



## RESEARCH ARTICLE

# Sensory and Knee Range of Motion Responses of Slump Test on Unaffected and Radiculopathy Affected Limb in Patients with Lumbar Disk Herniation

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## ABSTRACT

**Background:** Disk herniation is common—it is seen in up to a quarter of magnetic resonance imaging (MRI) and can be detected even in asymptomatic adults. The slump test has become widely advocated as a neural tissue provocation test for clinical assessment of patients with spinal and lower limb pain. The purpose of this study was to determine the sensory and terminal knee extension limitation responses produced during slump test on radiculopathy affected and unaffected limb in patients with lumbar disk herniation.

**Objectives:** To compare the sensory and knee range of motion (ROM) responses produced during slump test on affected and unaffected limb.

**Materials and methods:** Fifty patients, 25 to 45 years of age chronic disk herniation patients with unilateral radiculopathy with/without lower backache. Patient underwent standardized history and physical examination followed by slump test. Outcomes included terminal knee extension limitations and sensory response produced in terms of intensity numeric rating scale (NRS), nature and location (pain drawings).

**Results:** During slump test end position, NRS score and restricted terminal knee ROM comparative results were highly significant ( $p < 0.001$ ). Based on nature and location of sensory response, maximum number of subjects in affected limb had pain in center of lower back radiating to whole lower limb and for unaffected limb stretch at back of knee.

**Conclusion:** In this study, it was suggested that though sensory and knee ROM responses are present in both affected and unaffected limb but the radiculopathy affected limb was more affected in terms of intensity of pain and limitation of motion.

**Keywords:** Disk herniation, Radiculopathy, Slump test.

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## INTRODUCTION

Disk herniation is often defined as a herniation of the nucleus pulposus of an intervertebral disk through its fibrous outer covering. This often results in compression of adjacent nerve roots and/or other structures.<sup>1</sup> Clinically, significant radiculopathy due to disk herniation has been reported to occur in 4 to 6% of the population in patients aged 30 to 50 years.<sup>2</sup>

Diagnosis of disk herniation should first be made clinically. Further investigations like magnetic resonance imaging (MRI) are used to confirm the nature and level of the lesion when symptoms persist and intervention is being considered.<sup>3</sup> Neural tissue tension test like straight leg raising (SLR), slump test are advocated for clinical assessment of patients with spinal and lower limb pain.<sup>4-6</sup> In slump test, unlike SLR, the vertebral canal or foramen structures are put on maximum stretch by additional hip and spinal flexion. This helps in better determining the relationship between the patient's symptoms and restriction of movement of the pain-sensitive structures within the vertebral canal or intervertebral foramina.<sup>7</sup>

A positive slump test has been defined as one that decreases a patient's range of motion available in the lower extremity or the one that reproduces a patient's lower-quarter symptoms.<sup>6,8</sup> In the clinical setting, the mere reporting of a response by a patient is insufficient to merit a 'positive' slump test.<sup>9</sup> The response reported must be explored further as high false positive and negatives are also reported. Studies have reported a higher diagnostic sensitivity (0.83) compared to specificity (0.55) of slump test. But intra and inter-reliability of the test is well established. This study was done with an objective to compare the results of sensory and limitation in terminal knee extension ROM responses through slump test in radiculopathy affected leg and unaffected leg.

## MATERIALS AND METHODS

Fifty MRI positive chronic disk herniation patients with unilateral radiculopathy participated in this observational

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study. They were 25 to 45 years of age who visited the Outpatient Department of Saket Orthopaedic Hospital, Panchkula. Patients who had an acute disk herniation, bilateral radiculopathy, any previous spinal surgeries were excluded.

