Lumbar disk prolapse: Response to mechanical physiotherapy in the absence of changes in magnetic resonance...

Article *in* Neurorehabilitation · February 2008

DOI: 10.5167/uzh-3870 · Source: PubMed

6 authors, including:

Doris Broetz
University of Tuebingen
40 PUBLICATIONS **1,022** CITATIONS
SEE PROFILE

Wolfgang Wick
Universität Heidelberg
559 PUBLICATIONS **17,492** CITATIONS
SEE PROFILE

Wilhelm Küker
University of Oxford
170 PUBLICATIONS **4,269** CITATIONS
SEE PROFILE

Lumbar disk prolapse: response to mechanical physiotherapy in the absence of changes in magnetic resonance imaging. Report of 11 cases

Broetz, D; Hahn, U; Maschke, E; Wick, W; Kueker, W; Weller, M

Lumbar disk prolapse: response to mechanical physiotherapy in the absence of changes in magnetic resonance imaging. Report of 11 cases

Abstract

BACKGROUND: Lumbar disk prolapses are among the most common neurological conditions. In this open study, we asked whether repeated end-range spinal movements (McKenzie method) as physiotherapy in patients with lumbar disk prolapse induce early changes in location, size and signal intensity of lumbar disc material detectable by magnetic resonance imaging (MRI). We compared clinical with radiographic changes. The clinical efficacy of mechanical physiotherapy according to the McKenzie method within 5 days was documented. METHODS: Eleven consecutive patients with lumbar disk prolapse were included. Patients were treated with repeated end-range spinal movements and MRI was performed before and after 2-5 treatments. RESULTS: All patients achieved a reduction in symptoms and signs of disk prolapse during and after these procedures but none showed any change in the MRI features of the prolapses. CONCLUSIONS: Beneficial effects of specific mechanical physiotherapy in patients with radicular syndromes from lumbar disk prolapse are not paralleled by changes in the MRI appearance of the prolapses. Alternative explanations for the early clinical responses in some patients with lumbar disc prolapse treated according to the McKenzie method must be sought.

Lumbar disk prolapse: response to mechanical physiotherapy in the absence of changes in magnetic resonance imaging. Report of 11 cases.

Doris Broetz, Ulrich Hahn, Evelin Maschke, Wolfgang Wick, Wilhelm Kueker, Michael Weller

D Broetz, PT, is Physical Therapist, Center for Therapy and Department of General Neurology and Hertie Institute for Clinical Brain Research, University of Tübingen, Germany

U Hahn, MD, was Neuroradiologist, Department of Neuroradiology, University of Tübingen, Germany when this study was conducted.

E Maschke, PT, was Physical Therapist, Center for Therapy and Department of General Neurology and Hertie Institute for Clinical Brain Research, University of Tübingen, Germany when this study was conducted.

W Wick, MD, was Neurologist, Department of General Neurology and Hertie Institute for Clinical Brain Research, University of Tübingen, Germany when this study was conducted.

W Kueker, MD, was Neuroradiologist, Department of Neuroradiology, University of Tübingen, Germany when this study was conducted.

M Weller, MD, is Professor and Chairman, Department of General Neurology and Hertie Institute for Clinical Brain Research, University of Tübingen, Germany.

All authors provided concept/idea/research design/writing, and data analysis.

Address correspondence to: D. Broetz, Center for Therapy and Department of General Neurology and Hertie Institute for Clinical Brain Research, Hoppe-Seyler-Str. 3, 72076 Tübingen, Germany, Telephone: +49 7071 2983263, Fax: +49 7071 29 5331, E-mail: doris.broetz@web.de

Lumbar disk prolapse: response to mechanical physiotherapy in the absence of changes in magnetic resonance imaging. Report of 11 cases.

