Original Article

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Radiology Section

Magnetic Resonance Imaging Quantification of Lumbar Spinal Canal Stenosis in Symptomatic Subjects

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ABSTRACT

Introduction: Low backache is a common condition to occur in the middle age. It is mainly caused by the degeneration of the intervertebral disc which forms the main support to the vertebral column. Lumbar spinal canal stenosis results in the compression of spinal cord and nerves at the level of lumbar vertebra.

Aim: The purpose of this study is to measure the spinal canal dimensions and correlate with the clinical symptoms to establish a radiological criterion based on MRI for diagnosis of lumbar canal stenosis. This study is done to improve the diagnostic accuracy of lumbar spinal canal stenosis.

Materials and Methods: Two hundred subjects with complaints of low backache without a traumatic history underwent Magnetic Resonance Imaging (MRI) after assessment of pain by two methods: 1. Oswestry Disability Index (ODI) scoring and 2. Wong Baker Facial Expression scale. All the images were qualitatively analyzed to obtain the MRI grading for central canal at various levels from L1 to S1 vertebra after making sure that the neural foramina is not involved. Anteroposterior (AP) and transverse diameter of spinal canal at intervertebral disc and upper part of vertebral body levels and spinal canal area are measurements that are taken. Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on mean±SD (min-max) and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance.

Results: The spinal canal diameter measured along its AP and transverse direction is found to be correlating with the severity of low backache complained by the patient. Comparing the two methods of clinical assessment, ODI scoring was found to be more significant.

Conclusion: The spinal canal measurements can be used as a radiologic criterion for diagnosis of acquired lumbar spinal canal stenosis. This will improve the diagnostic accuracy. However, in case of presence of any other pathology or traumatic history with bony fractures, these criterions could not be used.

Keywords: Cauda equina, Intervertebral discs, Low backache, Neural foramina, Oswestry Disability Index (ODI)

INTRODUCTION

Lumbar spinal canal stenosis results in the compression of spinal cord and nerves at the level of lumbar vertebra. There can either be central stenosis or foraminal stenosis. Central stenosis is the narrowing of the entire canal and foraminal stenosis is the narrowing of the foramen through which the nerve root exits the spinal canal [1]. The most common causes for lumbar spinal stenosis include spondylosis, disc degeneration, and ligament thickening. Other causes include spinal fracture and an abnormally narrow spinal canal, which may be an inherited condition.

Clinical manifestations of stenosis include low back pain as well as radiating pain in the thighs legs and feet. It can also results in loss of bowel and bladder control [2]. These clinical symptoms occur due to the cauda equina and the lumbar nerve roots compression leading to neural root ischemia and neurogenic claudication. The narrowing of the neural foramina is responsible for the radiating pain to the lower limb. Similar symptoms may also occur in case of any tumour mass or an abscess. Usually, patients with narrowing of the spinal canal or neural foramina gives a history of lifting heavy weights (while doing household works or while doing workouts in gym etc.,), doing strenuous work or chronicity. Hence, personal and medical history are important while evaluating the case of low backache. The preferred method for diagnosis and evaluation of this condition is MRI [3].

Although, studies on spinal canal stenosis using various techniques like conventional radiography, CT and MRI and various parameters are documented, still the radiological criteria for diagnosing significant lumbar stenosis is controversial especially in early symptomatic stage. The recent development of MRI has made it possible to obtain clear images of the spinal canal non-invasively, thereby making measurements of spinal canal and spinal cord more applicable to routine practice and suitable for best diagnosis of spinal canal stenosis [2].

MATERIALS AND METHODS

This observational clinical study was performed in the Department of Radiodiagnosis, Mahatma Gandhi Medical College and Research Institute, Puducherry, India, for 1 year from August 2013 to July 2014.

Patients of all age groups who were referred for MRI of Lumbo-sacral spine with complaints of low backache and willing for MRI were included in this study. PHILIPS 1.5T MRI was used throughout the study.

