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Original Research Article

A STUDY OF LUMBAR SAGITTAL BALANCE ON CLINICAL RESULTS AFTER POSTERIOR INTERBODY FUSION FOR PATIENTS WITH ISTHMIC SPONDYLOLISTHESIS

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Abstract

Introduction: The spine and the body function within a cone of equilibrium with the focus of maintaining sagittal and coronal alignment with minimum energy expenditure. Differences in the anatomic development of the spine and the pelvis may cause individual variation in vertebropelvic alignment. Studies have confirmed that some structural features of the pelvis modulate and largely determine the amount of standing lumbar lordosis, as well as the sagittal pelvic alignment and spinopelvic balance. These effects on sagittal balance are related to the locked position of the fused vertebra.

Materials and Methods: A prospective study done at Department of Orthopaedics, Rama Medical College-Hospital & Research Centre,(Kanpur) of clinical outcomes of patients from October 2019 to 2021 August on patients with one or two level spondylolisthesis.

Preoperatively patient diagnosed with spondylolisthesis ,a clinical disability will be determined by Oswestry disability index[3] and radiological sagittal balance parameters pelvic tilt (PT), sacral slope (SS), pelvic incidence (PI) will be evaluated.

Results: mean Pelvic incidence (PI) of Pre-op were 27.25±3.30 followed by 3 Month Post OP 29.36±4.34, 6 Month Post OP 29.23±4.10 and 1 Year Post OP 29.70±4.53.

Conclusion: Low back ache has multifactorial etiology. Differences in sagittal spino-pelvic alignment in patients with low back ache are minor and that clinically, multiple factors contribute to Low Back Ache and lumbar disk degeneration.

Keywords: Spondylolisthesis, Lumbar, Spino-pelvic

Introduction

Low back pain is the most common cause of work related disability and one of the most common contributors to missed time at work[1]. This back pain can be aggravated by activity, which then leads to avoidance of activity and eventually disability. Back pain is also one of the most expensive burdens on the health care system. Low back pain (LBP) is a common medical problem. There is a 50–70% chance of a person having LBP pain during his or her lifetime[2].Non-specific low back pain can be characterized as acute if lasting less than six weeks, sub-acute if lasting between six weeks and three months, and chronic if lasting for longer than three months. Pain is often initiated by instability at a single motion segment, or the result of abnormal motion of vertebral bodies[2].Low back

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pain is one of the most common and disabling morbidities in the world today. It has a multifactorial etiology which may be due to psychosocial, environmental, postural, morphological or pathological factors . The chronicity of low back ache is found to be mainly determined by the psychosocial factors, however spino-pelvic mal alignment is also found to be one of the proven causes for persistent back ache. Once the normal spino-pelvic alignment is lost, there is more energy consumption by the body to maintain balance with a horizontal gaze without using any external aid. Hence, understanding the elements that compose sagittal alignment is essential for learning about its role in body balance and locomotion. In all individuals after puberty, pelvic incidence is found to be a fixed anatomical parameter and does not change with age or pathology. Pelvic incidence is defined as the angle between the line perpendicular to the sacral plate at its midpoint, and the line connecting this point to the axis of the femoral heads . Hence, it can be used as a reference guide to understanding variations among individuals and its relationship in people with low back ache. Although there are many studies that describe the spino-pelvic parameters among the normal population , its relation with low back ache is poorly understood in the Indian population.Patients with low back ache are found to have a more vertical sacrum, less distal lumbar lordosis and more proximal lumbar lordosis . found no relationship between lumbar lordosis and pelvic parameters when they compared asymptomatic subjects with LBA subjects, found that lumbar lordosis was reduced in patients with LBA, demonstrated increased lumbar lordosis in patients with chronic LBA when compared to controls.The objective of this study was to analyse the sagittal spino-pelvic parameters in patients presenting with low back ache and to find out the relationship between LBA, demographic and spino-pelvic parameters. Lumbar spinal instability is defined as the loss of ability of the spine to maintain its pattern of displacement under physiologic loads with no initial or additional neurological deficit, no major deformity, and no incapacitating pain.[3] Spinal fusion is a procedure in which two or more vertebral bodies are fused together using a bone graft and some form of stabilizing device. The majority of fusions are performed in an attempt to alleviate pain or correct disorder in the region of the intervertebral disc space, and success of this procedure relies on the type of instrumentation, bone graft material, and the individual biological factors of the patient[4]. The biomechanical result of a successful fusion is the elimination of movement at the instrumented segment[5].Fusion is defined as "the presence of bridging trabecular bone between the vertebral bodies". The most reliable radiographic indication of fusion postoperatively is the sentinel sign, or the presence of bridging bone anterior to the fusion cage[6].Fusion drastically changes the mechanics of the spine. The main problem results from the fact that it does not change the total amount of load placed upon the lumbar spine. The angular requirements for movement of the spine are then met by fewer segments, which have greater bending moments applied to them as a result. This can easily speed up the degeneration process at other segments, especially those adjacent to the fusion site[7].