Abstract

Background. Lumbar disk prolapses are among the most common neurological conditions. In this open study, we asked whether repeated end-range spinal movements (McKenzie method) as physiotherapy in patients with lumbar disk prolapse induce early changes in location, size and signal intensity of lumbar disc material detectable by magnetic resonance imaging (MRI). We compared clinical with radiographic changes. The clinical efficacy of mechanical physiotherapy according to the McKenzie method within 5 days was documented. **Methods.** Eleven consecutive patients with lumbar disk prolapse were included. Patients were treated with repeated end-range spinal movements and MRI was performed before and after 2-5 treatments. **Results.** All patients achieved a reduction in symptoms and signs of disk prolapse during and after these procedures but none showed any change in the MRI features of the prolapses. **Conclusions.** Beneficial effects of specific mechanical physiotherapy in patients with radicular syndromes from lumbar disk prolapse are not paralleled by changes in the MRI appearance of the prolapses. Alternative explanations for the early clinical responses in some patients with lumbar disc prolapse treated according to the McKenzie method must be sought.

Key words: conservative treatment, physiotherapy, lumbar disk prolapse, magnetic resonance imaging

Short title: Lumbar disk prolapse: mechanical physiotherapy and changes in magnetic resonance imaging

Introduction

Although lumbar radicular syndromes due to disk prolapses are among the most common neurological conditions, there is no consensus on their appropriate management. Thus, the roles of surgery, physiotherapy and pharmacological treatment have remained obscure. Previously the clinical effects of mechanical physiotherapy using repeated end-range spinal movements based on the McKenzie method [26] in patients with neuroradiologically confirmed lumbar disk prolapse have been shown [8, 9]. It was noticed that a significant proportion of patients show pain centralisation and a prominent reduction in neurological symptoms and signs within the short time of 5 days of mechanical physiotherapy. Accordingly, in the present study, we asked whether mechanical physiotherapy, when clinically successful, induces early changes detectable by magnetic resonance imaging (MRI). Understanding the mechanism underlying the clinical benefit of this specific therapeutic approach could help to standardise the management of patients with disc herniation. Decision making for or against disc surgery could be supported.

Disc herniation is associated with mechanical causative factors and is hence principally a mechanical problem. Whole body vibration, prolonged sitting, rotation and flexion of the spine can all produce extrusion of the nucleus pulposus [1, 2, 6, 27]. Radiating pain and neurologic deficits can be induced by compression of the nerve root as well as by inflammation [10, 31].

It is known that extruded discs tend to decrease in size over a period of several months [10, 16, 23, 24, 28, 30]. MRI and computed tomography (CT) have been used to show this. In the cited studies regression of prolapsed discs correlated with clinical improvement. However, no previous study has assessed whether such visible changes in size of disc herniation as well as in clinical signs and symptoms occur in the short course of only a few days. Further, little is known about the correlation between the

extent of disc herniation and clinical signs and symptoms [4, 10, 20, 21, 25, 31]. Moreover, the mechanisms that induce such changes are also unclear.

Flexion of the spine is accompanied by posterior migration of the nucleus pulposus and extension of the spine is accompanied by anterior migration of the nucleus pulposus [2, 15]. McKenzie and May proposed that compensatory pressure on the disc in the direction of the lesion can reduce the displacement of the nucleus if the outer annular wall is intact [26]. We here assessed whether in the case of a disc prolapse, even when sequestrated, repeated end range spinal movements induce early changes in location and size of lumbar disc material detectable by MRI.

Patients and Methods

Eleven consecutive patients (4 female, 7 male) with a history of referred leg pain for 5 days up to 2 years (median 5 weeks) and lumbar disk prolapse confirmed by MRI who gave informed consent were treated with mechanical physiotherapy (Ethics committee approval 318/2002). The patients were between 18 and 65 years of age and could have sensory and motor neurological deficits (Tables1 and 2).

The physical therapy concept [26] proposes a mechanical diagnostic evaluation which forms the basis for mechanical physiotherapy guided by the reduction of neurological symptoms and signs. Peripheralization and centralization refer to changes in the projected area of radicular pain associated with lumbar disc disease [3, 13, 26]. The physiotherapy aims specifically at identifying therapeutic movements of the spine which promote centralization and avoid peripheralization. These movements are learned and subsequently used by the patients who need to actively participate in the therapeutic strategy both as in-patients and out-patients. Mechanical physiotherapy is an effective treatment strategy for many patients with lumbar disc prolapse [8, 9]. Changes in pain location and intensity occur immediately during exercises. Hence improvement is associated directly with the therapeutic approach.