The principal investigator (trained physiotherapist) undertook a standardized history and physical examination of patients. Demographic data like age, sex, location and nature of patient’s symptoms were noted. Hamstring muscle tightness was tested and neural tissue provocation test, i.e. SLR and slump tests were performed. During slump test standardized verbal instructions were given by the examiner to explain the test to each subject. Each subject was asked to sit on the plinth with his or her knees together and as far back as possible to ensure a standardized starting position. The starting position was 90° flexion at the knee joint as recorded by universal goniometer.

The procedure was divided into three stages: (I) Slump seating—the subject was asked to put her hands behind her back, to slump at the mid- and lower back, and to tuck her chin into the chest, while the examiner placed her hand at the cervicothoracic junction to monitor cervical position; (II) Knee extension—while maintaining the above position, the subject was asked to extend the knee; (III) Ankle dorsiflexion—the subject was then asked to dorsiflex the ankle.

At this point, sensory response in terms of intensity, nature and location and knee range of motion (ROM) in extension from 90° knee flexion was recorded. The procedure once completed on unaffected limb was then repeated on affected limb with radiculopathy.

To determine the location of response and nature of response subjects were shown pain drawings.<sup>10</sup> To describe the nature of response, if the patient selected any other pain descriptors, all were recorded. To determine intensity, subjects were asked to rate the intensity of the response on a numerical rating scale (NRS)<sup>11</sup> of 0 to 10. To measure knee ROM universal goniometer was used. From the reading obtained restriction of terminal knee extension was calculated.

The data were analyzed for statistical significance by using the Statistical Package for Social Sciences (SPSS 15.0) software. Informed consent from all patients was taken prior to their enrollment in the study.

**RESULTS**

The NRS mean ± standard deviation and median values in the unaffected and radiculopathy affected limb are shown in Table 1. The comparative results based on non-parametric Wilcoxon Signed Rank-test of NRS in unaffected and affected limb were highly significant.

Of 50 subjects tested, nature and location of sensory response to end position of slump test in unaffected and affected limb is shown in Table 2. For the unaffected limb maximum responses as perceived by patients was stretch at back of knee (n = 20) and for radiculopathy affected limb pain in lower back radiating to whole lower limb (n = 17).

Table 3 shows that the mean ± standard deviation of restriction in terminal knee ROM of were significantly higher in radiculopathy affected limb than in the unaffected one.

Table 4 shows that among the subjects with hamstring tightness the mean ± standard deviation of restriction in terminal knee ROM were significantly higher in the radiculopathy affected limb than the unaffected limb.

**Table 1:** Numeric rating scale of unaffected and affected limb (n = 50)

Parameter	Mean ± SD		Z-value
	Unaffected limb	Affected limb	
NRS			
0–2	3	0	5.650*
3–4	13	2	
5–6	21	12	
7–8	11	24	
9–10	2	12	
Mean values	5.26 ± 1.882	7.38 ± 1.640	

\* Significant at 0.001 level

**Table 2:** Nature and location of sensory response to slump testing in unaffected and affected limb (n = 50)

Parameters	Nature and location of sensory response on	
	Unaffected limb	Affected limb
Pain in lower back	10	3
Stretch at back of thigh	1	2
Stretch at back of knee	20	10
Stretch at back of lower leg	14	13
Pain in back of lower leg	0	5
Pain in lower back radiating to whole lower limb	5	17

**Table 3:** Comparison of restricted terminal knee ROM in unaffected vs affected limb (n = 50)

Parameter	Number of responses		t-test
	Unaffected limb	Affected limb	
Restricted terminal knee ROM			
0–20°	27	18	3.0306*
20–40°	22	28	
40–60°	1	4	
Mean ± SD	17.3 ± 8.21	22.66 ± 9.42	
(range)	(5° – 45°)	(5° – 45°)	

\*Significant at 0.001 level



**Table 4:** Comparison of restricted terminal knee ROM mean in unaffected vs affected limb for hamstring tightness positive subjects

