The Limited Protocol MRI in Diagnosis of Lumbar Disc Herniation

Orasa Chawalparit MD*, Anchalee Churojana MD*,
Pipat Chiewvit MD*, Surin Thanapipatsir MD**,
Visit Vamvanij MD**, Panida Charnchaowanish MD*,

** Department of Radiology, Faculty of Medicine Siriraj Hospital, Mahidol University*
*** Department of Orthopedics, Faculty of Medicine Siriraj Hospital, Mahidol University*

Objective: *To assess agreement in detection of lumbar disc herniation (LDH) between limited and full protocol MRI.*
Material and Method: *123 patients who requested lumbar MRI for diagnosis of disc herniation were assessed. The full protocol MRI composed of sagittal T1-wi, sagittal T2-wi and axial T2-wi was performed on each patient. The sagittal T2-wi was selected as the limited protocol MRI. The limited and full protocols MRI of each patient were separately interpreted by three neuroradiologists to assess disc herniation and nerve root compression. The consensus results of limited and full protocol were compared. The diagnostic performance of each protocol was analyzed using surgery as the gold standard.*
Results: *There were 62 females and 61 males enrolled into the study between the age of 21-60 years old (means = 42.91 years). The duration of pain was 1-204 months (mean = 31.20 months). The degree of severity was mild in 23.58%, moderate 45.52% and severe 30.89% of cases. Thirty-three cases were operatedon. For detection of LDH, the limited protocol gave the same interpretation results as the full protocol (= 1.04, 95%CI = 0.94, 1.14 with accepted range of 0.95-1.05). In nerve root compression, the limited protocol was not accurate as the full protocol (= 0.75, 95%CI = 0.87, 0.63). The sensitivity, specificity, accuracy, PPV, NPV, and LR+ in the surgical group of limited protocol in diagnosis of LDH were 82.61%, 80%, 81.82%, 90.48%, 60.67%, 4.13 and in nerve root compression were 54.84%, 100%, 57.58%, 100%, 12.5% respectively. The same statistics of full protocol MRI in diagnosis of LDH were 82.61%, 70.80%, 78.79%, 86.36%, 63.64%, 2.75 and of nerve root compression were 80.65%, 100%, 81.82%, 100%, 25% respectively. The sensitivity and specificity in diagnosis of LDH were not different in both protocols but the sensitivity of nerve root compression was statistically significant different (p < 0.013, 95%CI = -0.33, -0.25).*
Conclusion: *The authors concluded that limited protocol MRI may replace full protocol MRI in diagnosis of LDH but not in nerve root compression.*

Keywords: *Low back pain, Magnetic resonance imaging, MRI, Lumbar disc herniation, Diagnosis*

J Med Assoc Thai 2006; 89 (2): 182-9
Full text. e-Journal: *http://www.medassocthai.org/journal*

Low back pain is the second most common complaint encountered by primary care physicians[1,2]. In Thailand, 62% of complicated cases that the Provincial Social Security Offices consulted the Medical Committee of the Compensation Fund in 1996-1998 were musculoskeletal causes. Among these, 25% were occupational back pain and 7% were occupational lumbar disc herniation[3]. The average medical cost was 10,387.24 baht and average number of days lost was 17.3 days[4]. Lumbar intervertebral disc herniation (LDH) has a favorable prognosis in the majority of circumstances. Without red-flag signs of serious pathology, it is generally unnecessary to order an imaging study to assess the status of a lumbar disc or spinal neural elements during the initial 6-8 weeks

Correspondence to : Chawalparit O, Department of Radiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

after the onset of pain. If surgery is contemplated, it is necessary to document with an imaging study of the nature and extent of the discal abnormality presenting at the clinically suspected level(s). Myelography is clearly an invasive procedure[5,6]. Magnetic resonance imaging (MRI) is more preferable. However, MRI is an expensive modality especially in Thailand. From the authors' personal experience, it was found that in LDH, most of the information needed only one or two sagittal pulse sequences of the three routine pulse sequences [sagittal T1weighted image (T1wi.), sagittal T2weighted image (T2wi.), and axial T2wi]. Therefore, if MRI is done in only one pulse sequence, the cost of the study can be reduced to one-third of the routine protocol cost. The purpose of the present study was to evaluate the accuracy using limited protocol MRI of lumbar spine compared with full protocol in patients with lumbar intervertebral disc herniation.

