# CORRELATION BETWEEN CLINICAL NEUROGENIC CLAUDICATION OUTCOME SCORE (NCOS) AND RADIOLOGICAL GRADING OF LUMBAR SPINAL STENOSIS ON MAGNETIC RESONANCE IMAGING LUMBOSACRAL SPINE

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## ABSTRACT

***Objective***: To evaluate whether the clinical grading system of Neurogenic Claudication Outcome Score has the same causal relationship to severity of spinal stenosis on Magnetic Resonance Imaging in patients of neurogenic claudication.

***Study Design***: Cross sectional study.

***Place and Duration of Study***: Department of Neurosurgery, Combined Military Hospital Lahore. Jan 2020 to Apr 2020.

***Methodology***: Sixty patients of both genders with complaints of neurogenic claudication were scored as per Neurogenic Claudication Outcome Score. Symptoms of back pain, leg pain and numbness were recorded. Effect on daily routine, frequency of medication, doctor visit and pain intensity score were asked. Magnetic Resonance Imaging of lumbosacral spine was graded as; grade 0 = no obliteration of anterior cerebrospinal fluid space; grade 1 = mild stenosis with all cauda equina nerve roots separated, grade 2 = moderate stenosis some of cauda equina fibers aggregated, grade 3 = severe stenosis with none of cauda equina separate on T2 weighted image.

***Results***: Patient's age range was 33–80 years, mean of 60.6 ± 14.31 with female to male ratio of 1.5:1. For pain intensity scale (1-10), 21 (35%) gauged it to be 8 whereas 9 (15%) patients rated as 9 on pain scale. Most common level of spinal stenosis was L4/5 in 31 (51.6%), followed by L5/S1 level in 14 (23.3%) patients. Neurogenic claudication outcome score score ranged from 35-63 with mean 49.5. When neurogenic claudication outcome score was plotted against radiological grade, there was no statistically significant association amongst the two parameters ($p$=0.285).

***Conclusion***: There is no significant causative relationship between the clinical and radiological grading system for patients with spinal stenosis.

**Keywords**: Lumbar spinal canal stenosis (LSCS), Magnetic resonance imaging (MRI), Neurogenic claudication, Neurogenic claudication outcome score (NCOS), Spinal stenosis.



## INTRODUCTION

Patients with spinal canal narrowing present with neurogenic claudication which is feeling of pain, heaviness and paresthesia in one or both buttocks, legs/calf due to compression of spinal nerve roots in lumbar spine[1]. The disabling symptoms appear on standing upright and walking for variable distance depending on the severity of narrowing of spinal canal. Symptoms are relieved on stopping and sitting down. Reason of clinical presentation is that compression secondary to age related hypertrophied ligamentum flavum which compresses the thecal sac and spinal canal diameter narrows the most in standing posture and retracts on leaning/sitting posture essentially expanding the spinal canal. Various scoring systems have also been used in various studies to measure severity of back pain and disability such as Oswestry Disability Index, Roland Morris Disability Questionnaire, Japanese Orthopedic Associations score and Short Form-36 score[2,3]. In order to identify the clinical status of patients in spinal stenoses, Neurogenic Claudication Outcome Score (NCOS) was first used by Weiner and Fraser in spinous process osteotomies and laminectomies[4-6]. NCOS includes 7 questions (scores of

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0, 2, 4 and 6) and a pain score (0-10) and maximum score of 100, depending on the functionality of individual in daily life activities. Magnetic Resonance Imaging (MRI) grading scores like dural sac cross-sectional area and dural sac anterior-posterior diameter have been difficult to use in routine practice, with variable clinical relevance and require diagnostic work station. An easy to use grading system was given by Lee in 2011 which specifies 4 grades (0-3) depending on the degree of separation of cauda equina on MRI of lumbosacral spine T2 weighted images[7]. This study aimed to correlate the clinical score (NCOS) and radiological grade on MRI, for their relevance which has not been done before.

## METHODOLOGY

This study was conducted in Neurosurgery Department of Combined Military Hospital (CMH) Lahore. Sixty patients of both genders, age range of 30-80 years with history of neurogenic claudication were recruited, randomly selected and registered in January 2020 after their consent. Duration of study was four months (till 60 patients could be registered) and it was completed in April 2020. Patients with history of spine inflammatory, neoplastic disease, previous spine surgery, chronic depression on antidepressants, diabetes mellitus and those with co morbid which effect mobility like heart problems/hip and knee osteoarthritis were excluded from the study. The database collected included general patient data (age, sex, body mass index (BMI), smoking, and working status), nature of employment, distance before claudication symptoms starts, sitting and standing tolerance, symptoms relationship to daily activities, frequency of doctor visit and analgesics. Level of pain intensity felt by the patients (scale of 1-10) was recorded. Total score range of NCOS was 0-100 with high score representing better functional status. All the data were entered on predesigned proforma. We defined lumbar spinal canal stenosis (LSCS) as the obliteration of the cerebrospinal gluid (CSF) space in front of the cauda equina in the dural sac on T2-weighted axial images. In patients of multiple level spinal stenosis, the level with maximum compression was selected. LSCS was divided into four grades according to degree of separation of the cauda equina on T2-weighted axial images done on MR Scanner (Philips Healthcare 1.5 Telsa) with TE 120 and TR 2500: grade 0 defined as no LSCS as the anterior CSF space was not obliterated; grade 1 defined as mild LSCS in which the anterior CSF space was mildly obliterated but all cauda equina could be clearly separated from each other; grade 2 defined as moderate LSCS in which the anterior CSF space was moderately obliterated and some of the cauda equina were aggregated making it impossible to visually separate them; and grade 3 defined as severe LSCS in which the anterior CSF space was obliterated so severely as to show marked compression of the dural sac and none of the cauda equina could be visually separated from each other, appearing instead as one bundle