The following data were documented to assess the clinical course of the disease:

- Weakness grade 4: full range of motion against resistance, but not full power; weakness grade 3: full range of motion against gravity, but unability to move against resistance; weakness grade 2: full range of motion in the absence of gravity; weakness grade 1: impaired motion in the absence of gravity, but muscle activity detectable [11, 18]
- Pain was graded on a numeric analog scale (0, no pain, 10, worst pain)
- Reduction of sensory loss involved either reduction in the area of sensory loss or in the intensity of sensory loss

- The neural tension test straight leg raise (SLR) was measured in degrees
- The median disability score according to Roland and Morris 1983 [29] was documented
- Radicular pain was measured in cm as the distance from the affected spinal segment (vertebra) to the distal demarcation of referred pain
- The number of patients who used analgesics was documented
- The number of patients who needed surgery was documented

All patients were evaluated by MRI before the first treatment with repeated end range spinal movements and were reevaluated by MRI at a median of 5 days later (range: 3-7 days). Two independent blinded observers (U.H., W.K.) evaluated all MRI films. Specific attention was paid to changes in the size and location of the prolapsed disc material as well as the signal intensity and the topographic relation between prolapse and nerve root.

Results

Patient characteristics

Demographic data on all patients are summerized in table 1. Eight patients had a rather short history of pain, three had chronic lumbar disc problems.

Clinical findings

Mechanical physiotherapy involved repetitive end-range spinal movements in a preferred direction [22, 26]. Centralisation of pain occurred in 8 of 11 patients. Extension of the vertebral column reduced the symptoms in all patients. Ten of 11 patients also performed rotation in a supine position with hips and knees bent or leg movements as therapeutic movements. All patients achieved a reduction in symptoms and signs of disk prolapse during and after these procedures. Clinical data at study entry, after 2-5 days of mechanical physiotherapy and at a follow-up visit after 51 days (median; range 30-78 days) are summarized in Table 2. One patient required surgery (see Table 1) at 4 weeks for persistent lumbar radicular pain after withdrawal of all analgesics. The data of patients with short (n=8) and long (n=3) history were pooled because there was no apparent difference between these small groups.

Neuroradiologic findings

The prolapses occupied more than 2/3 of the spinal canal in 1, more than 1/3 in 3 and less than 1/3 in 7 patients. Ten of 11 prolapses were sequestrated. None of the patients showed any change in the MRI features of the prolapses on days 3-7 after study entry (Figure).

Discussion

The results of the present small prospective clinical trial do not support the hypothesis that clinical responses to mechanical physiotherapy in patients with lumbar disc prolapse are associated with changes in the MRI appearance of these prolapses. Earlier studies had shown that long-term changes in the MRI appearance of lumbar disc prolapses show a weak correlation to the clinical course [20, 25].

However, immediate effects of mechanical physiotherapy on MRI features have never been explored. Since 10 of 11 patients had no increase in their medication and 7 of 10 patients had a decrease of medication between the MRI investigations, the clinical improvement likely resulted from mechanical physiotherapy and not from confounding drug therapy. Pain centralisation and reduction in clinical symptoms and signs of disk prolapse evolved during and persisted after physiotherapy and were therefore probably specific and not attributable to the natural course of the disease.

Of note, this trial was not designed to prove or disprove the efficacy of physiotherapy, but to assess whether responses to physiotherapy are associated with changes on MRI.

The mechanism that induces the long-term volume reduction of lumbar disc herniations is unclear. Dehydration, retraction into the intervertebral space, and resorption due to inflammatory reactions have been discussed [16, 17, 23, 24]. MRI provides information about the size and localization of herniated discs. The correlation between this information, and kind and intensity of clinical signs and symptoms are not well known. Even in asymptomatic volunteers disc abnormalities detected by MRI have been described. However, extruded disc herniations in symptom-free volunteers are unusual [5, 7, 14, 19, 32]. It is not possible to predict whether signs and symptoms will improve with conservative therapy or whether the patient will require surgery from neuroradiological findings alone.