Material and Method

A prospective equivalent study was done when patients with low back pain and suspected LDH came into our radiology department for requested lumbar MRI. Only patients in the age range of 20-60 years old and with informed consent were included into the present study. Patients with a history of spinal surgery and trauma were excluded. General data and clinical assessment were collected by research assistance before the MRI examination. For the severity of pain, the patients were asked to fill in the questionnaire by using the Roland disability score[7]. The study was done with a 1.5 tesla machine (Philips ASCII). The routine full protocol lumbar MRI composed of sagittal T1wi (SE, TR/TE 400-600/12-15 ms, thickness 4/0.4 mm, NSA 6), sagittal T2wi (TSE, TR/TE 2000-2600/120-150 ms, thickness 4/0.4 mm, NSA 6), and axial T2wi (TSE, TR/TE 2200-2900/100-150 ms, thickness 3/0.3 mm, NSA 8). The sagittal T2wi was selected for limited protocol MRI. All MRI data was interpreted from the hard copy records.

The limited and full protocol MRI data were interpreted blindly from clinical information and separately by three radiologists (with more than 3 years experience in radiology). Each radiologist interpreted each set of imaging protocol at least 3 weeks separately to prevent memory bias from the previously seen image. Both sets of interpretation from each radiologist were analyzed separately. The final results were reached by consensus when there was some discrepancy.

If the patients underwent surgery, the surgical finding was recorded by the surgeons for any herniation, level and nerve roots compression.

The authors predetermined the definition of normal, bulging, herniation, and sequestration of disc and nerve root compression on the MRI and surgical field to decrease variation of previous knowledge. The operational definition is shown in Table 1.

Table 1. Operational definition of terminology

Terminology	Defintion
Herniated nucleus pulposus(HNP)	focal extrusion of the disc component out of the vertebral body margin with the maximum diameter of the herniated part more than the diameter of the attached base on imaging (Fig. 2).
Extrusion	extrusion of the disc out of the annulus fibrosus but still within the posterior longitudinal ligament (PLL) on surgical finding. This will be equivalent to herniated nucleus pulposus on imaging (Fig. 2).
Bulging disc	diffuse protrusion of the disc component out of the vertebral body margin with the maximum diameter of the protruded part less than of he the attached base on imaging. No predominontt area of protrusion in all sagittal images (Fig. 1).
Protrusion	protrusion of disc out of the vertebral body margin but within the annulus fibrosus on surgical finding. This will be equivalent to bulging disc on imaging.
Sequestration	The disc component extruded out of the vertebral body margin without connection with the mother disc.

Statistics

Demographic data was analyzed by descriptive statistics as appropriate. Severity of disease was classified as severe, moderate, mild and normal according to the Roland disability score of 0-7, 8-15, 16-23 and 24 respectively.

Agreement between each pair of three radiologists (inter-observer reliability) on limited and full protocol MRI data were evaluated using unweighted Kappa statistic.

To determine whether limited protocol MRI can be used instead of full protocol MRI, null hypothesis of difference between two tests was tested against alternative hypothesis of equivalence of 2 tests by using L statistics[8]. Under the predetermined half-width (w) of 0.05, if the calculated range of q falls into the range of 0.95-1.05, the null hypothesis will be rejected. For analysis of diagnostic test of limited and full protocol MRI, 2 x 2 tables were constructed using surgical finding as a gold standard.

Results

From March 2002 to January 2003, 123 patients suspected of lumbar disc herniation were included into the present study. There were 62 females and 61 males with the age range of 21-60 years (mean 42.9 years). The duration of pain before performing the MRI was between 1 and 204 months with a mean of 31.2 months. The severity of pain was mild in 29 cases(23.6%), moderate in 56 cases(45.5%) and severe in 38 cases (30.9%).

Reliability analysis

Radiologist #1 and #2 interpreted the MRI findings for each patient from intervertebral disc spaces of first lumbar through first sacrum. So with 5 levels on each side, this resulted in 10 interspaces for each patient. Then a total of 1230 interspaces were analyzed. The prevalence of disc herniation and nerve root compression observed by radiologist #1 and #2 are shown in Table 2. In the interspace analysis, agreement between two radiologists assessing limited protocol MRI was fair for both disc herniation and nerve root compression (k = 0.27, 0.23 respectively). The agreement on full protocol MRI was fair in disc herniation (k = 0.27) and good in nerve root compression (k = 0.66). Summarized result of inter-observer agreement and 95% CI was shown in Table 3.