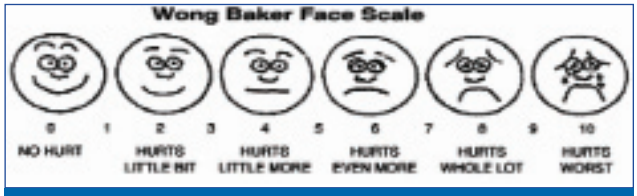
A total of 200 patients were involved in this study (male-106, female-94). Patients between 18-60 years of age referred for lumbosacral spine MRI with complaint of low backache were selected and their MRI images were qualitatively analysed and only those cases with spinal canal involvement alone and no neural foraminal involvement were selected. An informed consent was obtained from every patient. Patients not willing to give consent, patients with spinal deformities and post-operative patients were excluded from the study.

Clinical grading was done using the Wong Baker Facial Expression scale and ODI scoring. Both these scoring were used because the facial expression scale is a subjective scoring and it depends on individuals ability to bear the pain. Some patients even though having a minimal pain won't be able to bear it and will give a higher grade for their pain.

Wong Baker Facial Expression scale: It was mainly developed for young patients to quantify their pain themselves. It consists of 6 faces from no pain to worst pain [4]. Grading is as follows-

Face 0: is very happy because he doesn't hurt at all; Face 1: hurts just a little bit; Face 2: hurts a little more; Face 3: hurts even more; Face 4: hurts a whole lot more; Face 5: hurts as much as you can imagine, although you do not have to be crying to feel this bad [Table/Fig-1] [1].

Oswestry Disability Index scoring: ODI scoring was first published by Jeremy Fairbank et al. in Physiotherapy in 1980 [5,6]. Currently, many clinicians and researchers consider ODI as the gold standard to quantify the disability in a person with low backache [6,7]. It consists of a set of 10 questions that gives the clinicians the information as to how the pain has affected the patient's ability to manage in everyday life. Scoring methods is as follows: 0% to 20%: Minimal disability; 21%-40%: Moderate Disability; 41%-60%: Severe Disability; 61%-80%: Crippling back pain; 81%-100%: These patients are either bed-bound or have an exaggeration of their symptoms [8]. [Table/Fig-2] gives the image of the questionnaire that is used for scoring.



[Table/Fig-1]: Wong Baker's facial scale used for grading the pain. [1]

All scans were conducted on a 1.5T MRI with a sense spine coil.

T1-weighted and T2-weighted sagittal and axial images are acquired [T1W sag- TR/TE- 400/80; FOV:AP- 300, RL- 66, FH- 329; Slice gap- 0.4; Slice thickness- 4 mm; Matrix- 332X262; Flip angle- 90; T2W sag- TR/TE-3000/80; FOV:FH- 331 mm, RL-66 mm, AP- 285 mm; Slice thickness- 4 mm; Slice gap- 0.4 MM; Flip angle- 90; Matrix- 440X57; T1W axial- TR/TE-3500/90; FOV:FH- 30 mm, FH- 30 mm, RL- 170 mm, AP-170; Slice thickness- 4 mm; Slice gap- 0.4 MM; Flip angle- 90; Matrix- 240X166; T2W axial- TR/TE-550/84; FOV:FH-30 mm, FH-30 mm, RL-170 mm, AP-170; Slice thickness- 4 mm; Slice gap- 0.4 MM; Flip angle- 90; Matrix- 292X199;].

AP and transverse spinal canal diameter was measured in axial section at intervertebral disc level. Spinal canal area was measured at intervertebral disc level. The method with which the measurement is made is given in [Table/Fig-3a-c].

MRI grading of the central canal stenosis was also noted which is as follows: Grade 0 = No lumbar stenosis without obliteration of anterior CSF space; Grade 1 = Mild stenosis with separation of all cauda equina; Grade 2 = Moderate stenosis with some cauda equina aggregated; and Grade 3 = Severe stenosis with none of the cauda equina separated [9].

Ethics

The study was conducted after obtaining approval from the ethical committee of the institute. Informed and written consent was obtained from all the patients who were included in the study beforehand. Patients who were not willing to give consent were not included in the study.