Material and Methods

A prospective study done at Department of Orthopaedics, Rama Medical College-Hospital & Research Centre,(Kanpur) of clinical outcomes of patients from October 2019 to 2021 August on patients with one or two level spondylolisthesis. The indication for surgery was instability, as defined by the criteria for which instrumentation was needed to restore spine stability. The indications for fusion were in cases with combined severe low back pain and radicular pain, after failure of conservative treatment. All patients were initially assessed in the outpatient department and underwent a detail evaluation of neurological status; radiographs were taken and underwent treatment as per specific treatment plan.

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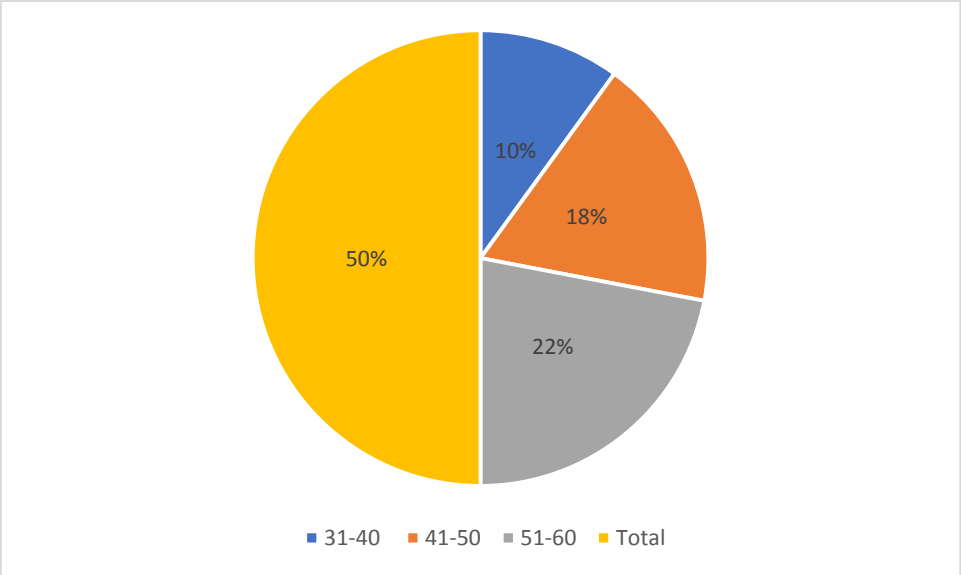
Result

Table 1: Distribution of Mean Age Groups

Age-Group (Year)	No	Percentage
31-40	**10**	**20**
41-50	**18**	**36**
51-60	**22**	**44**
Total	**50**	**100**
Mean±SD	**22.63±8.71 years**	

In table 1, most of the patients were in belongs to 51-60 years i.e 44% and least were 31-40 years 20%.



Graph 1: Distribution of Mean Age Groups

In Graph 1, most of the patients were in belongs to 51-60 years i.e 44% and least were 31-40 years 20%.

Table 2: Distribution of Gender

Gender	No	Percentage
Male	10	20
Female	40	80
Total	50	100

In table 2, female was predominant in our study 80%.