The findings of LDH and nerve root compression for each patient and each protocol were concluded as yes or no without considering the level or side. These data were analyzed by subject. A total of 123 subjects were analyzed. For the inter-observer reliability, the agreement between radiologist #1 and #2 was fair for diagnosis of disc herniation on both limited and full protocol MRI. The agreement of disc herniation between radiologist#1 and #3 was fair on both limited and full protocol MRI. The agreement between radiologist #2 and #3 in disc herniation, the result was fair on both limited and full protocol MRI. The agreement in nerve root compression for each pair of radiologists were fair to good on full protocol

Table 2. Prevalence of LDH and nerve root compression observed by radiologist #1 and #2 (n = 1230 by interspace and 123 by subject respectively)

		Disc herniation		Nerve root compression	
		Interspace (%)	Subject (%)	Interspace (%)	Subject (%)
Radiologist #1	Limited MRI	121 (9.8%)	54 (43.9%)	17 (1.4%)	11 (8.9%)
	Full MRI	157 (12.8%)	67 (54.5%)	71 (5.8%)	68 (55.3%)
Radiologist #2	Limited MRI	23 (1.9%)	17 (13.8%)	33 (2.7%)	47 (38.2%)
	Full MRI	27 (2.2%)	23 (18.7%)	114 (9.3%)	50 (40.7%)

Table 3. Inter-observer agreement between radiologist #1 and #2 by interspace analysis (kappa, 95%CI))

	Limited MRI	Full MRI
Lumbar disc herniation	0.27 (0.18, 0.36)	0.27 (0.18, 0.35)
Nerve root compression	0.23 (0.07, 0.38)	0.66 (0.58, 0.74)

MRI but rather poor on limited protocol MRI. The details of Kappa values are presented in Table 4.

Equivalent study

From the L statistics, to determine whether limited protocol MRI can be used instead of full protocol MRI in detection of lumbar disc herniation, the authors found that the limited protocol MRI can replace full protocol MRI (q = 1.04, 95%CI 0.95, 1.14). However, because the 95%CI is not in the predetermined range (0.95-1.05), the detection is not statistically significant. For nerve root compression, the limited protocol MRI cannot replace full protocol MRI (q = 0.75, 95%CI 0.63, 0.87).

Diagnostic performance

Of the total 123, 54 patients were treated conservatively and had some improvement after being treated for 3-6 months. There were 33 patients operated on at the suspected lumbar levels. Thirty-six patients were lost to follow up or were treated outside the hospital. Of the 33 operated cases, herniated disc with nerve root compression was found in 22, herniated disc without nerve root compression in 1, no herniated disc but nerve root compression from other causes mostly spinal stenosis in 9, and only mild bulging disc without nerve root compression in 1 case. The details of values of diagnostic test are summarized in Table 5.

The authors compared diagnostic performance between limited and full protocol by using exact binomial test due to the small sample size. There was no statistical difference between the sensitivity (p = 1 and 95%CI - 16.5%, 16.5%) and specificity (p = 1 and 95%CI - 17.3%, 36.4%) of full and limited protocol MRI for disc herniation. The difference between the sensitivity of full and limited protocol MRI for nerve root compression was statistically significant (p = 0.0047 and 95%CI 8.6%, 41.2%). When surgical finding was negative for nerve root compression (n = 2), both limited and full protocol MRI interpreted negative in all cases. So the specificity of both tests was equal.

