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Correlation between Neurodynamic Tests for Patients with Sciatic Radiculopathy

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볼기신경 뿌리병증 환자에 대한 신경동역학적 검사간의 상관관계

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＜초록＞

연구목적 : 본 연구는 볼기신경 뿌리병증 환자에 대하여 역학적 스트레스인 압박과 긴장을 가하여 환자의 증상을 나타내 신경동역학적 검사간의 상관관계를 수행하였다.

연구방법 : 신경동역학검사인 하지직거상검사, 수정된 활시위검사, 슬럼프검사에 앞서 방사선과 전문의에 의해 자기공명영상 판독을 실시하여 허리원반 이탈로 진단받은 다리쪽으로 방사통을 호소하는 21명의 환자가 참여하였다. 수집된 자료는 질적변수에 따른 빈도와 비율은 교차분석표로 작성하였고, 신경동역학적 검사간의 상관관계를 검정하기 위해 피어슨의 카이스퀘어(Pearson's chi-square)을 시행하였다.

연구결과 : 허리 자기공명영상 결과, 증상에 대한 두 검사 간 교차표를 작성하여 하지직거상검사와 수정된 활시위검사, 하지직거상검사와 슬럼프검사는 유의한 상관관계는 없었지만($p>.05$) 수정된 활시위검사와 슬럼프검사는 통계적으로 유의한 상관관계($p<.05$)가 제시되었다.

결론 : 볼기신경 뿌리병증 환자에 대한 신경동역학검사인 수정된 활시위검사와 슬럼프검사가 통계적으로 유의한 상관관계를 나타내는 증거를 제공하였다. 신경동역학 검사는 신경계에 역학적 스트레스 즉, 긴장, 활주, 또는 압박 자극을 주어 신경기능이상 환자에 대해 적절한 검사를 제시하였다.

핵심단어 : 신경동역학검사, 하지직거상검사, 슬럼프검사

Ⅰ. Introduction

Upper limb tension test and low limb tension test are usual term for physical therapists to the examination of subjects complaining of neural tissue. Increased tension tests or compress into the neural tissue such as the SLR, slump test, bowstring test, are neuro-orthopaedic examination which tests

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are suggested as base test may give rise to sciatic pain from back due to disc herniation or stenosis (Butler, 1991). MRI(magnetic resonance imgaing) is the most common imaging technique used to evaluate lumbar spinal conditions(Rabin et al., 2007). However, that findings, bulging or even protrusion of discs on an MRI are common to show the asymptometic back of persons (Jensen et al., 1994) so, it is extremely important that to test the neurodynamic test about the lumbar radiculopathy by the physical therapist. SLR test has been used as the primary test to diagnosis lumbar disc herniations and found to have high correlation with findings on operation since it's sensitivity is high in only disc herniation leading to root compression(Majlesi et al., 2008). The slump test has been also used as the examination of movement of the pain sensitive structures, the dura mater, nerve root sleeve and the clinical implication of restriction in range together with reproduction of patient's pain(Maitland, 1979) the other, slump knee bend neurodynamic test is used to represent neurogenic disorders of the back, upper and mid lumbar nerve noot compression(Trainor and Pinnington, 2011). The modified bowstring test has the potential advantages of not only providing reduced patient discomfortly not placing the supine position of patient but also ease and safe performing the test(Kaltenborn, 1993). A positive bowstring test is a strong indicator for surgery, but it need only be performed if the SLR is positive with the addition of dorsiflexion(Dutton, 2002). Therefore, it is highly desirable that an accurate structural differentiating, SLR, slump test response in terms of range of movement between neural tissue and non neural tissue to practice the patients initially for manual physical therapists(Herrington et al., 2008). Another opinions suggested that the nerve tension test had limitations, the use of ankle dorsiflexion or passive neck flexion to increase the mechanical tension on neural tissue does not help to localize the tissues at fault because other structures were moving with the nerves during these procedures(Di Fabio, 2001) and cervical flexion component of the slump test increased posterior thigh pain have connected with deep fascia, blood vessels, skin and neural structures(Lew and Briggs, 1997) and the thoracolumbar fascia has connected with the lower limb widely(Vleeming et al., 1995). The study of neurodynamics imply the interactions between mechanics and physiology of the nervous system which includes their relationship and mobilisation of the nervous system has the purpose of assessment is to stimulate mechanically and move neural tissues to gain an impression of their mobility and sensitivity to mechanical stresses also in the presence of pathomechanical in the neural tissue, the purpose of treatment is to improve their mechanical and physiological function(Elvey, 1986; Shacklock, 2005; Butler, 2009). Functional anatomy, physiology of the nervous system which viscoelasticity is elongate progressively with sustain loading, it removed the length return to original condition(Kwan et al., 1992), high pressures may be one of the cause of the nervous mechanical barrier also blood flow is sensitive to alterations in circulation(Werner et al., 1983, 1985). The continuum of the nervous system to move alone or be influenced by surroundings structures, those system well adapts to tolerate mechanical forces generated during the positions or movement associated with activity of daily living and sport life especially(Butler, 1989; Nee and Butler 2006). The nervous system is a continuum which the peripheral, central, and autonomic nervous systems all combine to form one system that interacts as a unit of input and output to exist as a mechanical, electral, and chemical form so, it is reasonable to neurodynamic tests are more appropriate a differentiation between neural and non-neural tissues(Shacklock, 1995; Walsh, 2005; Butler, 2009). Although there are abundantly literature in relation to the SLR test in the identification of