STATISTICAL ANALYSIS

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on mean±SD (min-max) and results on categorical measurements are presented in number

Patient's Name_____ Number_____ Date_____

LOW BACK DISABILITY QUESTIONNAIRE (REVISED OSWESTRY)

This questionnaire has been designed to give the doctor information as to how your back pain has affected your ability to manage in everyday life. **Please answer every section and mark in each section only ONE box** which applies to you. We realize you may consider that two of the statements in any one section relate to you, but **please just mark the box which MOST CLOSELY describes your problem.**

Section 1 - Pain Intensity

- ☐ I can tolerate the pain without having to use painkillers.
- ☐ The pain is bad but I can manage without taking painkillers.
- ☐ Painkillers give complete relief from pain.
- ☐ Painkillers give moderate relief from pain.
- ☐ Painkillers give very little relief from pain.
- ☐ Painkillers have no effect on the pain and I do not use them.

Section 2 -- Personal Care (Washing, Dressing, etc.)

- ☐ I can look after myself normally without causing extra pain.
- ☐ I can look after myself normally but it causes extra pain.
- ☐ It is painful to look after myself and I am slow and careful.
- ☐ I need some help but manage most of my personal care.
- ☐ I need help every day in most aspects of self care.
- ☐ I do not get dressed, I wash with difficulty and stay in bed.

Section 3 – Lifting

- ☐ I can lift heavy weights without extra pain.
- ☐ I can lift heavy weights but it gives extra pain.
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example on a table.
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.
- ☐ I can lift very light weights.
- ☐ I cannot lift or carry anything at all.

Section 4 – Walking

- ☐ Pain does not prevent me from walking any distance.
- ☐ Pain prevents me from walking more than one mile.
- ☐ Pain prevents me from walking more than one-half mile.
- ☐ Pain prevents me from walking more than one-quarter mile
- ☐ I can only walk using a stick or crutches.
- ☐ I am in bed most of the time and have to crawl to the toilet.

Section 5 -- Sitting

- ☐ I can sit in any chair as long as I like
- ☐ I can only sit in my favorite chair as long as I like
- ☐ Pain prevents me from sitting more than one hour.
- ☐ Pain prevents me from sitting more than 30 minutes.
- ☐ Pain prevents me from sitting more than 10 minutes.
- ☐ Pain prevents me from sitting almost all the time.

Scoring: Questions are scored on a vertical scale of 0-5. Total scores and multiply by 2. Divide by number of sections answered multiplied by 10. A score of 22% or more is considered significant activities of daily living disability.
(Score ___ x 2) / (Sections x 10) = %ADL

Section 6 – Standing

- ☐ I can stand as long as I want without extra pain.
- ☐ I can stand as long as I want but it gives extra pain.
- ☐ Pain prevents me from standing more than 1 hour.
- ☐ Pain prevents me from standing more than 30 minutes.
- ☐ Pain prevents me from standing more than 10 minutes.
- ☐ Pain prevents me from standing at all.

Section 7 -- Sleeping

- ☐ Pain does not prevent me from sleeping well.
- ☐ I can sleep well only by using tablets.
- ☐ Even when I take tablets I have less than 6 hours sleep.
- ☐ Even when I take tablets I have less than 4 hours sleep.
- ☐ Even when I take tablets I have less than 2 hours sleep.
- ☐ Pain prevents me from sleeping at all.

Section 8 – Social Life

- ☐ My social life is normal and gives me no extra pain.
- ☐ My social life is normal but increases the degree of pain.
- ☐ Pain has no significant effect on my social life apart from limiting my more energetic interests, e.g. dancing.
- ☐ Pain has restricted my social life and I do not go out as often.
- ☐ Pain has restricted my social life to my home.
- ☐ I have no social life because of pain.

Section 9 – Traveling

- ☐ I can travel anywhere without extra pain.
- ☐ I can travel anywhere but it gives me extra pain.
- ☐ Pain is bad but I manage journeys over 2 hours.
- ☐ Pain is bad but I manage journeys less than 1 hour.
- ☐ Pain restricts me to short necessary journeys under 30 minutes.
- ☐ Pain prevents me from traveling except to the doctor or hospital.

Section 10 – Changing Degree of Pain

- ☐ My pain is rapidly getting better.
- ☐ My pain fluctuates but overall is definitely getting better.
- ☐ My pain seems to be getting better but improvement is slow at the present.
- ☐ My pain is neither getting better nor worse.
- ☐ My pain is gradually worsening.
- ☐ My pain is rapidly worsening.