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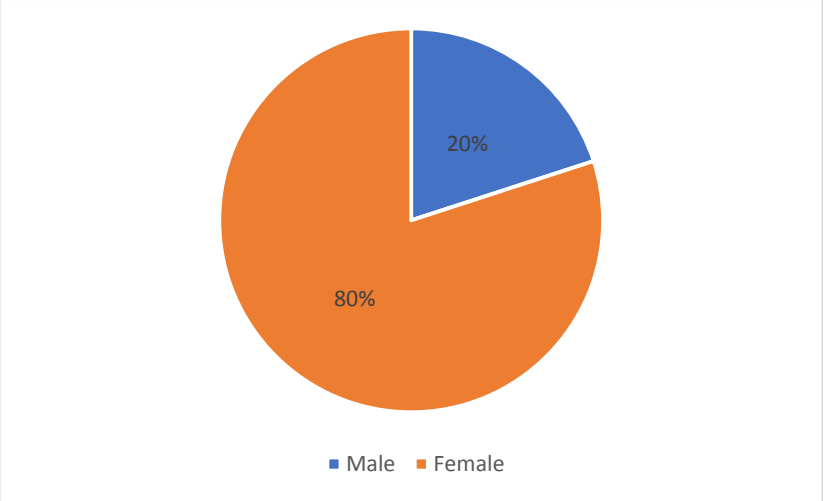


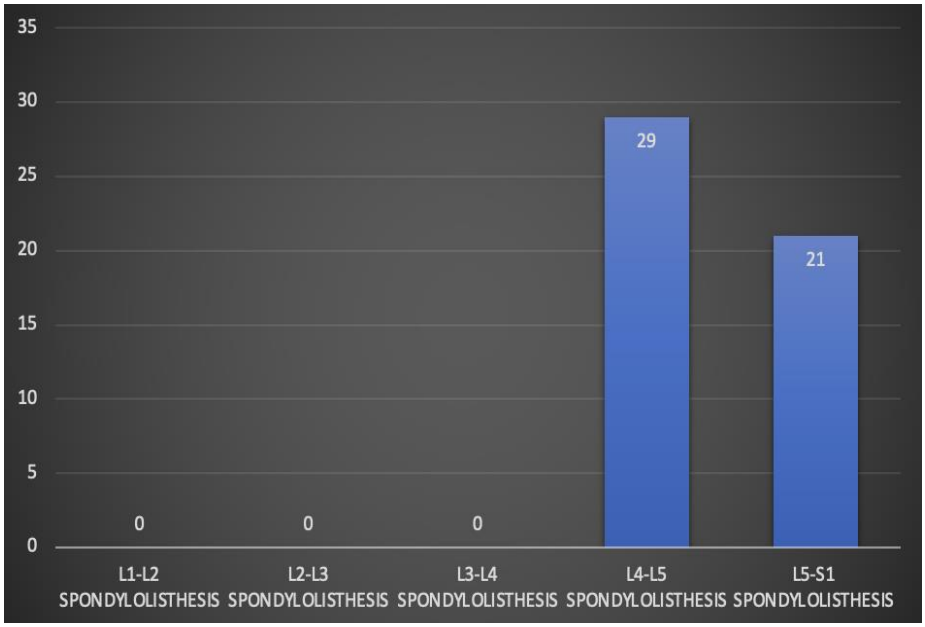
Graph 2: Distribution of Gender

In Graph 2, female was predominant in our study 80%.

Table 3: Distribution of Diagnosis of patients

Diagnosis	No	Percentage
L1-L2 SPONDYLOLISTHESIS	0	0
L2-L3 SPONDYLOLISTHESIS	0	0
L3-L4 SPONDYLOLISTHESIS	0	0
L4-L5 SPONDYLOLISTHESIS	29	58
L5-S1 SPONDYLOLISTHESIS	21	42
Total	50	100

In table 3,
L4-L5 Spondylolisthesis were 42% and L5-S1 Spondylolisthesis were 42%.



Graph 3: Distribution of Diagnosis of patients

In Graph 3, L4-L5 Spondylolisthesis were 42% and L5-S1 Spondylolisthesis were 42%.