The clinical improvement alone justifies the therapeutic approach applied. It is nevertheless interesting, theoretically, to conjecture about the mechanism of the improvement. Can repeated end range movements of the spine shift the extruded disc, so that the nerve root is less compressed? Do these movements cause dehydration of the disc? Clinical and theoretical knowledge together could help to develop the best treatment strategy and to avoid ineffective or deleterious approaches in the treatment of patients with herniated discs.

We find that the beneficial effects of mechanical physiotherapy in patients with radicular syndromes from lumbar disk prolapse are not paralleled by changes in the MRI appearance of the prolapses, suggesting that physiotherapy does not translocate or mobilize prolapsed disc material. Possible alternative explanations for the beneficial effect of mechanical physiotherapy include a decrease in the pressure on the prolapsed tissue as a result of a relocation of disc material remaining in the intervertebral space, enhanced diffusion of proinflammatory mediators from the site of root compression and a recovery of function resulting from mobilization.

Conclusion

The use of repeated end range spinal movements was clinically effective in the treatment of patients with lumbar disc herniation. This method of physiotherapy is mechanical, but the mechanical effects on the herniated disc and compressed nerve root remain unclear. Further MRI studies, in a larger group of patients, before and after specific physiotherapy could be helpful to clarify the mechanism of clinical improvement. Randomised controlled trials have to prove whether one specific therapeutic intervention is superior to another specific intervention or natural history.

References

1. MA Adams, WC Hutton. Prolapsed intervertebral disc-a hyperflexion injury. Spine 7 (1982), 184-191
2. MA Adams, WC Hutton. Gradual disc prolapse. Spine10 (1985), 524-542
3. A Aina, S May, H Clare. The Centralisation phenomenon of spinal symptoms – a systematic review. Manual Therapy 9 (2004), 134-143
4. M Benoist. The natural history of lumbar disc herniation and radiculopathy. Joint Bone Spine 69 (2001), 155-160
5. SD Boden, DO Davis, TS Dina, NJ Patronas, SW Wiesel. Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects. J Bone Joint Surg 72-A (1990), 403-408
6. N Bogduk, LT Twomey. Clinical anatomy of the lumbar spine. London Churchill Livingstone 1987
7. N Boos, N Semmer, A Elfering, V Schade, I Gal, M Zanetti, R Kissling, N Buchegger, J Hodler, CJ Main. Natural history of individuals with asymptomatic disc abnormalities in magnetic resonance imaging. Predictors of low back-related medical consultation and work incapacity. Spine 12 (2000), 1484-1492
8. D Brötz, M Weller, W Küker, J Dichgans, A Götz. Mechanical physiotherapeutic diagnosis and therapy in patients with lumbar disc disease. Akt Neurol 28 (2001), 74-81
9. D Brötz, W Küker, E Maschke, W Wick, J Dichgans, M Weller. A prospective trial of mechanical physiotherapy for lumbar disk prolapse. J Neurol 250 (2003), 746-749
10. K Bush, N Cowan, DE Katz, P Gishen. The natural history of sciatica associated with disc pathology. A prospective study with clinical and independent radiologic follow-up. Spine 17 (1992), 1205-1212

11. SC Cuthbert, Gj Goodheart. On the reliability and validity of manual muscle testing: a literature review. Chiropractic and Osteopathy (2007), 15:4

12. R Donelson, W Grant, C Kamps, R Medcalf. Pain response to sagittal end-range spinal motion. A prospective, randomized, multicentered trial. Spine 16 (1990), 206-211

13. R Donelson, C Aprill, R Medcalf, W Grant. A prospective study of centralisation of lumbar and referred pain. Spine 22 (1997), 1115-1122

14. CW Ernst, TW Stadnik, E Peeters, C Breucq, MJC Ostreaux. Prevalence of annular tears and disc herniation on MR images of the cervical spina in symptom free volunteers. Europ J Radiol 55 (2005), 409-414