Table 4. Inter-observer agreement of three radiologists, kappa statistic (95%CI)

Radiologist	Disc herniation		Nerve root compression	
	Limited MRI	Full MRI	Limited MRI	Full MRI
#1 VS #2	0.32 (0.19, 0.46)	0.33 (0.20, 0.45)	0.20 (0.05, 0.36)	0.59 (0.45, 0.72)
#2 VS #3	0.36 (0.22, 0.50)	0.44 (0.29, 0.59)	0.44 (0.29, 0.59)	0.50 (0.37, 0.64)
#1 VS #3	0.50 (0.35, 0.66)	0.57 (0.43, 0.71)	0.16 (0.07, 0.25)	0.60 (0.46, 0.74)

Table 5. Diagnostic performance of the limited and full protocol MRI with their 95%CI

		Sensitivity (%) (95%CI)	Specificity (%) (95%CI)	Accuracy (%) (95%CI)	PPV (%) (95%CI)	PV (%) (95%CI)	LR(+)
Limited	LDH	82.6 (62.9, 93.0)	80.0 (49.0, 94.3)	81.82	90.5 (71.1, 97.3)	66.7 (39.1, 86.2)	4.13
MRI	Nerve root	54.8 (37.8, 70.8)	100.0 (34.2, 100.0)	57.58	100.0 (81.6, 100.0)	12.5 (3.5, 36.0)	-
Full	LDH	82.61 (62.9, 93.0)	70.0 (39.7, 89.2)	78.79	86.4 (66.7, 95.3)	63.6 (35.4, 84.8)	2.75
MRI	Nerve root	80.6 (63.7, 90.8)	100.0 (34.2, 100.0)	81.82	100.0 (86.7, 100.0)	25.0 (7.1, 59.1)	-

PPV = positive predictive value, NPV = negative predictive value, LR(+) = likelihood ratio positive, Nerve root = nerve root compression

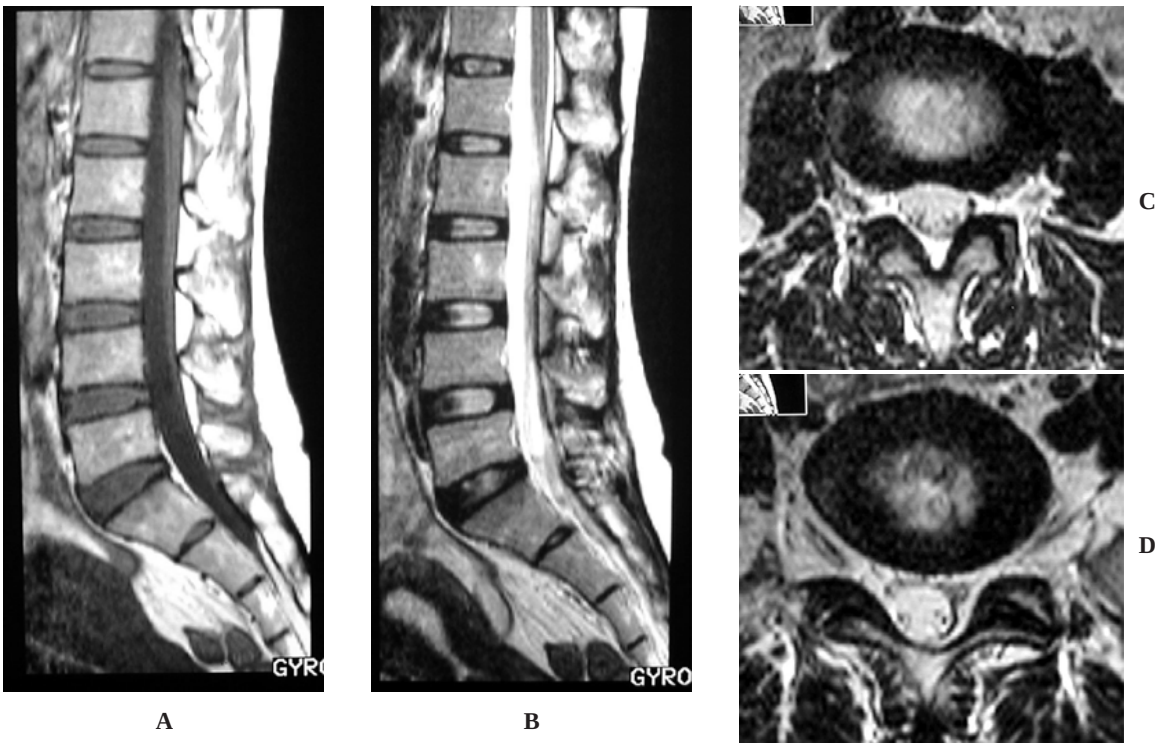

Fig. 1 MRI lumbar spine in full protocol (A) sagittal T1wi, (B)sagittal T2wi, (C, D)axial T2wi. This patient had low back pain with suspected herniation of nucleus pulposus. The MRI demonstrates mild bulging of the L5-S1 disc (D) and normal L4-5 disc (C)