lumbar disc heriation but it is not ease to find out the research that the use of SLR, slump and modified bowstring tests of neural tissue also, correlation between neurodynamic test, SLR, modified bowstring and slump tests using MRI result have not been previously reported. The purpose of this study was to demonstrate the correlation between neurodynamic tests for patients with sciatic radiculopathy to gain a symptom of neural tissue to stimulate the tension and pressure, mechanical stress.

Ⅱ. Methods

1. subjects

All 21 patients were recruited at the D hospital in KwangJu city and J hospital in ChonNam, May/ June 2011. They had pain radiating into the lower extremity from lumbar spine area who were performed the MRI findings diagnosed LDH by professional radiologists. Patient with “red flags” for a serious spinal condition, osteoporosis, tumors, infection, spinal fracture were excluded. Individuals who were pregnant, has a history of spinal surgery also exclude. All patients provided consent prior to participation and subjects were able to withdraw from the study at any time.

2. procedure

1) Magnetic Resonance Imaging

Twenty-one subjects had MRI evidences of nerve root compression demonstrated lumbar disc herniation. These studies were diagnosis by various radiologists specialized in neuroradiology who did not have prior knowledge of the neurodynamic tests result(Fig 1).

2) Neurodynamic Test

This neurodynamic test can be considered positive if it produces the patient's symptoms(pain, numbness, tingling), there is asymmetry when testing right and left sides(limitation in range of motion, resistance of movement, production of symptom during movement), test responses altered by movement of distant body part(neck, ankle). The test is performed by more than 10 years an experienced physical therapists who did not have knowledge of the MRI results on each side and sound side is priorly(Kostopoulos, 2004).

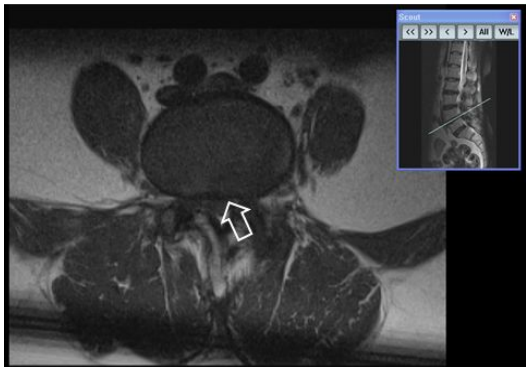

Fig 1. MRI of the lumbar spine

Fig 2. The SLR test

(1) SLR test

The patient lies supine on the examination table with arms relaxed at the sides. The physical therapist stands next to the patient at the level of the patient's pelvis. The physical therapist grasps the patient's lower leg from posterior directly above the malleoli the other hand is placed loosely on the anterior thigh just proximal to the patella. The hip is then brought passively into flexion, keeping the knee extened, once the point of irritation has been reached, the patient's lower leg is gently back untill the symptoms fade, the physical therapist has added ankle dorsiflexion and eversion to the SLR(Fig 2). If the symptoms are brought on by this maneuver, SLR test is positive. (Winkle et al., 1996).