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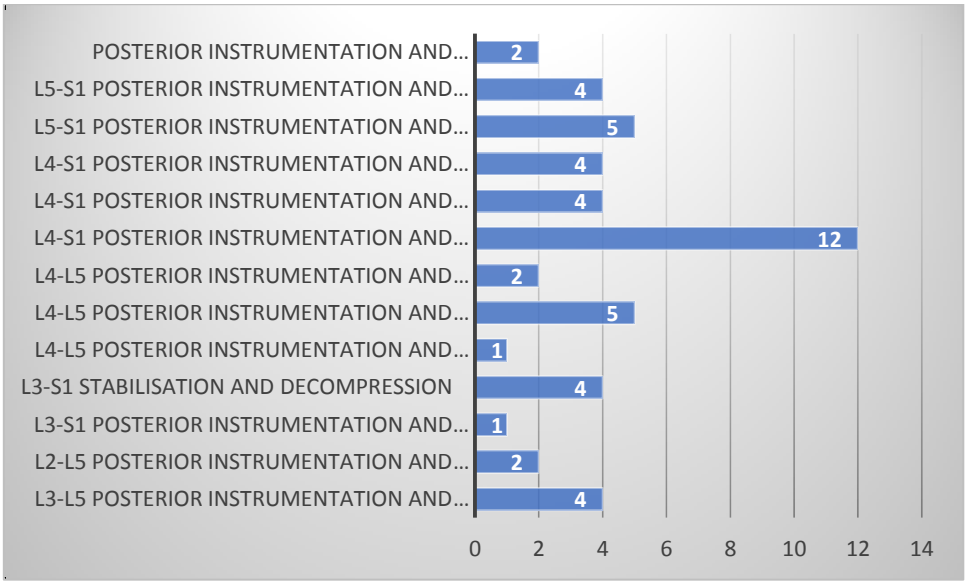
Table 4: Distribution of procedure done

Procedure	No	Percentage
L3-L5 POSTERIOR INSTRUMENTATION AND STABILISATION	4	8.0%
L2-L5 POSTERIOR INSTRUMENTATION AND STABILISATION AND PLF FUSION	2	4.0%
L3-S1 POSTERIOR INSTRUMENTATION AND STABILISATION	1	2.0%
L3-S1 STABILISATION AND DECOMPRESSION	4	8.0%
L4-L5 POSTERIOR INSTRUMENTATION AND STABILISATION	1	2.0%
L4-L5 POSTERIOR INSTRUMENTATION AND STABILISATION AND PLIF L4-L5	5	10.0%
L4-L5 POSTERIOR INSTRUMENTATION AND STABILISATION AND TLIF L4-L5	2	4.0%
L4-S1 POSTERIOR INSTRUMENTATION AND STABILISATION	12	24.0%
L4-S1 POSTERIOR INSTRUMENTATION AND STABILISATION AND DECOMPRESSION	4	8.0%
L4-S1 POSTERIOR INSTRUMENTATION AND STABILISATION AND PLIF FUSION AND DECOMPRESSION	4	8.0%
L5-S1 POSTERIOR INSTRUMENTATION AND STABILISATION	5	10.0%
L5-S1 POSTERIOR INSTRUMENTATION AND STABILISATION+TLIF TITANIUM AND ILIAC GRAFT	4	8.0%
POSTERIOR INSTRUMENTATION AND STABILISATION FROML4-S1	2	4.0%



Graph 4: Distribution of procedure done

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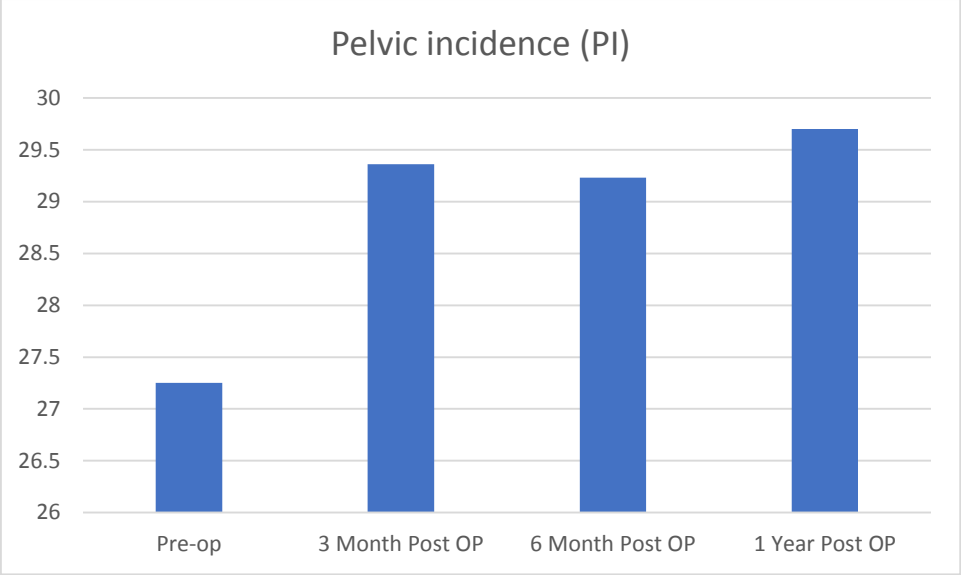
Table 5: Distribution of mean Pelvic incidence (PI)

Duration	Pelvic incidence (PI) Mean±SD
Pre-op	27.25±3.30
3 Month Post OP	29.36±4.34
6 Month Post OP	29.23±4.10
1 Year Post OP	29.70±4.53

In table 5, mean Pelvic incidence (PI) of Pre-op were 27.25±3.30 followed by 3 Month Post OP 29.36±4.34, 6 Month Post OP 29.23±4.10 and 1 Year Post OP 29.70±4.53.