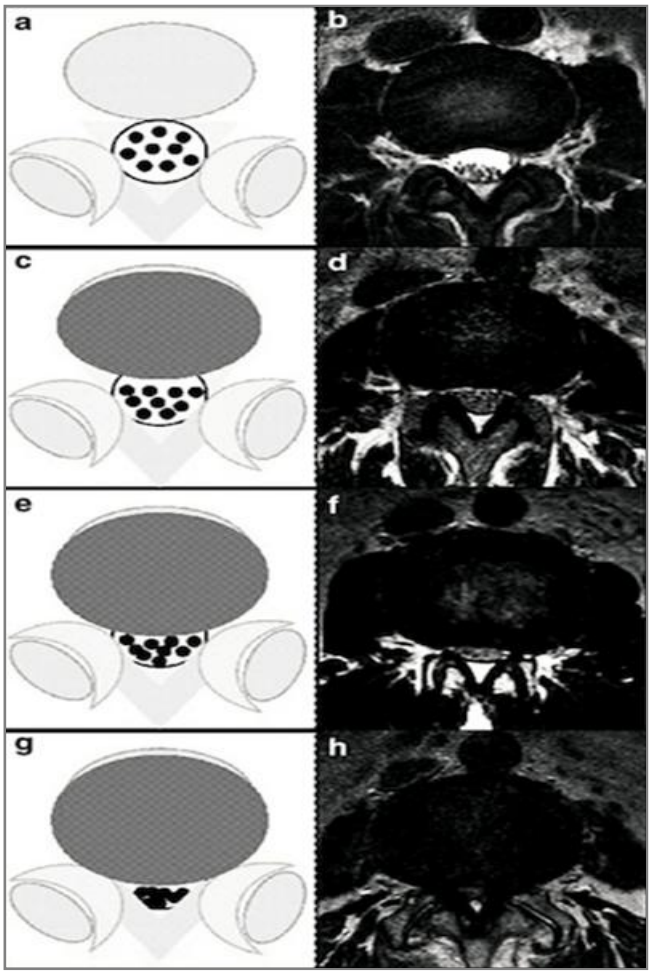


**Figure-1: Radiological grading of stenosis.**

(figure). Ethics review board approval was obtained vide reference number 147/2020. Data was analysed using SPSS software version 20. Frequencies, percentages and means were calculated for quantitative variables.

## RESULTS

Patients' age range was 36–80 years with mean of 60.6 ± 14.31 years, with female to male ratio of 1.5:1. There was history of smoking in 44 (73%) but smoking did not have a statistical relationship with lower NCOS ($p$=0.206). Patients with BMI in range of being either overweight or obese for their age were found to be 30 (50%) but we could not find any relationship of higher BMI with limitation in walking distance before claudication symptoms start ($p$=0.601). Most of the patients with symptoms of claudication had been involved in strenuous work 47 (78.3%). Half of the patients with claudication had associated backache and 58.3%, could stand for <15 min before they developed claudication symptoms. A total of 31 (51.7%) patients had to take analgesics daily to get relief of their symptoms. For pain intensity scale (1-10), 21 (35%) gauged it to be 8 whereas 9 (15%) patients rated as 9 on pain scale. Most common level of spinal stenosis was L4/5 in 31 (51.6%) patients followed by L5/S1 level in 14 (23.3%) patients. Multiple level spinal stenosis was present in 17 (28.3%) patients. NCOS score ranged from 35-63 with mean score of 49.5. When NCOS was plotted against radiological grade, we could not find any statistically significant association amongst the two parameters ($p$=0.285).

**Table-I: Radiological level and severity of spinal stenosis.**

| Level | Mild Stenosis | Moderate Stenosis | Severe Stenosis | Total |
|---|---|---|---|---|
| L1/2 | 0 | 2 | 0 | 2 |
| L2/3 | 0 | 1 | 4 | 5 |
| L3/4 | 4 | 4 | 0 | 8 |
| L4/5 | 5 | 13 | 13 | 31 |
| L5/S1 | 5 | 3 | 6 | 14 |
| Total | 14 | 23 | 23 | 60 |

**Table-II: Age distribution & level of spinal stenosis.**

| Age | L1/2 | L2/3 | L3/4 | L4/5 | L5/S1 | Total |
|---|---|---|---|---|---|---|
| 30-40 yrs | 0 | 0 | 3 | 3 | 3 | 9 |
| 41-50 yrs | 1 | 1 | 1 | 2 | 3 | 8 |
| 51-60 yrs | 0 | 0 | 1 | 6 | 1 | 8 |
| 61-70 yrs | 1 | 2 | 3 | 7 | 2 | 15 |
| 71-80 yrs | 0 | 2 | 0 | 13 | 5 | 20 |