(2) Modified Bowstring Test

Modified bowstring test(MBT) utilised that can be placed on the bowstring by patient sidelying. The patient lies in a sidelying, facing the edge of the table. It is important that to avoid side flexion of lumbar spine a small pillow is placed under the patient's lumbar. For the starting position to the test, the hips are flexed to approximately 70̊ with the knee flexed to a degree that is stable and comfortable for the patient body. The physical therapist stands in front of the patient at the level of her knee and one hand is placed of the dorsi flexed of foot the other thumb is placed of middle of the posterior knee joint between the femoral condyle. The patient's arms are folded across the chest with hands of opposite shoulders. The clinician moves the patient's shoulder caudally to produce flexion in the spine keeping the lumbar is maintained in neutral position. The physical therapist puts on stretch the knee with dorsiflexion of the ankle joint, once the point of irritation has been reached, the patient's knee is gently flexed untill the symptoms fade, the clinician presses into the popliteal fossa in the middle knee and the patient is asked to raise her head(Fig 3). If the symptoms are brought on by this maneuver, the modified bowstring test is positive (Kaltenborn, 1993).

Fig 3. Modified bowstring test

(3) Slump Test

The patient is positioned sitting with the hands behinds back, the creases should be at the edge of the bed and the lumbar spine is maintained in neutral position. The physical therapist stands next to the patient try to guide the movement so that the pelvis doesn't rotate backwards. This position should be followed by a slump of the lumbar and thoracic spine as the physical therapist maintains the patient's neck is in neutral. The spinal slump position maintained, ask patient to bend her head down and than it can be gently guided this with one hand on her occiput. placing the chin on the chest, and than to straighten the knee as much as possible. If symptoms have yet to occurr, active dorsiflexion is added, the foot brought into dorsiflexion(Figure 4). Use physical therapist's

Fig 4. Slump test

hand to help guide patient's neck back and be aware of any change in symptomes(Dutton, 2002, Butler, 2009).

3. Data Analysis

The cross tabulation was used to counts and percentage of the neurodynamic tests according to the qualitative variable. In addition, The chi-square was used to analyze in order to determine the pearson correlation coefficients between the neurodynamic tests. All statistical procedures were analyzed using the IBM SPSS for window software, version 19, and P-values<.01 were considered as significant.

Ⅲ. Results

1. General Characteristics of Subject.

Characteristics of the 21 study patients with are detailed in Table 1. The abnormal MRI group consisted of 21 patients in the study. The patients included 7 males and 14 females. The mean age was 47.90±3.18 years. They have presented low back pain, leg pain or low back and leg pain. The duration of treatment was 128.57±85.35 days but, the mean symptom duration was 527.71±147.20 days. All the patients had positive MRI findings but at different level in lumbar spine.

Table 1. General characteristics of subjects

Characteristics		Subject(n=21)
Age(year)[a]		47.90±3.18
Height(cm)[a]		164.57±1.85
Weight(kg)[a]		60.24±3.15
Duration of treatment(day)[a]		128.57±85.35
Duration of symptoms(day)[a]		527.71±147.20
Gender		
	Female	14
	Male	7
Involved side		
	Left	11
	Right	8
	Both	2

a; Values are mean±SD

2. The cross tabulation of SLR test by MBT for patient with sciatic radiculopathy

Neurodyamic tests of positive only occurred on the symptomatic side, there were no positive neurodynamic tests recorded on the asymptomatic side. Seven subjects(33.3%) were positive on the SLR test, whereas 17(81.0%) were positive on the MBT. 7 subjects were positive for both test(Table 2).