Parameter	Mean $\pm$ SD (range)	
	Unaffected limb (n = 18)	Affected limb (n = 11)*
Restricted terminal knee ROM in hamstring tightness positive cases	23.5 $\pm$ 8.12 (15° – 45°)	29.8 $\pm$ 7.82 (20° – 45°)

\*11 cases could not be checked for hamstring tightness due to intolerable pain

## DISCUSSION

In prolapsed intervertebral disk (PIVD), patients symptoms are produced due to disk herniation which affects nerve roots by mechanical compression and nucleus pulposus tissue through biochemical mechanisms.<sup>12</sup> This results in restriction of pain sensitive structures and radiculopathy along the affected limb. Slump test, a progressive series of maneuver, places these structures under increasing tension by traction along neuromeningeal tract.<sup>13</sup> Actually adhesions produced in chronic disk herniation patient's limits mobility of neuromeningeal structures. With neuroprovocative tests, such as slump test the lengthening of vertebral canal will be accompanied by adverse nerve root tension and greater pain sensed by patients in affected leg.

The result of present study demonstrated a significant difference in intensity of pain response to slump test along with restricted terminal knee range in affected and unaffected limb. Slump test is a spinal test that elicits pain in the presence of lumbar disk herniation due to traction of meningeal tissues, nerve roots, and the sciatic and tibial nerves.<sup>14</sup>

Basically with the application of sufficient deforming forces on pain sensitive structures, such as dural sheath an undesired symptomatic response are produced.<sup>15</sup> Same is responsible for reporting of many false positive cases for slump test in many studies done on asymptomatic subjects. A study that was done on asymptomatic subjects reported mean intensity of pain in terms of VAS as 5.5 during slump position of full spinal flexion followed by knee extension and ankle dorsiflexion.<sup>9</sup> This forms an evidence of support for our results of NRS in unaffected limb.

In this study, the nature and location of pain/sensory response to slump test was also analyzed in chronic disk herniated patients with unilateral radiculopathy. For affected limb, results represents radiculopathy pattern with maximum reported responses localized below the knee. Patients reported stretch or pain in back of lower leg though some cases presented with the radiculopathy along whole lower limb. This could be explained by the degree of herniation which affects the severity of radiculopathy and other symptoms.<sup>16</sup> Response of a stretch at back

of knee produced in unaffected leg alike to Walsh et al study in asymptomatic subjects represents normative data to slump test.

It is also inferred from this study that restricted terminal knee ROM was present during slump test with the response appreciable in both unaffected (17.3°) and radiculopathy affected limb (22.66°). Johnson and Chiarello demonstrated a limitation of knee extension to be an expected normal response to positions of the slump in healthy test subjects.<sup>17</sup> Johnson study considering effect of head and lower extremity position on knee extension shows limitations in terminal knee extension ROM of 18.2° in healthy subjects. Davis et al study on slump position in asymptomatic subjects had 15.1° of knee extension limitation.<sup>14</sup> Yeung et al study of knee angle associated with slump position in group of whiplash cases and a control group found terminal knee extension limitation of 22 and 16° respectively with greater limitation of knee terminal extension in whiplash group.<sup>18</sup> This represents that with slump test the tension is transmitted to injured neural and non-neural tissues.

These observations suggest that limitation in terminal knee extension ROM up to 18° can be a normal finding of slump test in healthy subjects. In our study, for 50 disk herniation patients on the radiculopathy affected side greater knee ROM restriction was seen. This may have relatively some contribution from hamstring tightness along with severe degree of disk herniation. Studies have reported that if the patient is unable to achieve full extension of the knee, it may be due to the tension in the neuromeningeal tract (a positive slump test) or tight hamstring muscles.<sup>5,19</sup>

Therefore, to establish diagnostic validity of slump test whenever possible the therapists should compare radiculopathy affected and unaffected leg on basis of pain and restriction of knee extension ROM. Higher NRS recordings with greater knee extension limitations in radiculopathy affected limb further suggest the test to be truly positive for the presence of disk herniation.

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