Biomechanical examination of patients suffering from specific low back pain syndrome

Theses of doctoral (Ph.D.) dissertation

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INTRODUCTION

Chronic low back pain syndrome (cLBP) is a serious public health-, medical-, and economical issue in developed countries. There are numerous conservative ways of treatments for cLBP, with different degrees of efficiency. The indication field and efficiency of the treatments had been controversial issues for long time but by the appearance of evidence based medicine (EBM) they became clear in international physiotherapy. Hungarian practise significantly differs from the international one. According to EBM, in cases of cLBP, active physiotherapeutic methods are recommended, namely remedial exercise and patient - education. Methods of remedial exercises with long term efficiency are: elongation, stabilizing therapy, progressive strength training and sports therapy. Partly and primarily short term efficiency therapies are: Astor-therapy, Heller - therapy, mobilizing exercises, subaqueous exercises, Maitland-manual therapy and Mulligan-therapy. The McKenzie method supplemented with other therapies is recommended mainly for short-term treatment of less severe deformations andof acute and sub-acute LBP. The traction and Williams-method are not efficient therapies for cLBP. Therapies, either not recommended by or of which efficiencies are not known to EBM, are (except for some cLBP subdivisions, for example: piriformis - syndrome, pseudo-radicular syndrome) the passive physiotherapeutic methods: massage, electrotherapy, thermotherapy, external waist support.

Patient - education in itself is not efficient but if supplemented with remedial exercises it is the most effective conservative method. Methods including both patient-education and remedial exercises are for example the back school programs, Caesar therapy, Mensendieck therapy, and the multidisciplinary rehabilitating program.

Successful education for cLBP patients includes developing proper posture and proper spine-usage. It’s essential element, which also influences its efficiency, is the automatic development of everyday forms of motion which do not increase the burden of the disc. The automation of the movements has a special exercise-methodology background, which is applied in both science of physical education and sports education, but is less used in physiotherapy.

AIM OF RESEARCH

The aim of this research is to examine the efficiency of active and passive physiotherapies among cLBP patients regarding intensity of lumbosacral pain, posture and spine-usage.

Its additional aim is the biomechanical motion-analysis of the movement-elements of posture and that of spine-usage.

We would also like to do the biomechanical motion-analysis of the automatism of spine-usage.

HYPOTHESIS

1. Active physiotherapeutic methods have significant short-term and long-term pain relieving and posture correcting effects for cLBP patients.
2. Passive physiotherapeutic methods have significant short term pain relieving effect but they do not provide long term relief.
3. Participants of the active physiotherapy group apply automatic and proper spine-usage short-, and long-term.
4. Participants of the passive therapy group do not develop automatic, proper posture and spine-usage.
5. Those applied automatic proper spine-usage experienced decrease of lumbar pain.
6. Those applied proper posture experienced decrease of lumbar pain.

PROCEDURE AND SUBJECT OF RESEARCH

Subject of research

We conducted a randomized, controlled research with 6 to 12 months follow up among cLBP patients.

Criterions of participation:

Only cLBP patients past 18 years of age, who had been suffering from lumbar pain for at least 13 weeks, were selected to participate.

Criterions of exclusion:

Those patients who had been diagnosed with any of the list below, were not allowed to participate:

acute or sub-acute LBP; spondylolisthesis; spondylarthritis ankylopoetica; fracture; central or peripheral neurologic disorder; cauda syndrome; hernia disci intervertebral in case of surgical indication; tumour; failed back syndrome; rheumatologic or other loco-motor disorder which may reduce the room for articular movement-range by

30%; depression and other psychiatric disorders (only if medical proof presented); chronic pain syndrome; internal-, gynaecological-, or urological disorders causing lumbosacral pain. Other disorders, conditions that rule out the use of active and passive physiotherapeutic methods were: fever; cardinal de-compensation; temperature sensation disorder; thrombosis; thrombophlebitis; arteriosclerosis; pacemaker; prosthesis or any kind of implanted metal; gravidity; if the patient was currently under or had been under other physiotherapeutic treatment in the last 3 months (the frequency and intensity of the treatment has achieved the level needed for effectiveness); or if the patient underwent spinal operation in the last 6 months. In order to guarantee the accuracy of biomechanical posture-analysis, patients with dorsum planum posture-disorder were not allowed to participate.

The randomization was done by mechanical sample-taking of 1:1.

During the research 240 patients were examined and during the 12 months follow-upwe could repeat the examination of 180 (75%) of them. There were 92 people in the group their average age was 42.1 years (36-68). 19.5 weeks (13-24) had passed since LBP was diagnosed.

There were 88 people in the control group their average age was 43.4 years (39-69). 17.8 weeks(14-27) had passed since LBP was diagnosed.

Procedure of research

The method of posture and spine-usage were examined by Zebris WinSpine Pointer Posture and Triple Lumbar biomechanical motion-analyser right before commencement and at completion of the treatment and it was repeated 6 and 12 months later. The pain experienced by the patient was examined by Visual Analogue Scale (VAS) simultaneously with the biomechanical motion-analysis. Changes of patients` lumbosacral pain were examined during the research, as well as from among the biomechanical parameters of posture, the angles of thoracalis kyphosis and lumbar lordosis were examined. During motion-analysis of spine-usage when lifting an object, flexion, extension, lateral flexion, rotating movements and tilt movement range of pelvis were analysed and movement-automation was examined.