3. The cross tabulation of SLR test by slump test for patient with sciatic radiculopathy

Fourteen subjects(66.7%) were negative on the

Table 2. Cross tabulation of SLR by MBT

(n=21)

			MBT		Total
			N	P	
SLR	N	Count	4	10	14
		% within SLR	28.6%	71.4%	100.0%
		% within BT	100.0%	58.8%	66.7%
	P	Count	0	7	7
		% within SLR	.0%	100.0%	100.0%
		% within BT	.0%	41.2%	33.3%
Total		Count	4	17	21
		% within SLR	19.0%	81.0%	100.0%
		% within BT	100.0%	100.0%	100.0%

SLR: Straight leg raise test, MBT: Modified bowstring test, P: Positive, N: Negative

Table 3. Cross tabulation of SLR by slump

(n=21)

			Slump		Total
			N	P	
SLR	N	Count	2	12	14
		% within SLR	14.3%	85.7%	100.0%
		% within Slump	100.0%	63.2%	66.7%
	P	Count	0	7	7
		% within SLR	.0%	100.0%	100.0%
		% within Slump	.0%	36.8%	33.3%
Total		Count	2	19	21
		% within SLR	9.5%	90.5%	100.0%
		% within Slump	100.0%	100.0%	100.0%

SLR: Straight leg raise, N: Negative, P: Positive

Table 4. Cross tabulation of MBT by Slump test

(n=21)

			Slump		Total
			N	P	
MBT	N	Count	2	2	4
		% within BT	50%	50%	100.0%
		% within Slump	100.0%	10.5%	19.0%
	P	Count	0	17	17
		% within SLR	.0%	100.0%	100.0%
		% within Slump	.0%	89.5%	81.0%
Total		Count	2	19	21
		% within SLR	9.5%	90.5%	100.0%
		% within Slump	100.0%	100.0%	100.0%

MBT: Modified bowstring test, N: Negative, P: Positive

SLR test of lumba disc herniation in the spine, whereas 19(90.5%) were positive on the slump test. 7 subjects were positive for both test(Fig 3).

4. The cross tabulation of MBT test by slump test for patient with sciatic radiculopathy

Seventeen subjects(81%) were positive on the MBT test of lumba disc herniation in the spine, and 19(90.5%) were positive on the slump test. 17 subjects were positive for both test(Fig 4).

5. The correlation between MBT and slump test for patient with sciatic radiculopathy

A strong positive pearson correlation(Cramer's V=.669; p<.01) between MBT and slump test, whereas SLR test and MBT, slump test were not correlation of lumba disc herniation in the spine for patient sciatic radiculopathy.

Table 5. The correlation of the SLR, MBT and slump tests

(n=21)

	SLR	MBT	ST
SLR	1	.343	.229
MBT	.343	1	.669**
ST	.229	.669**	1

Pearson correlation coefficient r and p value **P<.01,
SLR: Straight leg raise test,
MBT: Modified bowstring test,
ST: Slump test

Ⅳ. Discussion

This study indicate that both the MBT and slump tests had a good corrleation comparing to SLR and MBT, SLR and slump tests had a low correlation because MBT included the tibia nerve was palpated manually, highest scores of diagnostic accuracy were obtained(Walsh and Hall, 2009) and slump test add cephalad and caudal gliding of the spinal cord, while the SLR maneuver only offers caudal gliding of the nerve roots, the MBT and slump tests add specificity because neck flexion and extension help distinguish motion restrictions in neural tissue from other soft tissue inflexibility. The findings of the impact of neurodynamic testing, SLR with different position and slump test on the perception of experimentaly induced muscle pain lend support to the validity of the use of sensitizing manoeuvres during neurodynamic testing(Coppieters et al., 2005). That is to say, support the idea that the MBT and slump test applies more traction to more neuromeningeal tissues(Majlesi et al., 2008) and nearly like in this study(90.5%) it was high percentages(94.2%) with disc herniation had pain distribution on slump test for patients with suspected HNP, in comparison with findings on computed tomography and MRI scan(Stankovic et al., 1999) so, these tests are applicable to access patients with lumbar disc herniation. As we know, physical therapists have to purpose to determine the exact tissue that symptome and pain arises from to make the specific diagnosis to practice the patients at the clinic. The above results are in similar agreement with previously presented that validity of the SLR test for patients with sciatic pain using MRI indicated low accuracy of the SLR in diagnosis of LDH if compared with MRI results(Capra et al., 2011). Furthermore, the SLR test was not predictive in patient suspected of lumbosacral nerve root compression and the diagnostic accuracy of SLR test is limited by its low specificity in diagnosing herniated discs(Devillé et al., 2000, Vroomen et al., 2002). There have also been report of structural differentiating manoeuvres have a useful clinical slump knee bend neurodynamic test for identifying patients with mid lumbar nerve root compression (Trainor and Pinnington, 2011). On the contrary, These findings are in contrast to the results of Walsh and Hall(2009) reported that when the SLR