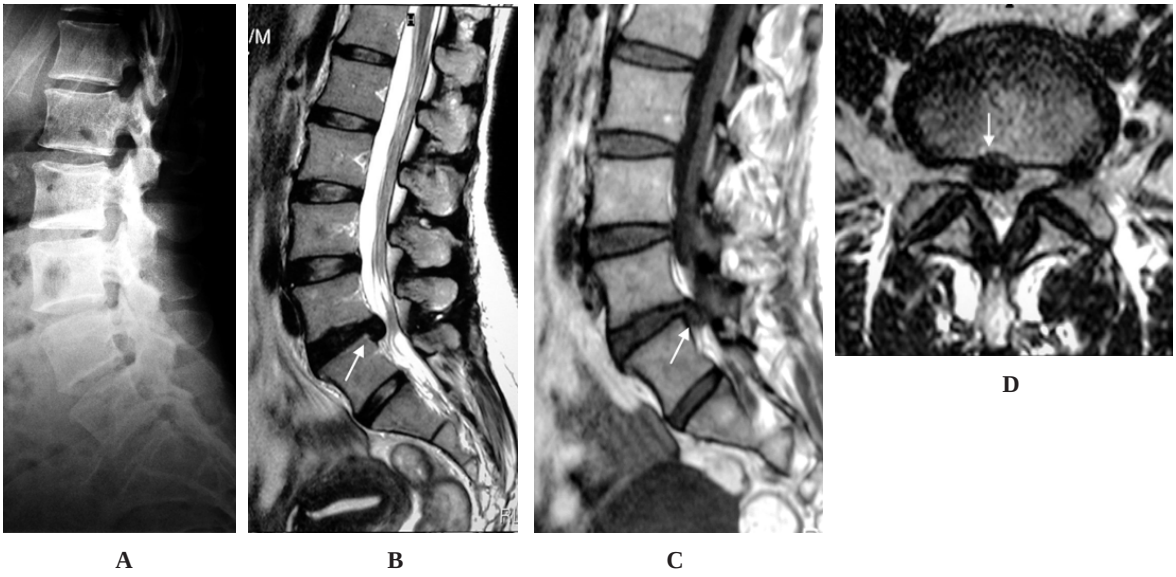

Fig. 2 Lumbar disc herniation. (A) The lateral roengenogram of lumbar spine shows questionable decreased height of the L4-5 intervertebral disc space. The MRI in sagittal T2wi (B) and sagittal T1wi (C) clearly demonstrates lumbar disc herniation at L4-5 level (arrows). The axial T2wi (D) shows herniated disc(arrow) compressing the right nerve root

Discussion

Many terminology classifications were proposed in describing pathology of lumbar disc herniation. Surgical approach and imaging approach often contradicted. The American Society of Neuroradiology, American Society of Spine Radiology and North American Spine Society recommended nomenclature and classification of lumbar disc pathology adapted from Milette PC[9]. In this recommendation a herniated disc means the observation of displacement of disc material beyond the edges of the ring apophyses less than 50% of the circumference of the disc in axial plane and beyond the limit of intervertebral space in sagittal plane. A protrusion and extrusion differ in the maximum cranio-caudal diameter of the herniated part compared with the edge of the base. For a protrusion, the herniated distance is less than its base, whereas in an extrusion the distance is greater than its base. This nomenclature cannot describe a bulging disc in the sagittal plane. A bulging disc was defined in the axial plane, however. When the cranio-caudal distance is less than its base, it could be both bulging and herniated disc. In practice, partial volume averaging can cause images appearing in focal herniation in the axial plane if the plane of the scan is not exactly parallel with the disc space especially in a much narrowed disc from pathologic degeneration. In the present study the authors found that careful evaluation of the shape of the disc in the sagittal plane in every image scan can separate the bulging disc from the protruded disc. If the displaced disc was seen in nearly all sagittal images, it could be a bulging disc. If the displaced disc was seen focally or predominantly in one area, it could be protrusion.

