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Original Research Article

A CROSS SECTIONAL STUDY ON LUMBAR SPONDYLOLISTHESIS AT L4-L5 AND L5-S1 LEVEL VERTEBRAE IN SOUTH KARNATAKA REGION

[1]Dr. Adil Ahmed Karnul, [2]Dr. Azra Mubeen Karnul, [3]Dr Abdul Aziz Riyaz, [4]Dr. Mahjabeen HB

[1]Assistant Professor, Vydehi Medical College, Bangalore.

[2]Associate Professor, Department of Anatomy, East Point College of Medical Sciences, Bangalore.

[3]Consultant Neurosurgeon at S S Sparsh Hospital, Bangalore.

[4]Junior Resident at Department of Neurosurgery at Malnad Lifeline Hospital, Shimoga.

Corresponding Author: Dr. Azra Mubeen Karnul

Abstract

Introduction: Purpose of this study is to find out clinical profile of low-grade spondylolisthesis at L4-L5 and L5-S1 vertebrae in rural south Karnataka population. Co-relation between grades of spondylolisthesis and Modic change (MC) is not extensively reasearched. In heavy workers incidence of low back ache is common. Low grade spondylolisthesis has more options of treatment than high grade spondylilosthesis.

Material and Methods: Cross sectional study was carried out in a span of 2 years in 40 patients with age 20-70 years with single-level L4/L5 and L5/S1 low grade (Meyerding's grade I and II) spondylolisthesis, with clinical and neurological examination, assessment of pain by Visual Analogue Score (VAS) and investigations like X ray CT scan & MRI.

Statistical analysis: Descriptive statistics like tables and percentages were used to present the data. Mean and standard deviations are calculated for quantitative parameters. Chi-square test was used to find co relation between MC & grades of lumbar spodylolisthesis.

Results: Out of 40 cases, 27.5% were males and female were 72.5%. The most affected age group was 40-60 years (65%). Lower back pain (LBP) was the most common symptom (100%). Straight leg raise test was positive in 81.25%. Sensory and motar deficit was seen in 45% of patients. Average slip angle was 16. L4-L5 level is affected in 60%. Incidence of Meyerding's grade I & II were 67.5% & 32.5% respectively. In both grades females were more in distribution than males and L4-L5 vertebral level was involved significantly. Isthmic (IS) & Degenerative (DS) spondylolisthesis was 82.5% & 17.5% respectively and seen significantly in females. In IS the level affected was L5-S1 and in DS L4-L5 level. Incidence of MC type1 is 15%, type 2 is 85% and type3 were not found in any cases. Incidence of females was higher in type 1 & 2 M.C (83.3% & 70.6%) as compared to males (16.6% & 29.4%). MC were found to be common in grade II spondylolisthesis (48%) at L4-L5.

Conclusions: Incidence of spondylolisthesis, grade and MC are gender specific. This study elucidates the clinical presentations of low-grade spondylolisthesis and specific changes associated with it and that will help in tracing factors responsible for it and assessing treatment outcome.

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Key words: spondylilosthesis. Myerding's grade, VAS, Modic changes, Slip angle, Isthemic and degenerative.