Comments_____

Reference: Fairbank, Physiotherapy 1981; 60(8): 271-3. Hudson-Cook. In Roland, Jonnor (eds.), Back Pain Now Approaches To Rehabilitation & Education. Manchester Univ Press, Manchester 1989: 187-204

[Table/Fig-2]: Oswestry disability Index Questionnaire with which scoring is made [2-4].

(%). Significance is assessed at 5 % level of significance. The following assumption on data is made, Assumptions: 1. Dependent variables should be normally distributed, 2. Samples drawn from the population should be random, and cases of the samples should be independent.

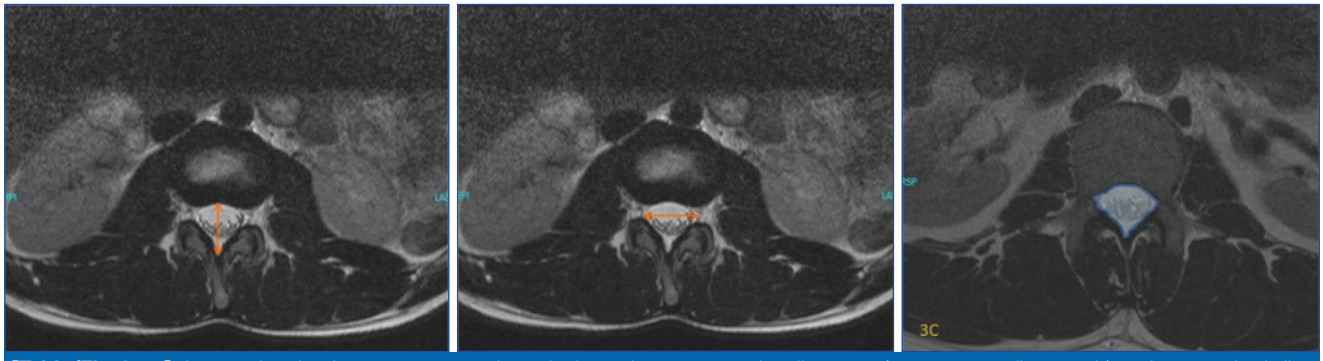
To find the significance of study parameters between three or more groups of patients, Analysis of Variance (ANOVA) has been used. Between two groups (Inter group analysis), to find the significance of study parameters on continuous scale, Student's 't'-test (two tailed, independent) has been used. Based on categorical scale between two or more groups, the significance of study parameters has been found by Chi-square/Fisher's Exact test.

Significant figures:

+ Suggestive significance (p-value: $0.05<p<0.10$)

* Moderately significant (p-value: $0.01<p\leq0.05$)

** Strongly significant (p-value: $p\leq0.01$)



[Table/Fig-3a-c]: Image showing how to measure the spinal canal anteroposterior diameter a); transverse diameter b); at intervertebral disc level and c) spinal canal area.

Statistical software: The statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc. All these softwares were used for cross reference for better quality results. However, only the result from SPSS 15.0 was used in the study [10-13].

RESULTS

Out of the 200 patients included under the study, the number of males and females were almost equal, with a slight male predominance of 53%. Majority of those were in the age group of 41-50 (28%), 31-40 (25%) and 20-30 (24%). Symptomatic male patients were among the age group of 20-60 years, with slightly more number in the 2nd to 3rd decade, then 5th to 6th decade whereas in females, predominant symptomatic patients were in the age group of 4th to 5th decade.

In our study, the AP diameter of spinal canal measured at the intervertebral disc level is in the range of 14.81±1.78 mm. The transverse diameter of the spinal canal falls in the range of 21.47±3.22 mm at intervertebral disc level. Minimum and maximum spinal canal area in our study, with a range of 151.34±40.85 mm^2, was 37 mm^2 at L4-L5 and 500 mm^2.