15. AJ Fennell, AP Jones, DW Hukins. Migration of the nucleus pulposus within the intervertebral disc during flexion and extension of the spine. Spine 21 (1996), 2753-2757

16. T Henmi, K Sairo, S Nakano, Y Kanematsu, T Kajikawa, S Katoh, VK Goel. Natural history of extruded lumbar intervertebral disc herniation. J Medical Invest 49 (2002), 40-43

17. T Ikeda, T Nakamura, T Kikuchi, S Umeda, H Senda, K Takagi. Pathomechanism of spontaneous regression of the herniated lumbar disc: histologic and immunohistochemical study. J Spinal Disord 9 (1996), 136-140

18. V Janda, D Pavlu, A Herbenova: Manuelle Muskelfunktionsdiagnostik. Urban and Fischer, 2000

19. MC Jensen, MN Brandt-Zawadzki, N Obuchowski, MT Mosic, D Malkasian, JS Ross. Magnetic resonance imaging of the lumbar spine in people without back pain. N Engl J Med 331 (1994), 69-73

20. H Komori, A Okawa, H Haro, T Muneta, H Yamamoto, K Shinomiya. Contrast-enhanced magnetic resonance imaging in conservative management of lumbar disc herniation. Spine 23 (1998), 67-73.

21. H Komori, A Okawa, H Haro, K Shimomiya-Ki, B Yushima. Factors predicting the prognosis of lumbar radiculopathy due to disc herniation. J Orthop Sci 7 (2002), 56-61
22. A Long, R Donelson, T Fung. Does it matter which exercise? A randomized control trial of exercise for low back pain. Spine 29 (2004), 2593-2602
23. JY Maigne, B Rime, B Deligne. Computed tomographic follow-up study of forty-eight cases of nonoperatively treated lumbar intervertebral soft disc herniation. Spine 17 (1992), 1071-1074
24. JY Maigne, B Deligne. Computed tomographic follow-up study of twenty-one cases of nonoperatively treated cervical intervertebral disc herniation. Spine 19 (1994), 189-191
25. T Masui, Y Yasutsugu, N Shigeru, K Gakuji, M Yuji, K Fumihiko, I Naoki. Natural history of patients with lumbar disc herniation observed by magnetic resonance imaging for minimum 7 years. J Spinal Disord Tech 18 (2005), 121-126
26. R McKenzie, S May: The Lumbar Spine: A Mechanical Diagnosis and Therapy. Waikanae, New Zealand: Spinal Publications, 2003
27. MH Pope, M Magnusson, DG Wilder. Kappa Delta Award. Low back pain and whole body vibration. Clin Orthop 354 (1998), 241-248
28. A Reyentovich, WA Abdu. Multiple independent, sequential, and spontaneously resoving lumbar intervertebral disc herniations. Spine 27 (2002), 549-553
29. M Roland, R Morris. A study of the natural history of back pain. Spine 8 (1983), 141-144
30. KV Slavin, A Raja, J Thornton, FC Wagner. Spontaneous regression of a large lumbar disc herniation: report of an illustrative case. Surg Neurol 56 (2001), 333-336
31. H Weber. The natural history of disc herniation and the influence of intervention. Spine 19 (1994), 2234-2238
32. D Weishaupt, M Zanetti, J Hodler, N Boos. MR imaging of the lumbar spine: prevalenz of intervertebral disk extrusion and sepuestration, nerve root compression, end plate

abnormalities, and osteoarthritis of the facet joints in asymptomatic volunteers. Radiology 209 (1998), 661-666

Table 1: Demographic data

Patient No.	Age [years]	Gender	History of pain	Surgery for lumbar disc prolapse
01	44	female	acute (up to 6 weeks)	no
02	49	male	acute	yes
03	51	female	acute	no
04	33	male	acute	no
05	47	male	acute	no
06	41	male	chronic (over 6 weeks)	no
07	34	female	chronic	no
08	67	male	acute	no
09	27	female	acute	no
10	41	male	acute	no
11	38	male	chronic	no

Table 2. Patient characteristics at diagnosis and after 5 treatment sessions.[a]