Introduction

Spondylolisthesis is defined as displacement of one vertebra over the adjacent lower vertebra in sagittal plane which is one of the commonest causes for low backache (LBA). In general, it is due to posture, gravity and repeated stress, activities that involve repetitive lumbar hyperextension and sagittal orientation of facets etc. [(1)] The incidence of spondylolisthesis is 5-6 % in the general population, however the increased prevalence up to 12% noted in adult engaged in heavy works, which signifies that mechanical factor is important etiology for this condition. Several studies suggest congenital predisposition to spondylolisthesis with prevalence of 27 to 69% among family members of the affected individuals. The most affected vertebrae are L4 and L5, which are the keystones of the lumbo-sacral spine, providing stability by supporting physiological loads preventing unnecessary motion. The risk factors that increase the likelihood of further slippage are younger age, increased BMR, female sex, presence of spina bifida, wedging of the vertebrae, increased pelvic incidence and tilt, rounding of the anterior sacral dome and hype lordosis [(1).] Pain in lower back is commonest symptom of low-grade spondylolisthesis. Sciatica can also be a presentation of spondylolisthesis. Radiological spondylolisthesis is graded into four types(Fig no, by Meyerding depending upon the severity of the vertebral slip. He divided the upper surface of inferior vertebra into four equal parts [(2)] and slip of the superior vertebra up to 25%-type I, 25-50% type II, 51-75% type III and 76-100% type IV. Grades 1 and 2 are considered as low grades, grades 3 and 4 are considered as high-grade spondylolisthesis [(2)]. Wiltse et al [(3)] classified into five types Type I-congenital i.e due to dysplasia, Type II-isthmic due to fatigue fractures of pars interarticularis due to repeated trauma, Type III-due to degenerative conditions like arthritis and associated with disc degeneration. Type IV-.traumatic to spine, Type V is pathologic and can be caused by lytic bone tumors, osteopetrosis, or osteoporosis. Type VI is iatrogenic spondylolisthesis and is a potential sequela of spinal surgery.

Isthemic spondylolisthesis is congenital or caused by a stress fracture of the bone and is especially common in adolescents who overtrain in sports activities [(4)]. Degenerative spondylolisthesis differs from isthmic/lytic spondylolisthesis by the normal pars interarticularis. Both Degenerative and isthmic spondylolisthesis can be observed as incidental findings in asymptomatic patients in CT scans. A good understanding of the natural history of these conditions is important to counsel patients and determine a course of action [(4)]. Modic changes (M.C) has strong corelation with LBP & is seen as degenerative vertebral endplate and here subchondral bone marrow changes are seen in MRI scans of spondylolisthesis cases [(4)]. M.C are 3 types [(5)], Type-1 - changes are hypointense on T1-weighted imaging (T1WI) and hyperintense on T2-weighted imaging (T2WI) and represent bone marrow oedema and inflammation. Type-2 - hyperintense on T1WI and isointense or slightly hyperintense on T2WI and associated with conversion of normal red hemopoietic bone marrow into yellow fatty marrow because of marrow ischemia. Type-3 - subsequently described as hypointense on both T1WI and T2WI and represent subchondral bone sclerosis. However mixed types are also observed, which is due to conversion of one type to another [(6)]. Etiology of M.C are not well understood but studies suggest it is due to mechanical stress leading to these degenerative changes. Albert et al reported possibility of anaerobic bacterial infection of disc which has not been proved so far [(7)]. Further research will dig into finding out therapeutic alternatives in management of this condition.

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Conservative management of spondylolisthesis consists of rest, pain control, bracing and physiotherapy. Surgical management of spondylolisthesis consists of decompression and instrumented fusion. Patients with grade I or II spondylolisthesis that have no accompanying impairments of daily living activities can be managed conservatively. In patients with grade III, IV spondylolisthesis, the decision to treat surgically is still very controversial [(8)].

Materials and methods:

A prospective study of 40 patients of low-grade lumbar spondylolisthesis has been conducted in 14 months periods. After meeting all inclusion, exclusion criteria and written consent, patient with age of 20-70 patient with low back ache, sciatica & Single-level L4/L5 and L5/S1 grade I or grade II were included, pathological and traumatic cases were excluded in the study. Neurological examination, assessment of pain by questionnaires and visual analogue score (VAS) and investigations like X ray – AP view, lateral view, flexion and extension, CT scan & MRI were recorded. MRI was done in individuals who were showing neurological symptoms and signs.

Statistical analysis:

Descriptive statistics was done to present the data with mean±SD,data was presented in frequency distribution
tables. Analysis was done with IBM SPSS statistics ver.16. To corelate between MC with gender, levels of vertebrae & grades, Chi-square test was utilised. Statistical significance was defined as a p value of <0.05.