and slump tests are interpreted as positive in the event of reproduction of presenting leg pain that are intensified by ankle dorsiflexion, these tests show substantial agreement and good correlation in the leg pain population. The reason of different results may indicate that they did not included the using the MRI results. In recent year we have noticed that it has been the substitution of the sidelying MBT for the traditional supine straight leg raise test to has been used as the primary test to diagnosis lumbar nerve root compression by disc herniation. This tests may reduce patient discomfort and easy to the patients assessment(Rabin et al., 2007). This study has some limitation. First, we did not enroll low back pain patients with or without lumbar disc herniation using the MRI evidence so, the present study did not demonstrate sensitivity of the neurodynamic test, SLR, MBT and slump tests in patients with lumbar disc herniation. Second, the physical therapists who examined were aware of the presenting symptoms that the subject had sciatic radiculopathy and also which side was radiating pain. It could cause controversy that this might have led to the therapists performing the test differently between the two sides. However, when performing these tests clinically, the therapists would be aware of this imformation, and as author was researching these tests as they are used clinically. Although there is an abundance of papers in relation to the use of SLR and slump tests in the identification of LDH, research into the correlation between neurodynamic tests as tests of patients with LDH using MRI results is lacking. Collectively, the results of this study show that neurodynamic test, MBT and slump test were statically good correlation so, may be a valuable tool for suggesting a differential diagnosis patients with LDH and could be used extensively.

Ⅴ. Conclusion

The study results highlight major gaps in our understanding of the role of this correlation between neurodynamic tests for patients complaining of LBP with pain radiating into the leg from back who were performed the magnetic resonance imaging findings diagnosed lumbar disc herniation by professional radiologists. The results provide evidence that neurodynamic tests, modified bowstring and slump test for patients with sciatic radiculopathy were more statically good correlation than SLR test and MBS test, slump test to focus specifically on the nervous system. It is suggested that neurodynamic tests are an appropriate tests for patients with neural dysfunction. Further research is need to establish the difference between the correlation of the SLR test versus that of the MBS test, slump test for patients with sciatic pain.

Reference

Butler DS. The sensitive nervous system. 4th ed. Adelaide. Noigroup. 2009;98-99.

Butler DS. Mobilisation of the nervous system. London. Churchill Livingstone. 1991;19-127.

Butler DS. Adverse mechanical tension in the nervous system: A model for assessment and treatment. Austr J Physiother. 1989;35(4):227-38.

Capra F, Valti C, Donati R et al. Validity of the straight-leg raise test for patients with sciatic pain with or without lumbar pain using magnetic resonance imaging results as a reference standard. J Manipulative Physiol Ther. 2011;34:231-8.

Coppieters MW, Kurz K, Mortensen TE et al. The impact of neurodynamic testing on the perception of experimentally induced muscle pain. Man Ther. 2005;10:52-60.

Devillé W, Windt D, Bezemer A et al. The test of lasegue: Systematic review of the accuracy in diagnosing herniated discs. Spine. 2000;25:(9). 1140-7.

Di Fabio RP. Neural mobilization: The impossible. Journal of Orthopaedic & Sports Physical Therapy. 2001;31(5):224-5.

Dutton M. Manual therapy of the spine: An integrated approach. The united states. Mcgraw-Hill. 2002; 181-85.