Contained disc or low volume of displaced disc material was found to have better outcome when treated by conservative method compared with non-contained or low volume herniated disc[10,11]. Usually imaging finding of contained disc is the same as protrusion which has cranio-caudal distance of herniated part less than its base[10,11]. In this point, imagings help in selecting patients as candidates for early surgery.

For the reasons explained above, the authors decided to include protrusion in Milette's nomenclature into a bulging disc if no predominant area of protrusion is seen in all images of sagittal T2-wi. There may be a reason why the limited protocol MRI agree with full protocol MRI.

The present study demonstrated that though the equivalence test between sagittal T2-wi and full protocol MRI for evaluating whether there is herniated disc or not is falling into the accepted range but this finding does not show statistical significance (as the 95%CI fell outside the predetermined accepted range). This may be because of the small sample size. The limited protocol MRI also cannot be used to evaluate the nerve root compression.

Considering diagnostic performance of the test, in this point, the good test should have low false positive. Because LDH can be treated conservatively, operation in patients with no LDH (also no other causes) does more harm than not operated on patients with LDH (false negative test). In another words, a test is needed which has a high specificity or high positive predictive value (PPV) and acceptable sensitivity or negative predictive value (NPV). In the present study the authors found that full protocol MRI had a specificity of 70% and PPV of 86.36% (LR positive of 2.75) approximately the same as another study (specificity = 70%, LR positive = 2.8)[5]. When compared with a limited protocol MRI which has a specificity of 80% and PPV of 90.48% (LR positive of 4.13), the diagnostic performance of limited protocol is better than full protocol. The authors believe that the way radiologists interpreted the images influences the result. In a limited protocol, radiologists tried to interpret the findings using the predetermined operational definition. However, in full protocol, radiologists interpreted the findings by using their own previous experience. The axial T2wi influenced decision making more than sagittal T2wi and caused over reading (more false positive).

For nerve root compression, sagittal T2wi cannot give information as axial T2wi do. This made lower accuracy and more false negative. Though the sensitivity of nerve root compression in full protocol is significantly better than limited protocol, the specificity is the same. For patient management, surgeons usually consider nerve root compression on the patients' signs and symptoms. Also they can better evaluate nerve root compression in the operative field. Pain can also be from other causes such as referred pain from annular tear. In conclusion, the decision for nerve root decompression operation is from signs and symptoms rather than from imaging findings.

Patients or subjects in the present study were only cases suspected of having LDH and could pay for the MRI examination. This influenced limitation of the study for diagnostic performance in general use. The authors cannot conclude the findings for all cases with low back pain but only those who were clinically

diagnosed or suspected of having LDH. The prevalence of detected LDH by MRI is about half of the total cases, whereas the prevalence of operated cases is about 70%. The true predictive values may be changed according to the prevalence of the population. Further study to assess the diagnostic performance of the tests is needed such as follow up for the non-operated cases. This will cost more, in time and money.

The inter-observer agreements in LDH were not so good between radiologist #2 and #1 or #3 especially in full MRI. This may be because the basic knowledge of radiologist #2 that differed from #1 and #3. The inter-observer agreements in nerve root compression on limited protocol were very low between radiologist #1 and #2 or #3. This may be because radiologist #1 believed that nerve root compression can be evaluated only in axial plane (instrument bias). Raininko R, et al (1995) studied about inter-observer agreement in the assessment of disc herniation using the same protocol as the present study and found that kappa coefficient was 0.30[12]. Brant-Zawadski M, et al (1995) also studied inter-observer agreement by using two nomenclature of interpretation of disc abnormality[13]. They found that the kappa statistics was good (0.61). Their results were not so different from the authors (0.32-0.59).

However, the authors found that controlling observers to interpret the findings as defined in operational definition was difficult especially in experienced radiologists with high self confidence. This may be another bias in the present study.

Conclusion

The limited protocol MRI (sagittal T2wi) may be enough for evaluating lumbar disc herniation before surgery in cases of clinically suspected LDH but not enough for evaluating nerve root compression.