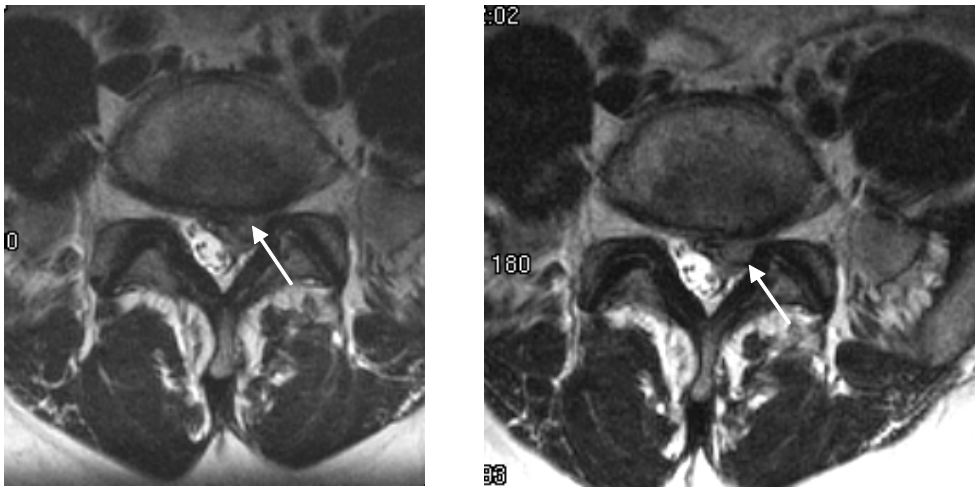
Patient status	at diagnosis	after 5 treatment sessions	At first follow-up
No weakness	5/11 (45%)	7/11 (63%)	7/10 (70%)
Weakness (grade 4)[b]	3/11 (27%)	1/11 (9%)	2/10 (20%)
Weakness (grade 3)[b]	2/11 (18%)	2/11 (18%)	0/10 (0%)
Weakness (grade 2)[b]	0/11 (0%)	1/11 (9 %)	1/10 (10%)
Weakness (grade 1)[b]	1/11 (9%)	0/11 (0%)	0/10 (0%)
Pain 5-10[c]	9/11 (81%)	2/11(18%)	2/10 (20%)
Pain 1-4[c]	2/11 (18%)	7/11 (63%)	4/10 (40%)
Sensory loss	7/11 (63%)	4/11 (36%)	3/10 (30%)
Reduction of sensory loss[d]	n.a.[g]	4/4 (100%)	3/3 (100%)
SLR (median±SEM and range in degrees)[e]	50±7.2 (10-90)	65±4.9 (39-90)	66± 4.5 (50-95)
Disability score[28] (median)	13 (8-20)	9 (4-17)	7 (0-12)
Radicular pain extension[f] (median)	65 (7-119)	7 (0-102)	0 (0-78)

Therapy with analgesics	8/11 (72%)	6/11 (54%)	2/10 (20%)
Operated	n.a.[5]	0/11 (0%)	1/11 (9%)

[a]column 4 include only 10 patients not operated for lumbar disk disease
[b]weakness grade 4: full range of motion against resistance, but not full power; weakness grade 3: full range of motion against gravity, but unability to move against resistance; weakness grade 2: full range of motion in the absence of gravity; weakness grade 1: impaired motion in the absence of gravity, but muscle activity detectable (11, 18)
[c]pain was graded on a numeric analog scale (0, no pain, 10, worst pain)
[d]reduction involved either reduction in the area of sensory loss or in the intensity of sensory loss
[e]straight leg raise (SLR) was measured in degrees
[f]radicular pain was measured in cm as the distance from the affected spinal segment (vertebra) to the distal demarcation of referred pain
[g]n.a. not applicable

Figure legend.

Transverse T2-weighted MRI of patient P.E. before the first treatment (a) and after 5 treatment sessions (b) showing a left mediolateral disc prolapse at the level of L5/S1 (arrow). The disk is hypointense compared with the adjacent CSF and compresses nerve root S1. There is neither a change in size nor location and signal intensity between both examinations.



a b