Results:

In our study, out of 40 patients, females were 72.5%, males were 27.5%, the mean age was 49.2 years (S. D is 11.71). The commonest age group affected was between age of 40-49 and 50-60 years 32.5% in each group followed by age group of 60-70 year, 20% cases. In the range of age group of 40-60 there were 50.3% male patients and 65% female patients. There was no male patient below 40 years of age. Spondylolisthesis was higher in females than males in almost all the age groups except 60-70 years where 62.5% males & 37.5% females are affected (Table No.1).

The mean BMI was found to be 26.8 with SD of 4.3. Lower back ache was the commonest symptoms in all 100% cases, radiating pain was 2nd most common symptoms. 81.25% of patients showed unilaterally SLRT test positive (Table No 2) at L4-L5 level and in grade I as compared to other levels. 75% had EHL weakness and 25% patient had FHL weakness. Sensory deficits were noted at L5 dermatome in 42.8% patients and 57% patients at S1 dermatome (Table No-3). The duration of symptoms was up to 1 year in 55% patients, 1-2 years in 12.5 % patients, 2-3 years in 12.5 % patients and more than 3 years in remaining 20% of patients. Average VAS was 8.33. Average Slip angle was 14.6 and 17.69 in male and female respectively with S.D of 4.1 in males and 3.98 in females. Slip angle of 10-14 in 16% of cases, in other ranges, 15-19, 20-24 and 25-29 angles were up to 20% in each.

The vertebral level involved in spondylolisthesis is L4-L5, 24 cases (60%) and at L5-S1, 16 cases (40%). Meyerding's Grade 1 and 2 spondylolisthesis cases were 67.5% and 32.5% respectively (Table No-3). In grade I, males were 10% and 5% and females were 27.5% & 25% at L4-L5 & L5-S1 levels. In grade II males 10% & 2.5% as compared to females 12.5% & 7.5% in distributions at L4-L5 & L5-S1 (Table No-3).
Distribution of Isthmic spondylolisthesis (IS) was 82.5% (Table No-3), out of that at both levels L4-L5 grade I and L5-S1 grade I, males 9% & 3% as compared to females were by

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21.2% & 27.3% respectively. L4-L5 and L5-S1 grade II, males 12.1% and 3%as compared to females were more by 15.5% and 9%. IS was seen maximum in females in the grades I spondylolisthesis at L5-S1 level. Distribution of degenerative spondylolisthesis (DS) was 17.5% (Table No-3). Grade I at L4-L5 and L5-S1 males were 14.2% each at both levels and females were 57.1% and 14.2% respectively. No cases were seen in at L4-L5 II and L5-S1 grade II. DS was seen maximum in females in grade I at L4-L5.

Type 1 MC changes are seen in 15% cases out of that 16.6% were of males and 83.3% of females and Type 2 changes were 85% of cases out of that 29.4% of males and 70.6% were of females. Modic type 3 changes were not noted in any patient (Table No-4).
MC were seen 70% of grade II spondylolisthesis cases 30% in grade I. In grade II, type 2 MC were seen in males 21.4% and females 62.3% (p value-0.005). MC in relation vertebral level at L4-L5 42.8% cases and at the L5-S1 levels 21.4% in both low grades spondylolisthesis (p value 0.008).

Table 1: age and gender wise distribution of cases.

Age	Males	Females	Total
20-29	0 (0%)	2 (100%)	2(5%)
30-39	0 (0%)	4 (100%)	4(10%))
40-49	3 (23%)	10 (76.9%)	13(32.5%)
50-59	3 (27.3%)	10 (76.9%)	13(32.5%)
60-70	5 (62.5%)	3 (37.5%)	8(20%)
Total	11 (27.5%)	29 (72.5%)	40(100%)

Table 2: Out of 40 Positive SLRT with grade wise distribution of cases

SLRT	Right leg	Left leg
L4 -L5 -I	15(37.5%)	11(27.5%)
L4 -L5 -II	8(20%)	8(20%)
L5-S1 -I	8(20%)	8(20%)
L5-S1-II	4(10%)	3(7.5%)
Total	35(87.5%)	30(75%)

Table No 3: Distribution of spondylolisthesis cases for various indices:

