosacral spine – AP and lateral view. The dynamic translations of vertebra over each other and their rotations were computed in 3 different levels: L5-S1, L4-L5 and L3-L4. The amount of translation was obtained from calculating absolute values of translation in both flexion and extension positions. After eliminating the magnification effect of radiographs, we measured the width of L3, L4 and L5 vertebral body. The vertebral width translation was expressed in percentage. Any translation more than 8% from the neutral lateral view or the sum of any angulations more than 11° in flexion and extension lateral views were considered as lumbar spinal instability.

We divided 500 patients in two group, group A & group B. In group A (N 350) we included patients having translation >8% or angulation > 11°considered as spinal instability with lower back pain. In group B (N 150) , we included patients having translation <8% or angulation < 11° considered as lower back pain without spinal instability.

OBSERVATIONS & RESULTS

In our study 500 Patient having lower back pain presented at govt. medical college, Kota on Outpatient door basis since September 2018 to December 2019 were included. In this group A contain 350 patient (backpain with spinal instability) while in group B 150 patient (backpain without spinal instability)

Out of 500 patients there was a male prevalence (290 male and 210 female). The mean age at the time presented at hospital 40.65 years (range 20-70years).

Table:- (1)distribution Of Cases According To Translation And Standard Deviation In Both Group

Spinal levels	Translations in group A (N=350)	STANDARD DEVIATION [GROUP A]	Translations in group B (N=150)	STANDARD DEVIATION [GROUP B]
L3-L4	7.0867 mm	2.37287	6.9459 mm	2.14237
L4-L5	7.7600 mm	2.70407	7.3848 mm	2.62584
L5-S1	7.8400 mm	2.03071	7.5471 mm	1.90753

Table:- (2) Distribution Of Cases According To Angulations And Standard Deviation

Spinal levels	Angulation in group A(N=350)	STANDARD DEVIATION [GROUP A]	Angulation in group B(N=150)	STANDARD DEVIATION [GROUP B]
L3-L4	8.6014°	3.10113	10.6097°	2.26701
L4-L5	9.2095°	2.99452	10.0000°	2.61667
L5-S1	10.7867°	9.81181	11.8531°	2.51796

Table:- (3) Distribution Of Cases According To Mean Verticular Width And Standard Deviation

Spinal levels	Mean vertebral width group A (N=350)	STANDARD DEVIATION [GROUP A]	Mean vertebral width group B (N=150)	STANDARD DEVIATION [GROUP B]
L3	42.2513 mm	2.00881	42.1313 mm	1.89775
L4	42.9120 mm	1.99810	42.8000 mm	1.94657
L5	43.8040 mm	1.94134	43.7150 mm	1.89881

Table:- (4) MEAN

Group	PI	Pelvic tilt	Sacral slope	Height	Weight	BMI
A (N=350)	47.6178	16.0060	39.4307	1.6396	64.3963	24.2533
B (N=150)	47.6178	16.0060	39.4307	1.6396	64.3963	24.2533

Table:- (5) Standard Deviation

Group	PI	Pelvic Tilt	Sacral slope	Height	Weight	BMI
A (N=350)	8.45874	5.71388	5.22822	.13906	12.94100	5.57425
B (N=150)	7.34272	4.97430	6.44398	.13440	12.51535	5.45917

Table:- (6) Mean Pelvic Incidence (PI)

Spinal levels	Mean Pelvic Incidence (PI)		P-value
	GroupA	GroupB	
L3-L4	56.6020±7.34272	47.6178±8.45874	0.06
L4-L5	55.67 ± 1.28	51.49 ± 1.62	0.06
L5-S1	47.38 ± 1.73	53.62 ± 0.91	0.01

RESULTS

In our study , out of 500 cases, 290 (52%) were males and 210 cases (48 %) were females with a mean age of 40.65 years (range 20-70years). All cases were divided according to presence of lumbar instability , group A (n=350): patients bearing nonspecific low back pain with lumbar instability (69.80%) and group B (n=150): patients bearing nonspecific low back pain without lumbar instability (30.20%).

The mean vertebral width of L3, L4 and L5 were 42.17 ± 1.97, 42.83 ± 1.98 and 43.7 ± 1.93 respectively and without any significant difference between two groups (P=0.06). We observed translations and angulations for each spinal level separately. We observed the maximum translation of 65% and angulation of 45° occur at L4 – L5 level followed by 20% translation and 33° angulation at L3 – L4 level and least translation of 5% and angulation of 10° at L5 – S1 level. We also measured mean pelvic incidence for both groups which was 47.6178 ± 8.45874 in group A and 56.6020±7.34272 in group B without any significant difference p value (0.06) in both groups. The evaluation of pelvic incidence separately for each level showed significantly lower in patients with lumbar instability of L5 – S1 origin (P=0.01) .

DISCUSSION

A normal lumbar spine movement follows a complex pattern during flexion and extension. The researchers have used various criteria for identifying abnormal kinematics in the patients with chronic low back pain, with the most common criteria being radiographically measurable abnormalities in the magnitude of sagittal plane rotation and translation found in statistically significant prevalence's in patients with recurrent chronic LBP The minimal changes in shape or orientation at one level of spinal segment will have a direct influence on the adjacent segment which leads to spinal instability[8]. Schuller[9] et al. found that A group of 49 patients with L4–L5 degenerative spondylolisthesis (12 males, 37 females, average age 65.9 years) was compared to a reference group of 77 patients with low back pain without spondylolisthesis (41 males, 36 females, average age 65.5 years). The patient's height and weight were assessed to calculate the BMI. The following parameters were measured on lateral lumbar radiographs in standing position pelvic tilt, pelvic incidence and sacral slope. The average BMI was significantly higher (P = 0.030) in the spondylolisthesis group compared to the reference group (28.2 vs. 24.8) and 71.4% of the spondylolisthesis patients had a BMI > 25. The radiographic analysis showed a significant increase of the following parameters in spondylolisthesis: pelvic tilt (25.6° vs. 21.0°; P = 0.046), sacral slope (42.3° vs. 33.4°; P = 0.002), pelvic incidence (66.2° vs.