Acknowledgements

This study is part of a thesis for Master Degree in Clinical Epidemiology. The authors wish to thank the Faculty of Medicine Siriraj Hospital for financial support and the following persons for their kind help: Prof Somjai Wangsuphachart, Prof Sathit Vannasaeng, Prof Visanu Thamlikitkul, Dr. Chulaluk Komoltri, Mr. Anek Suwanbundit, and all the personnel in the Department of Orthopedics and Radiology of Siriraj Hospital.

References

1. Andersson GB. Epidemiologic features of chronic low-back pain. Lancet 1999; 334: 581-5.
2. Hart LG, Deyo RA, Cherkin DC. Physician office visits for low back pain. Frequency, clinical evaluation, and treatment patterns from a US national survey. Spine 1995; 20: 11-9.
3. Office of Compensation Fund. The 1st conference on occupational back pain. In: Proceeding of meeting. Bangkok: Social Security Office, Ministry of Labor and Social Welfare; 1999.
4. Saicheua P. Occupational lumbar disc herniation among Thai workers claimed for compensation. J Med Assoc Thai 2001; 84: 253-7.
5. Low back pain syndrome-musculoskeletal and immunologic problems [online]. 1999. In: www.clinicalevidence.org.
6. Woodcock RJ, Marx WF, Johnson RM, Lowe JM, Lipper JM, Kallmes DF. Needle diameter in outpatient myelography: rates of adverse effects and current practice trends. Neuroradiology 2000; 42: 371-4.
7. Roland M, Morris R. A study of the natural history of back pain. Part I: development of a reliable and sensitive measure of disability in low-back pain. Spine 1983; 8: 141-4.
8. Lachenbruch PA, Lynch CJ. Assessing screening tests: extensions of McNemar's test. Statist Med 1998; 17: 2207-17.
9. Milette PC. Classification, diagnostic imaging and imaging characterization of a lumbar herniated disk. Radiol Clin North Am 2000; 38: 1267-92.
10. Saal JA. Natural history and nonoperative treatment of lumbar disc herniation. Spine 1996; 21: 2S-9S.
11. Jonsson B, Johnsson R, Stromqvist B. Contained and noncontained lumbar disc herniation in the same patient. Two case reports. Spine 1998; 23: 277-80.
12. Raininko R, Manninen H, Battie MC, Gibbons LE, Gill K, Fisher LD. Observer variability in the assessment of disc degeneration on magnetic resonance images of the lumbar and thoracic spine. Spine 1995; 20: 1029-35.
13. Brant-Zawadzki MN, Jensen MC, Obuchowski N, Ross JS, Modic MT. Interobserver and intraobserver variability in interpretation of lumbar disc abnormalities. A comparison of two nomenclatures. Spine 1995; 20: 1257-64.

การวินิจฉัยโรคหมอนรองกระดูกสันหลังส่วนเอวกดทับรากประสาทด้วยภาพเอมอาร์ไอท่าเดียว

อรสา ชวาลภาฤทธิ์, อัญชลี ชูโรจน์, พิพัฒน์ เชี่ยววิทย์, สุรินทร์ ธนพิพัฒนศิริ, วิศิษฏ์ วามวาณิชย์, พนิดา ชาญเชาว์วานิช

วัตถุประสงค์*: เพื่อศึกษาความเป็นไปได้ของการวินิจฉัยโรคหมอนรองกระดูกส่วนเอวกดทับรากประสาทโดยการสร้างภาพเอมอาร์ไอท่าเดียวเปรียบเทียบกับการสร้างภาพหลายท่าตามปกติ*

วัสดุและวิธีการ*: ผู้ป่วยที่มารับการตรวจเอมอาร์ไอและได้รับการวินิจฉัยจากแพทย์ว่าสงสัยเป็นโรคหมอนรองกระดูกสันหลังกดทับรากประสาทจะได้รับการซักประวัติจากพยาบาลเกี่ยวกับความรุนแรงและระยะเวลาของอาการปวด หลังภาพเอมอาร์ไอของผู้ป่วยจะได้รับการแปลผลโดยรังสีแพทย์สามท่าน แพทย์แต่ละท่านจะอ่านผลจากภาพเอมอาร์ไอท่าเดียวและอ่านจากทั้งสามภาพแยกกัน ในแต่ละรายจะได้รับการบันทึกว่ามีหมอนรองกระดูกยื่นออกมาหรือไม่และมีการกดทับรากประสาทหรือไม่ นำผลที่ได้จากแต่ละวิธีการ(ผลจากภาพเอมอาร์ไอท่าเดียวและจากภาพเอมอาร์ไอสามท่า) มาเปรียบเทียบเพื่อหาความแตกต่าง นอกจากนี้ยังเปรียบเทียบผลที่ได้ในแต่ละวิธีการกับผลผ่าตัดในผู้ป่วยที่ได้รับการผ่าตัด*