[Table/Fig-4] shows the correlation of measurements of AP diameter of the spinal canal at IVD level with ODI scoring in which strong significance was noted at levels L2-L3 and L3-L4, moderate significance was noted at L1-L2, L4-L5 and L5-S1 levels and overall, a strong significance was noted on correlation of the AP diameter of spinal canal at IVD level with ODI scoring. [Table/Fig-5] explains the correlation of measurement of AP diameter of spinal canal at IVD level

Measurement	ODI Grading					Total	p-value
	Minimal Disability	Moderate Disability	Severe Disability	Crippling Backache	Bed-Bound		
L1-L2	18.15±2.31	17.23±1.56	17.19±1.81	16.25±2.35	16.63±2.96	17.01±2.00	0.012*
L2-L3	18.53±2.21	16.79±1.36	17.14±2.31	16.34±2.39	18.07±2.74	16.94±2.13	0.009**
L3-L4	18.47±1.48	16.48±1.38	15.98±2.33	15.67±2.12	15.70±2.01	16.2±2.05	<0.001**
L4-L5	15.03±2.08	13.44±2.14	12.76±3.37	12.54±2.59	14.57±2.51	13.12±2.79	0.022*
L5-S1	12.55±2.01	10.98±2.95	10.97±2.71	9.82±3.78	11.20±1.49	10.79±3.08	0.048*
Average	16.54±1.58	14.98±1.18	14.82±2.01	14.12±1.82	15.23±1.88	14.82±1.78	<0.001**

[Table/Fig-4]: Spinal canal diameter (Anteroposterior) at intervertebral disc level with Oswestry Disability Index scoring.

Measurement	Facial Scale			Total	p-value
	Mild Pain	Moderate Pain	Severe Pain		
L1-L2	17.49±1.99	17.04±1.75	16.30±2.56	17.01±2.00	0.027*
L2-L3	17.14±2.12	17.04±2.16	16.34±2.02	16.94±2.13	0.175
L3-L4	17.00±1.85	15.98±2.20	15.92±1.45	16.20±2.05	0.011*
L4-L5	13.68±2.57	13.19±2.96	12.13±2.25	13.12±2.79	0.039*
L5-S1	11.59±2.65	10.89±2.62	9.44±4.38	10.79±3.08	0.006**
Average	15.37±1.74	14.82±1.79	14.03±1.52	14.81±1.78	0.003**

[Table/Fig-5]: Spinal canal diameter (Anteroposterior) at intervertebral disc level with facial scale grading.

Measurement	ODI Grading					Total	p-value
	Minimal Disability	Moderate Disability	Severe Disability	Crippling Backache	Bed-Bound		
L1-L2	24.40±1.29	21.83±2.79	22.85±2.39	21.64±2.72	20.90±2.87	22.26±2.67	0.002**
L2-L3	23.78±0.96	21.36±2.74	21.78±2.38	21.04±2.57	21.17±2.48	21.56±2.55	0.014*
L3-L4	22.73±1.36	20.22±2.36	21.22±3.55	20.15±2.72	20.07±2.78	20.69±2.94	0.019*
L4-L5	24.15±2.61	20.29±5.04	21.44±4.45	19.75±4.33	20.67±1.74	20.79±4.57	0.023*
L5-S1	23.90±6.06	21.53±6.00	23.09±5.52	20.49±6.82	25.23±5.06	22.05±6.11	0.075+
Average	23.79±1.67	21.04±3.32	22.07±3.17	20.61±3.17	21.61±2.67	21.47±2.67	0.009**

[Table/Fig-6]: Spinal canal diameter (transverse) at intervertebral disc level with Oswestry Disability Index scoring.

Measurement	Facial Scale			Total	p-value
	Mild Pain	Moderate Pain	Severe Pain		
L1-L2	23.78±2.49	22.23±2.57	20.39±1.94	22.26±2.67	<0.001**
L2-L3	22.66±2.25	21.73±2.36	19.62±2.52	21.56±2.55	<0.001**
L3-L4	22.05±2.03	20.67±3.03	19.02±2.77	20.69±2.94	<0.001**
L4-L5	23.55±3.81	20.62±4.25	17.81±4.54	20.79±4.57	<0.001**
L5-S1	24.49±5.23	22.24±5.47	18.32±7.42	22.05±6.11	<0.001**
Average	23.31±2.72	21.49±3.01	19.03±2.97	21.46±3.22	<0.001**