Elvey RL. Treatment of arm pain associated with abnormal brachial plexus tension. Austr J Physiother. 1986;32(4):225-30.

Herrington L, Bendix K, Cornwell C et al. What is the normal response to structural differentiation within the slump and straight leg raise test?. Man Ther. 2008;13:289-94.

Jensen MC, Brant-Zawadzki MN, Obuchowski N et al. Magnetic resonance imaging of the lumbar spine in people without back pain. N Engl J Med. 1994;331(2):69-73.

Kaltenborn FM. The spine: Basic evaluation and mobilization technique. 2th ed Minneapolis. OPTP. 1993;140.

Kostopoulos D. Treatment of carpal tunnel syndrome: a review of the non-surgical approaches with empasis in neural mobilization. J Bodywork Movement Ther. 2004;8:2-8.

Kwan MK, Wall EJ, Massie J et al. Strain, stress and stretch of peripheral nerve. Acta Orthop Scand. 1992;63(3):267-72.

Lew PC, Briggs CA. Relationship between the cervical component of the slump test and change in hamstring muscle tension. Man Ther. 1997; 2(2):98-105.

Maitland GD. Negative disc exploration: Positive canal sign. Austr J Physiother. 1979;25(3):129-34.

Majlesi J, Togay H, Ünalan H et al. The sensitivity and specificity of the slump and the straight leg raising tests in patients with lumbar disc herniation. J Clin Rheumatol. 2008;14(2):87-91.

Nee RJ, Butler D. Management of peripheral neuropathic pain: Integrating neurobiology, neurodynamics, and clinical evidence. Physical Therapy in Sport. 2006;7:36-49.

Rabin A, Gerszten PC, Karausky P et al. The sensitivity of the seated straight-leg raise test compared with the supine straight-leg raise test in patients presenting with magnetic resonance imaging evidence of lumbar nerve root compression. Arch Phys Med Rehabil. 2007;88:840-3.

Shacklock M. Neurodynamics. Physiotherapy. 1995; 81(1):9-16.

Shacklock M. Improving application of neurodynamic (neural tension) testing and treatment: A message to researchers and clinicians. Man Ther. 2005;10: 175-79.

Stankovic R, Johnell O, Maly P et al. Use of lumbar extension, slump test, physical neurological examination in the evaluation of patients with suspected herniated nucleus pulposus: A prospective clinical study. Man Ther. 1999;4(1):25-32.

Trainor K, Pinnington MA. Reliability and diagnostic validity of the slump knee bend neurodynamic test for upper/mid lumbar nerve root compression: A pilot study. Physiotherapy. 2011;97:59-64.

Vleeming A, Pool-Goudzwaard AL, Stoeckart R et al. The posterior layer of the thoracolumbar fascia. Its function in load transfer from spine to legs. Spine. 1995;20(7):753-8.

Vroomen P, De Krom M, Wilmink J et al. Diagnostic value of history and physical examination in patients suspected of lumbosacral nerve root compression. J Neurol Neurosurg Psychiatry. 2002;72:630-4.

Walsh J, Hall T. Reliability, validity and diagnostic accuracy of palpation of the sciatic, tibial and common peroneal nerves in the examination of low back related leg pain. Man Ther. 2009;14: 623-9.

Walsh J, Hall T. Agreement and correlation between the straight leg raise and slump tests in subjects with leg pain. J Manipulative Physiol Ther. 2009; 32(3):184-92.

Walsh MT. Upper limb neural tension testing and mobilization fact, fiction, and a practical approach. J HAND Ther. 2005;18:241-58.

Werner CO, Elmqvist D, Ohlin P. Pressure and nerve lesion in the carpal tunnel. Acta Orthop scand. 1983;54:312-16.

Werner CO, Ohlin P, Elmqvist D. pressures recorded in ulnar neuropathy. Acta Orthop Scand. 1985;56: 404-6.

Winkel D, Aufdemkampe G, Matthijs O et al. Diagnosis and treatment of the spine: Nonoperative orthopaedic medicine and manual therapy. Gaithersburg. Aspen. 1996;167.