54.2°; $P = 0.001$), The association of overweight and a relatively vertical inclination of the S1 endplate is predisposing factor for an anterior translation of L4 on L5.

The mean vertebral width of L3, L4 and L5 were 42.17 ± 1.97, 42.83 ± 1.98 and 43.7 ± 1.93 respectively and without any significant difference between two groups (P=0.06). We observed translations and angulations for each spinal level separately. We observed the maximum translation of 65% and angulation of 45° occur at L4 – L5 level followed by 20% translation and 33° angulation at L3 – L4 level and least translation of 5% and angulation of 10° at L5 – S1 level we also measured mean pelvic incidence for both groups which was 56.6020±7.34272 in group A and 47.6178 ± 8.45874 in group without any significant difference p value (0.06) in both groups. The evaluation of pelvic incidence separately for each level showed significantly lower in patients with lumbar instability of L5 – S1 origin (P=0.01) .The mean evaluation of pelvic incidence for L5 – S1 level showed significantly lower pelvic incidence in patients with lumbar instability. These finding of our study are comparable to above study of schulleret all Barrey et al. did a retrospective analysis of the spino-pelvic alignment in a population of 85 patients with a lumbar degenerative disease In this study, less than 45 years old, with a disc disease (DH or DDD) demonstrated to have a pelvic incidence significantly lower (48.3°) than the control group, $P < 0.05$. pelvic incidence ($P < 0.0005$ for DH, DDD and DSPL);

This observation of pelvic incidence in younger Individual with degenerative lumber instability is in concurrence of finding of our study which also show decreased pelvic incidence in cases of lumbar instability.[10]. Leone intimated disk shears are initially painful and can be presented as low back pain when pelvic incidence is increased. In this study, they have analysed the radiographic evaluation of pelvic incidence in 191 cases with chronic low back pain. Out of 191 cases, the levels of L5 – S1 cases showed 5% translation and 10° angulation. Which is again a similar observation in our study.[11]

Mohammad-Reza Golbakhsh1 etal did a study on 52 patient between 2010 to 2012 consisting group A) of 32 patient suffering from nonspecific low back pain without lumbar instability (61.5%) and group B comprises 20 patients diagnosed with nonspecific low back pain with lumbar instability (38.5%)

, They observed most translations and angulations occur at L4-L5 level with 65% at both. Next point belongs to L3-L4 level with 30% of translations and 25% of angulations. The Least frequency pertains to L5-S1 level with 5% and 8% for translations and angulations, respectively. At last by analyzing pelvic incidence, mean amounts set to 53.9 in group A and 57.7 in group B without any meaningful difference in both groups; but evaluating pelvic incidence separately for each level, they observed pelvic incidence is significantly lower in patients with lumbar instability of L5-S1 origin (P=0.01)[12]

In our study , mean vertebral width of L3, L4 and L5 were 42.17 ± 1.97, 42.83 ± 1.98 and 43.7 ± 1.93 respectively and without any significant difference between two groups (P=0.06). We observed the maximum translation of 65% and angulation of 45° occur at L4 – L5 level followed by 20% translation and 33° angulation at L3 – L4 level and least translation of 5% and angulation of 10° at L5 – S1 level . We also measured mean pelvic incidence for both groups which was 47.6178 ± 8.45874 in group A and 56.6020±7.34272 in group B without any significant difference p value (0.06) in both groups. The evaluation of pelvic incidence separately for each level showed significantly lower in patients with lumbar instability of L5 – S1 origin (P=0.01) The mean evaluation of pelvic incidence for L5 – S1 level showed significantly lower pelvic incidence in patients with lumbar instability Madhan Jeyaraman1, Vijay Kumar K1 etal did a study on 191 patient, out of them group A consisting of 91 cases suffering from nonspecific low back pain with lumbar instability (51.83%) and group B comprises 92 patients diagnosed with nonspecific low back pain without lumbar instability 48.16%)

They observed that mean pelvic incidence were calculated for both groups which set to 52.58 ± 1.18 in group A and 52.92 ± 1.67 in group B without any significant difference in both groups. The evaluation of pelvic incidence separately for each level showed significantly lower in patients with lumbar instability of L5 – S1 origin (P=0.01)[13].

CONCLUSION

The shape of the pelvis and spino-pelvic parameters influence the evolution of spinal degenerative disease. We observed that the patients with chronic low back pain with lumbar instability (Group A) showed decreased pelvic incidence whereas patients with chronic low back pain without lumbar instability (Group B) showed increased pelvic incidence. The cases with increased pelvic incidence are prone to develop degenerative spinal pathology or discogenic pathology which alters the postural balance of spinal column. Thus, the temporal association between pelvic incidence and lumbar stability was proved in our study. Lower pelvic incidences are associated with spine disorders but we think lower pelvic incidence is associated with lumbar instability in L5-S1 segment.

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