[Table/Fig-7]: Spinal canal diameter (transverse) at intervertebral disc level with facial scale grading.

with facial scale. Strong significance was noted at L5-S1. The correlation of measurement of Transverse diameter of spinal canal at IVD level with ODI scoring showed strong significance at L1-L2 level [Table/Fig-6]. Strong significance was noted at all the intervertebral disc levels on correlating the measurement of transverse diameter of spinal canal at IVD level with facial scale [Table/Fig-7]. The correlation of measurement of spinal canal area with ODI scoring showed strong significance at L1-L2, L2-L3, L3-L4 and L4-L5 levels except at L5-S1 level which showed moderate significance [Table/Fig-8] whereas, strong significant was noted only at L1-2 and L4-5 levels on correlation of the spinal canal area measurement with facial scale and moderate significant at L3-4 and L5-S1 levels [Table/Fig-9]. Overall, comparison of all the study variables

Measurement	ODI Grading					Total	p-value
	Minimal Disability	Moderate Disability	Severe Disability	Crippling Backache	Bed-Bound		
L1-L2	244.00±121.77	203.06±32.67	194.18±39.58	182.32±33.57	172.33±25.52	196.39±46.89	<0.001**
L2-L3	193.67±62.38	176.16±30.46	171.85±40.94	158.96±32.38	144.33±14.26	170.49±37.87	0.008**
L3-L4	191.83±60.60	158.13±31.93	147.41±46.38	131.6±31.18	113.00±20.57	148.52±41.87	<0.001**
L4-L5	192.67±106.51	132.72±51.69	126.26±55.54	109.04±29.9	94.67±31.5	127.06±56.04	<0.001**
L5-S1	153.67±128.11	125.69±45.86	106.21±56.03	105.12±50.29	80.00±32.88	114.23±59.11	0.015*
Average	195.17±93.57	159.15±29.16	149.18±41.02	137.41±22.44	120.87±20.57	151.34±40.84	<0.001**

[Table/Fig-8]: Spinal canal area with Oswestry Disability Index scoring.

Measurement	Facial Scale			Total	p-value
	Mild Pain	Moderate Pain	Severe Pain		
L1-L2	206.78±66.94	199.08±38.61	174.28±33.01	196.39±46.89	0.004***
L2-L3	175.26±43.24	172.31±36.22	158.44±34.23	170.49±37.87	0.098+
L3-L4	156.39±47.66	151.03±41.76	130.22±27.76	148.52±41.87	0.011*
L4-L5	149.65±69.37	124.49±51.91	106.61±39.16	127.06±56.04	0.002**
L5-S1	123.48±79.48	117.68±52.11	91.11±44.32	114.23±59.11	0.029*
Average	162.31±56.49	152.92±35.19	132.13±26.42	151.33±40.85	0.003**

[Table/Fig-9]: Spinal canal area with facial scale grading.

Measurement	ODI Scoring					Total	p-value
	Minimal Disability	Moderate Disability	Severe Disability	Crippling Backache	Bed-Bound		
Spinal Canal Diameter (AP): IVD	16.55±1.58	14.98±1.18	14.81±2.02	14.12±1.82	15.23±1.89	14.81±1.78	<0.001**
Spinal Canal Area	195.17±93.58	159.15±29.17	149.18±41.02	137.41±22.47	120.87±20.58	151.34±40.85	<0.001**
Spinal Canal Diameter (trans) IVD	23.79±1.68	21.05±3.32	22.08±3.18	20.61±3.17	21.61±2.67	21.47±3.22	0.009**

[Table/Fig-10]: Comparison of study variables with Oswestry Disability Index scoring.

Measurement	Facial Scale			Total	p-value
	Mild Pain	Moderate Pain	Severe Pain		
1. Spinal Canal Diameter (AP): IVD	15.38±1.74	14.83±1.79	14.03±1.52	14.81±1.78	0.003**
2. Spinal Canal Area	162.31±56.5	152.92±35.19	132.13±26.42	151.34±40.85	0.003**
3. Spinal Canal Diameter (trans) IVD	23.31±2.72	21.5±3.01	19.03±2.97	21.47±3.22	<0.001**

[Table/Fig-11]: Comparison of study variables with facial scale grading.

with ODI and facial scoring showed strong significance [Table/Fig-10,11].