Index	L4-L5				L5-S1				Total
Motar deficit: FHL/EHL	3(75%)				1(25%)				4(10%)
Sensory deficit	6(42.8%)				8(57%)				14(35%)
Vertebral levels with grades	L4 -L5 -I		L4 -L5 -II		L5-S-I		L5-S1-II		Total
Gender	Males	Female	Males	Female	Males	Female	Males	Female	

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Meyerding's grades	4 (10%)	11 (27.5%)	4 (10%)	5 (12.5%)	2 (5%)	10 (25%)	1 (2.5%)	3 (7.5%)	40 (100%)
Isthmic spodylolisthesis	3(9%)	7 (21.2%)	4 (12.1%)	5 (15.1%)	1 (3%)	9 (27.3%)	1 (3%)	3 (9%)	33 (82.5%)
Degenerative spodylolisthesis	1 (14.2%)	4 (57.1%)	0 (0%)	0 (0%)	1 (14.2%)	1 (14.2%)	0 (0%)	0 (0%)	7 (17.5%)

FHL: Flexor Hallucis Longus, EHL: Extensor Hallucis Longus

Table no 4: Modic changes with grade and gender wise distribution

VARIABLES	**TYPE1**	**TYPE2**	**X^2 & P VALUE**
Modic Change (n = 40)	6 (15%)	34 (85%)	-
Gender			
Male	1 (16.6%)	10 (29.4%)	1.792, 0.181
Female	5 (83.3%)	24 (70.6%)	
Grade			
Grade 1	2 (16.6%)	10 (83.3%)	1.050, 0.02*
Grade 2	4 (14.3%)	24 (85.7%)	
Levels affected			
L4-L5	1 (4.3%)	22 (95.6%)	0.037, 0.847
L5-S1	5 (29.4%)	12 (70.6%)	

Values are presented in percentages. N= number, *Statistical significance data <0.05

Fig no 1: Grade I Spodlolisthesis: upto 25% slip

Fig No 2: Grade II Spondylolisthesis: 50% slip

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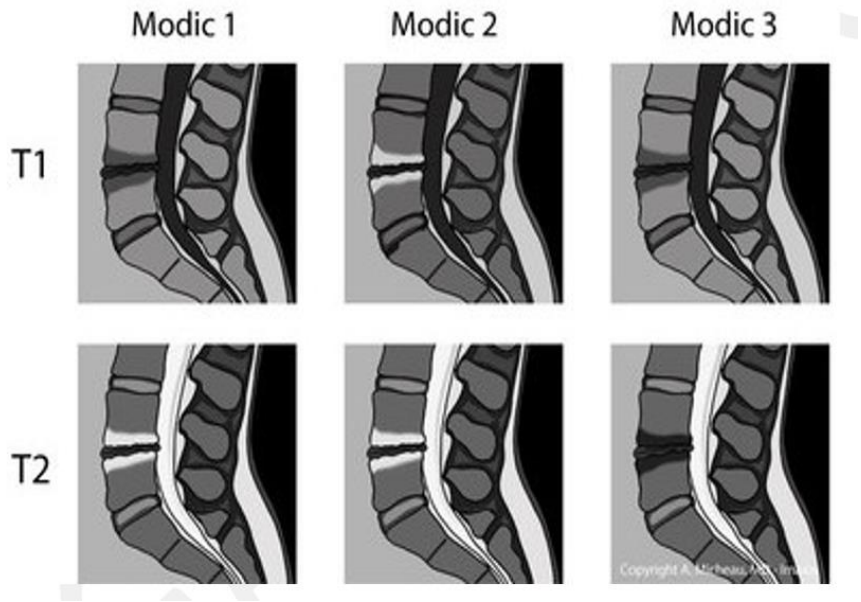

Fig No 3: Modic changes.