## DISCUSSION

With general improvement in health care facilities worldwide, elderly population is increasing and with ageing comes its peculiar health related problems. Spinal stenosis secondary to degenerative changes as part of ageing process in one of them[8]. Spinal stenosis is a disabling disease secondary to constriction of spinal canal and part of degenerative spine disease with advancing age[9,10]. Mean age in our study was 60.6 ± 14.31 years which corresponds to early study which has found it to be more common in >65 years[10]. There were more females as compared to males (1.5:1) which is also reported and according to Kim *et al* is partly due to increased pain sensitivity in females[11]. In our study, age had statistically significant relation-ship with severity of stenosis on MRI ($p$=0.006) but age had no correlation with level of stenosis ($p$=0.638). Patients at times have multiple level narrowing and most of patients are treated conservatively with surgical intervention having variable outcome post operatively[12]. We found smokers to have lower NCOS than non-smokers, a fact endorsed by Parreira in his systematic review[13]. BMI was not associated with adverse clinical symptoms of claudication. Geisser *et al*, conducted the study of relationship of spinal canal size and clinical outcome and identified that BMI is significantly

related to walking distance but not to the pain[14]. Depression is considered to be risk factor for pain perception though we excluded these patients[15].

LSCS measurement that we used is easily discernable in clinics based on reference print out copy of diagrammatic representation of different grades of lumbar spinal stenosis. Yuan studied the relevance of MRI grading as per their clinical symptomatology using the Oswestry Disability Index (ODI) and pain Visual Analogue Scale (VAS)[16]. They found that their MRI grading of spinal stenosis did not correspond with Visual Analogue Scale ($p$=0.257) but it did correlated with Oswestry Disablity Index ($p$<0.005). While Sirvanci *et al*, evaluated patients who were scheduled for elective surgery for degenerative spinal stenosis and studied the association of symptoms with MRI findings[17]. They could not find association between the two parameters. Limitation of their study was the selection bias of patients selected for surgery only while our study incorporated patients based on symptomatology. Sigmundsson included 109 consecutive patients who were operated for central spinal stenoses and underwent decompressive laminectomy or laminotomy and filled questionnaires pre operatively, they could found limited function and pain correlation with morphological findings[18]. Similarly other studies done have also found no corre-

**Table-III: NCOS score vs grade on MRI cross tabulation.**

| | | Grade on MRI | | | Total |
|---|---|---|---|---|---|
| | | Mild Stenosis | Moderate Stenosis | Severe Stenosis | |
| NCOS Score | 35.00 | 0 | 1 | 2 | 3 |
| | 36.00 | 0 | 1 | 0 | 1 |
| | 37.00 | 0 | 1 | 0 | 1 |
| | 40.00 | 0 | 1 | 2 | 3 |
| | 42.00 | 2 | 0 | 1 | 3 |
| | 43.00 | 1 | 0 | 0 | 1 |
| | 44.00 | 0 | 1 | 2 | 3 |
| | 45.00 | 0 | 1 | 1 | 2 |
| | 46.00 | 0 | 1 | 1 | 2 |
| | 48.00 | 0 | 0 | 1 | 1 |
| | 49.00 | 2 | 0 | 3 | 5 |
| | 50.00 | 2 | 1 | 3 | 6 |
| | 51.00 | 0 | 3 | 0 | 3 |
| | 52.00 | 1 | 2 | 0 | 3 |
| | 53.00 | 2 | 3 | 2 | 7 |
| | 54.00 | 1 | 0 | 2 | 3 |
| | 55.00 | 1 | 0 | 0 | 1 |
| | 56.00 | 0 | 2 | 2 | 4 |
| | 57.00 | 1 | 0 | 0 | 1 |
| | 58.00 | 0 | 2 | 0 | 2 |
| | 59.00 | 0 | 0 | 1 | 1 |
| | 60.00 | 1 | 0 | 0 | 1 |
| | 62.00 | 0 | 2 | 0 | 2 |
| | 63.00 | 0 | 1 | 0 | 1 |
| Total | | 14 | 23 | 23 | 60 |
| | | Value | df | *p*-value | |
| Pearson Chi-Square | | 50.946 | 46 | 0.285 | |

lation amongst the clinical and radiological evaluation[19-23].

Clinical findings should be assessed with the radiological abnormality to decide the best management plan for each patient. Limitation of our study was that we did not assess the inter clinician or intra clinician reliability of their assessment of MRI correlation with the diagrammatic representation available to them. However the clinician had sufficient experience in their field to be relied upon. Other limitation could be because of the fact that all the patients were from armed forces background which might affect their generalization of the results.

## CONCLUSION

Patient's clinical symptoms severity gauged on basis of NCOS scoring system did not correlate with the radiological grading on MRI. This can be further utilized in decision making for treatment modalities available for patients suffering as result of spinal stenosis.

## CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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