DISCUSSION

An Indian study on Western Maharashtra population consisting of measurements of lumbar spinal canal diameters showed statistically significant differences in their mean values for males and females indicating sexual dimorphism. Comparison with other groups showed ethnic variation [14].

A research done in India using MRI on skeletons of Indians and Italians on the anteroposterior diameter of lumbar spinal canal shows that the mean values are larger in Italian skeletons emphasizing the racial difference in the lumbar spinal canal diameter [15].

Another study in India on cadavers measuring the transverse and sagittal diameter of the lumbar vertebral canal in correlation with X-rays reveals that there are probably subtle racial differences in size of the spinal canal thus emphasizing the need for an established grading system [16].

A similar study has been done on CT to define the normal values of lumbar spinal canal in patients with symptoms of lumbar spinal stenosis to establish norms of the transverse diameter of the spinal canal [17].

A CT based study on quantitative size assessment of the lumbar spinal canal by Computed Tomography stated that lowest possible anteroposterior diameter at L4 is 8 mm and L5 is 10 mm [18]. Few other references stated that the lowest possible normal limit for anteroposterior diameter is 12 mm [19,20].

A study was conducted to establish the relationship between clinical symptoms with LSS and osseous AP spinal canal diameter as measured on axial magnetic resonance imaging [21]. This study found no significant correlation between imaging appearances and levels of disability in patients with LSS.

In the present study, on comparing the correlation of all these measurements with the two clinical assessment methods that we used (ODI and Wong Baker Facial scale), we found that the ODI scoring was more significant. This could be because of the fact that ODI scoring assesses the patient's disability through questionnaire, whereas the facial scale is more patient dependent. Assessment with facial scale differs in every patient depending on their ability to bear the pain. Some patients may be able to withstand pain while some may not be able to bear even a slight pain.

However, the clinical examination to assess the involved nerve root was not done in our study which will be helpful to look for pathology at that level of nerve root and only the quantity of pain was taken into account. Some cases with a non-traumatic low backache had other pathologies like Pott's spine or dural mass lesions. Such cases were not included in our study. While cases of Pott's spine may give a history of fever, cough and cold, cases with masses will not have such history. They may give history of low backache alone. Few cases had fracture of the lumbar spine but traumatic history was not present, which may be a pathological fracture also. However, such cases were excluded from our study.

Thus, the spinal canal diameter measured along its AP and transverse direction is found to be correlating with the severity of low backache complained by the patient (assessed by using ODI scoring and Wong Baker facial scale) which can be used as a radiologic criterion for diagnosis of acquired lumbar spinal canal stenosis. This will improve the diagnostic accuracy. However, in case of presence of any other pathology, these criterions could not be used.

LIMITATION

There are a few limitations in this study. First of all, low backache itself is a generalized symptom that can occur not just because of degenerative disc disease, it can occur with many other conditions like renal or ureteric calculus, tuberculosis or any other infective conditions involving the spine etc., to name a few. This study was done in patients with low backache who were not having any other pathologies other than the disc bulge or in post-operative patients. This criterion may not be used in such patients. The other limitation is that the pain scale used may or may not be accurate as the pain tolerance changes with each patient, some patients can

tolerate even severe pain while some may not tolerate even a minimal pain.

CONCLUSION

The spinal canal diameter measured along its AP and transverse direction is found to be correlating with the severity of low backache complained by the patient (assessed by using ODI scoring and Wong Baker Facial scale). Severity of the fatty infiltration of the lumbar multifidus muscle is strongly correlating with the severity of pain by ODI scoring rather than with the facial scale. The ligamentous inter facet distance, lateral recess and neural foraminal measurements were not found to be strongly correlating with the clinical severity. Comparing the two methods of clinical assessment we have used, ODI scoring was found to be more significant. Thus, the spinal canal measurements and severity of fatty infiltration can be used as a radiologic criterion for diagnosis of acquired lumbar spinal canal stenosis. This will improve the diagnostic accuracy.

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