ผลการศึกษา*: ผู้ป่วยที่เข้าร่วมในโครงการทั้งสิ้น 123 ราย (ชาย 61 รายและหญิง 62 ราย) อายุระหว่าง 21-60 ปี (เฉลี่ย 42.91 ปี) มีอาการก่อนมาทำการตรวจเอมอาร์ไอ 1-204 เดือน(เฉลี่ย 31.20 เดือน) ความรุนแรงของอาการน้อย ร้อยละ 23.58 ปานกลางร้อยละ 45.52 และมากร้อยละ 30.89 ผู้ป่วยได้รับการรักษาโดยการผ่าตัด 33 ราย นอกนั้นได้รับการรักษาตามอาการ จากการแปลผลภาพของรังสีแพทย์พบว่าการให้การวินิจฉัยว่ามีหมอนรองกระดูกยื่นออกมาจากรอยแตกของแอนนูลัสหรือไม่ (lumbar disc herniation)โดยใช้ภาพเอมอาร์ไอท่าเดียว ไม่ต่างจากการใช้ภาพครบทั้งสามท่าประกอบกัน (ซีตา = 1.04 หรือมีความแตกต่างร้อยละ 4, 95%CI = 0.94, 1.14) แต่การให้การวินิจฉัยการกดทับรากประสาทหรือไม่โดยใช้ภาพเอมอาร์ไอท่าเดียวต่างจากการใช้สามท่าโดยมี ความแตกต่างร้อยละ 25 ในจำนวนผู้ป่วยที่ได้รับการผ่าตัด 33 ราย พบว่าเป็นหมอนรองกระดูกยื่นและมีการ กดทับรากประสาท 22 รายและมีการยื่นของหมอนรองกระดูกโดยไม่มีการกดทับรากประสาท 1 ราย อีก 10 ราย ไม่มีการยื่นของหมอนรองกระดูก แต่มีการเคลื่อนตัวของข้อกระดูกร่วมกับการกดทับรากประสาท 4 ราย มีการเคลื่อนตัวโดยไม่มีการกดทับ 4 ราย เป็นการนูนของหมอนรองกระดูก โดยไม่มีการกดรากประสาท 1 ราย และมีการกดอีก 1 ราย ความไว ความจำเพาะและความถูกต้องในการวินิจฉัยการยื่นของหมอนรองกระดูกโดยเอมอาร์ไอท่าเดียวเท่ากับร้อยละ 82.61, 80 และ 81.82 ตามลำดับ โดยสามท่าเท่ากับร้อยละ 82.61, 70 และ 78.79 ตามลำดับ ส่วนความไว ความจำเพาะและความถูกต้องในการวินิจฉัยการกดทับรากประสาทโดยเอมอาร์ไอท่าเดียว เท่ากับร้อยละ 54.84, 100 และ 57.58 ตามลำดับ โดยสามท่าเท่ากับร้อยละ 80.65, 100 และ 81.82 ตามลำดับ ความไวและความจำเพาะ ในการวินิจฉัยการยื่นของหมอนรองกระดูกในภาพเอมอาร์ไอท่าเดียวและสามท่าไม่แตกต่างกัน แต่ความไวในการวินิจฉัยการกดทับรากประสาทในทั้งสองวิธีแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($p < 0.013$, 95%CI = -0.337, -2.501)*

สรุป*: จากการศึกษานี้สรุปได้ว่า ไม่มีความแตกต่างในการวินิจฉัยการยื่นของหมอนรองกระดูกจากการใช้ภาพเอมอาร์ไอท่าเดียวหรือจากการใช้ภาพเอมอาร์ไอมาตรฐานครบสามท่า แต่มีความแตกต่างในการวินิจฉัยการกดทับรากประสาทซึ่งภาพสามท่าจะวินิจฉัยได้ดีกว่าภาพท่าเดียว*