Graph 5: Distribution of mean Pelvic incidence (PI)

In table 5, mean Pelvic incidence (PI) of Pre-op were 27.25±3.30 followed by 3 Month Post OP 29.36±4.34, 6 Month Post OP 29.23±4.10 and 1 Year Post OP 29.70±4.53.

Discussion

Earlier theory suggested that isthmic defects result of separate ossification centers, this theory now have been largely discredited. Recent findings support the theory that spondylosis and isthmic spondylolisthesis probably results from a combination of genetic factors and mechanical factors. There is a increased prevalence of spondylolisthesis among first degree relatives of patients with isthmic spondylolisthesis or spondylosis .This strongly supports and inherited predisposition, it is more common in sports person suggesting that mechanical factors also play a significant role. The peak mechanical stress of centered at the isthmus. This it has been accepted that this isthmus defects are the result of successive fatigue fractures are common in patient with genetic predisposition.

It is important to isolate the specific symptoms signs and functional disability that distinguish spondylolisthesis from other type of low back pain. In our study we examined cases of isthmic spondylolisthesis in which this despite conservative treatment previously received by these patient, their symptoms has not decrease and also most of most of the patients have neurological deficient on examination and their dynamic radiological i.e.flexion extension views revealed lumbar instability. A slip or fracture of the intervertebral joint is usually

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acquired between the age of 6 and 16 years, but remain unnotice until adulthood .In our study 75% of the patient 21 out of 28 patient were in a group of 40 to 60 years which made us understand that even though the are prone for the disease in the adolescent age group but most patients remain asymptomatic until their middle ages. Since spinal arthrodesis was first reported 90 years ago, various techniques have been developed for lumbar spine fusion. The field has evolved from uninstrumented fusion to use of 1 or more of the following: allograft, auto graft, metallic cages, carbon fiber cages, BMP, and supplemental instrumentation. Lumbar fusion has been recommended in some patients who did not improve after an extended, multimodality trial of non surgical therapy. Age and sex distribution: In our study we had most of the patients were in belongs to 51-60 years i.e 44% and least were 31-40 years 20%. most of the patients were in belongs to 51-60 years i.e 44% and least were 31-40 years 20%,female was predominant in our study 80%.Ching-Hsiao Yu et al[87] in their study had 56% males and 46% females in BG group, 23% males and 77% females in cage group with mean age 59% yrs.

Table 6: Comparing Age and Sex.

	Our study (50)		Ching-Hsiao Yu et al[8]	
	BG group(50)	Cage group (50)	BG group(34)	Cage group(42)
Males	10 (20%)	9 (11%)	19 (56%)	10 (23%)
Females	40 (80%)	41 (89%)	15 (44%)	32 (77%)
Mean age(yrs)	22.63	68.07	58.7	59.4

Level of instability: In our study, L4-L5 Spondylolisthesis were 42% and L5-S1 Spondylolisthesis were 42%. Dong yeob lee et al[68], in their study found 77% instability at L4-L5, 19 % at L5-S1 level and 4% at L3-L4 level.

Table 7: Comparing level of instability

Level	Our study		Dong yeob lee et al[9]	
	BG group(10)	Cage group (10)	BG group(34)	Cage Group(42)
L1-L2	0	0		
L2-L3	0	0		
L3-L4	0	0	2 (6%)	7 (2%)
L4-L5	29(58%)	4O (80%)	20 (59%)	32 (76%)
L5-S1	21 (42%)	10 (20%)	11 (33%)	(7%)

Clinical outcome: Satisfactory outcomes were obtained in Cage group because there is better maintenance of disc space, vertebral height and no collapse. In BG group, bone graft alone is used, which is less rigid and lead to collapse before the fusion occurs. This was attributed to increase pain, disability and less satisfaction even after surgery.

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