Discussion:

Out of 40 cases, 65% of cases were noted in the age group of 40-60 years. The mean age of the patients in our study is 49years.The mean age in a study by Lei Cheng et al [8] study was 49 years and Sakeb et al [9] were 46 yrs. A study done in South India by Manickam et al [10] had similar mean age which was 40.64 years, while as study done by Vatsal et al [11] showed most of cases are in the range of 50-59. In our study, 72.5% are females and males 27.5% which indicate female preponderance and M:F ratio 1:3, which could be due to females are lacking in having strong protective muscle strength and ligaments. The female preponderance of our study was comparable to 68 % of females in a study by Manickam et al [10]. and 78.8% of females in a study by Sakeb et al [9]. Females are more in number with lytic (isthemic) spondylolisthesis in our study. It is noted by Ivkovic et al [12] that women are at greater risk for stress fractures than men. Though pars interarticularis defects are more common in men than in women, women are more likely to have spondylolisthesis reported by Tallarico et al [13]. Males suffer lytic spondylolisthesis more commonly than females [2,14]. As most of the females in our study were agricultural laborers engaged in heavy and hard field work causing stress fractures of pars inter articularis. This could be the probable reason for the female preponderance in isthemic spondylolisthesis subgroup.

In our study low back pain (LBP) was noted in all 100% cases and radiculopathy was 87.5%. It corelates with study done by Lei Cheng et al [8], it was noted 91.3% of patients suffered from LBA and 89% suffered from radiculopathy. Sakeb et al [9] documented that 100 % of patients in their study suffered from LBA whereas 86% of patients suffered with radiculopathy. The duration of symptoms was up to 1 year in 55% patients and 2-3 and 3 years equally 20%, our finding does'nt match with study done by Vatsal et al [11] and Newman et al [15]. SLRT is positive in most of grade I cases (p value->0.05) indicating that presentation of spondylolisthesis is regardless of grade of spondylolisthesis. Our study showed slip angle 10-14 in 16%, in other ranges of angle upto 20%. Similar to the study by DK Vatsal et al [12] showed 10-14 angle in 16.7% of cases and equally distributed in other groups. Degree of slip is low in in DS grade I [16]. Since spondylolisthesis is not only forward vertebral slip but also there is rotational displacement which could produce errors while measuring by observers as reported by Yi Xiang [17]. It has been reported that the progression of slipping is slow and not correlated to age at diagnosis and initial degree of

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spondylolisthesis [17]. However, improvement in Slip angle is the index which can be used for assessing the segmental instability and progress of spondylolisthesis while treating it.

L4-L5 level of spondylolisthesis is noted in our study in 60 % of cases. Our findings are in accordance with study done in south Indian population, Manickam et al [10] the authors noted 56 % of patients had L4-5 and 44 % of L5- S1 spondylolisthesis. Dantas[18] reported equal number of patients involving L4-5 and L5-S1 levels. Debnath et al [19] and Panchal et al [20] 84 % of patients were suffering from L5-S1 level compared to only 16% of L4-5 level. This inconsistent result could be due to variation in study population.

Grade I spondylolisthesis was noted in 67.5% while as grade II was in 32.5% of spondylolisthesis cases which is similar to study done by Cheng et al [8], Vatsal et all [11] and Panchal et al [20]. Our study shows majority of females were affected significantly (p value-=0.008) in grade I, at L4-L5 then followed by L5-S1 & in grade II spondylolisthesis at L4-L5 indicating that lower grades of spondylolisthesis is gender specific, but our study is limited to low grades of spondylolisthesis, needs further exploration of research to higher grades of spondylolisthesis.

In our study, Isthmic type of spondylolisthesis (82.5%) is more common than degenerative type (17.5%). Similar observation was noted in another study by Devkota et al [21], where they have noted 41 % of IS patients were 22 % of DS patients, in both females were showing more incidence than males. Isthmic spondylolisthesis is found to have no severe disability thus indicates that no surgical requirement is needed [22]. IS found to be more in females at L5-S1 levels because of L5 pars defect, this finding is same as that of Aruna et al [23]. Recurrent trauma because of repeated flexion, hyperextension and rotational movements in women field workers are the factors for development of IS in our study. Similat to our study Yi Xiang reported higher incidence of DS in female gender in grade I at L4-L5, they also concluded that DS is gender-specific and age-specific [16]. Our finding is also in accordance with Youmonas et al [24] & Lara-Almunia et al [14].
We noted all the all patients showed Modic changes in the endplates, type 2 changes in 85%. Similar to studies done by Rahme et al [25] and Kuisma et al [26]. According to Yue-Hui Zhang [4] type 1 and type 2 are the most common patterns in the lumbar spine, it is disputed whether type II is more frequent than type 1. Andrew et all [27] reported Modic type 2 changes more common and significantly associated with disc degeneration in lower lumbar vertebrae particularly at L4-L5, our study includes both IS & DS.

All 100% cases showing Modic change, presented with LBP indicating strong association between LBP and Modic changes, particularly to type 2 changes and higher incidence in female gender. Similar to the study done by Yue-Hui Zhang [4]. According to Kuisma et al [26] type 1 MC is associated positively with LBP symptoms, who included only females in their study. Jarvinen et al [28] reported type 1 MC is more common and after adjustment it becomes insignificant and concluded that type1 change with LBP should be considered as specific subgroup of LBP cases, this difference in the occurrence of type of MC could be due to inclusion of disc degenerative cases in their study.

It has been found that most MC type 1 progresses to type 2 in 18–24 months [6]. Type 2 M.C appears to be more stable state however, it may convert to MC type 1 in unstable conditions or may eventually progress to type3 [27,28]. Conversion of MC can be affected by measures of clinical intervention, which aim at treating symptoms of spondylolisthesis or the disease itself by surgical treatment.

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Exact causes of MC are not clear, their occurrence may be closely related to abnormal load and stress, increased BMI, lax abdominal musculature and lordosis due to multigravida, conditions related to harmones like lactation and menopause are the risk factors that will affect vertebral endplates and the microenvironment of adjacent vertebral bone marrow, resulting in these histological and radiological changes [27,28]. The relationship between heavy smoking and MC also was showed by Leboeuf-Yde et al [29]. Low levels of female sex hormones in postmenopausal women can be associated as evidenced by the benefit of regimen of early harmone replacement therapy(HRT) in menopausal women in lumbar degenerative spondylolisthesis may be considered in cases with anatomical high risk of developing DS, such as high lumbar lordosis, vertebral end-plate inclination, severe disc degeneration and loss of height, and facet joint sagittal orientation particularly with symptoms [30].Our study lack in comparing MC in relation to IS and DS. Further research has to be conducted to find out MC in this particular subgroup of spondylolisthesis. In our study type 2 MC are significantly high in grade II spondylolisthesis in females involving L4-L5 levels. To our knowledge this corelation between Modic changes and grades of spondylolisthesis was no done so far in literature, the current study is the first study to present such data. Link between M.C and levels of vertebrae and grade of spondylolisthesis is helpfull in finding out etiological factors involved in the progression of MC and could be helpful in taking measures of treatment. Our study is limited to low grade spondylolisthesis hence further follow up studies should be be carried out to co relate MC, mechanism responsible for changes and effect of treatment on this changes which will help in deciding the best clinical treatment.

Conclusion:

Spondylolisthesis is common between 40-60 years of age. L4-L5 vertebral level was involved more. SLRT is a presentation of spondylolisthesis regardless of grade. Grade I spondylolisthesis incidence is high and were seen more in females and at L4-L5. Females are more prone for both isthemic and degenerative types of spondylolistheses. In IS, LS5-S1 level is affected more and in DS L4-L5 level. MC is specifically related to LBP due to spondylolisthesis. Type2 change is seen in grade II spondylolisthesis cases at L4-L5 levels more evidently and it is gender specific. Grade of spondylolisthesis could be linked to specific type M.C, which could help in finding out factors responsible. MC and its conversion could be the indicator of progress of disease and treatment provided. Further studies of MC will explore relationship between symptoms and therapeutic possibilities. Link between clinical features, specific radiological signs and understanding of structural changes will help in taking decision of trearment.

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