Applied physiotherapy

The research group participated in back school program for 12 weeks, twice a week, each sessions lasting for 60 minutes, in total 24 sessions. Patients were advised to repeat the taught exercises at home daily or at least 5 times a week, each time for 20 minutes and to try and integrate those exercises into their everyday life and movements. Development of the back school program we use, in compliance with national and international specialized literature, included patient-education; lifestyle consultation and remedial exercises. Physiotherapy included elongation; Magnus-therapy; Norris`s theory of active lumbar stabilization exercises then progressive strength-training and sports therapy were used (Kempf 2000, Zatsiorky 2000, Jordan 2002).

Participants of the control group received 10 minutes of patient-education, which touched on information regarding proper posture and spine-usage and advices regarding spine-friendly lifestyle applicable during both leisure-time and work. They were also given illustrated materials on the subject. The patients were to read the materials and practise what they had been advised, 5 times a week, and to try and integrate the taught into their everyday life and movements.

They participated in passive therapy twice a week for 12 weeks so they received 24 treatments. Patients were given classic Swedish massage; TENS treatment; descending galvanic treatment in longitudinal treatment method or diadinamic - and interference treatment as well as paraffin pack for the lumbosacral area as directed by the consultant, which was to relieve of pain; to decrease paravertebral spasm and to provide local vasodilatation.

Method of statistic analysis

Statistical analysis was done by using SPSS 15.0. We calculated mean value and experimental dispersion and applied paired t-test. The test was to show whether data collected before and after treatment were significantly different.

RESULTS AND CONCLUSIONS

Results of posture examinations (ZebrisWinSpine Pointer Posture)

Patients` graph of thoracalis kyphosis and lumbar lordosis showed significant ($p<0.001$) improvement during therapy and the same was true for both the 6 and the 12 months follow up examination period. The angle of the thoracalis kyphosis did

not change significantly (p=0.571) in the control group neither after treatment nor during follow-up examinations (p=0.744, p=0.651). Neither did we find significant change (p=0.662, p=0.777, p=109) during examination of lumbar lordosis of patients in the control group.

Hildebrant and his colleagues examined 222 people during their randomized, controlled blind 6-12 months follow-up examination in Holland. The examined group (n=112) received Caesar therapy consisting of posture exercises and exercise programs, and the control group (n=110) received standard treatment of medicine and lifestyle-consultation by family doctors. Changes of posture-based on Caesar posture-analysis- were examined by experienced independent Caesar therapists as well as they did the Vicon optical-electronic bio-mechanical posture-analysis. Using Caesar examination, they found significant difference between the Caesar group and the family doctor treated group, regarding changes of posture. Using Vicon examination, minimal difference was found between the 2 groups (Hildebrant 2000).

Results of Caesar therapists` posture examination and those of Vicon examination might have been different because Vicon optical-electronic examination is of the order of centimetre therefore it cannot record smaller changes of posture. One reason for the defect of Vicon measuring system is that the positions of the markers can be changed by movements of the skin. Because of the movements of the skin and the size of the markers, exact marking of the anatomical points is not possible. Zebris system allows a more precise examination of the posture. Using pointer examination, movements of the skin can be eliminated, error of measuring is 1 mm. Markers used by the 2 systems are very different. Vicon system uses markers of 5 cm diameter with 5 mm active part, fixed to the surface of the body. Using a pointer, Zebris system marks the given anatomical point (Seo 1997, Zsidai 1999, Kocsis 2007, Kiss 2010). The reason for not being able to prove significant changes of posture using Vicon system could be the different measuring errors of the measuring systems but using Zebris system, we were able to prove significant changes of posture.

Examination results of spine-usage (ZebrisWinSpine Triple Lumbar)

ROM results of movement-elements

Flexion movement-range of the trunk significantly decreased ($p<0.001$) of the examined group during movement-analysis of lifting and tilt ROM results of anterior pelvis significantly increased ($p<0.001$) both after therapy and during follow-up

examinations. Changes of ROM resultsled to the conclusion that patients lifted objects with proper spine usage. Movement-range of lateral flexion and rotation decreased significantly ($p<0.001$) which indicated proper execution of movement. Movement-range of extension of the trunk and tilt movement-range of posterior pelvis decreased significantly ($p<0.001$) which also indicated proper execution of movement because trunk extension (bent backwards compared to erect standing) and posterior pelvis tilt do not belong to movement-elements needed for lifting.

In the control group trunk flexion significantly decreased during vertical lifting both after therapy ($p<0.003$) and in the 6-12 months follow-up period ($p=0.006$ and $p=0.004$). Taking into consideration the mean value of differences, we found that the results regarding the control group were between 2.057-2.227, while the results regarding the examined group were 14.902-15.196. In case of the control group-compared to the examined group-the change is of a lesser degree, however, statistically significant, which meant a minimal, 2 degrees trunk flexion ROM decrease in clinical practise. The control group`s results of anterior pelvis tilt significantly decreased during all the 3 examinations ($p=0.003$). In the case of the control group we could see a lesser degree, statistically significant change which meant a minimal 1.5 degrees decrease in clinical practise. Mean value of the examined group was 19. In case of the control group the following did not change significantly: trunk lateral flexion ($p=0.494$, $p=0.461$, $p=0.355$); extension ($p=0.541$, $p=0.624$, $p=0.586$) and rotation ($p=0.579$, $p=0.578$, $p=0.421$), also the movement-range of pelvis posterior tilt ($p=0.767$, $p=0.974$, $p=0.859$). Compared to the assessment done in the beginning, participants of the control group executed lifting with better usage of spine but only partially and to a lesser degree reduced movement-forms which increase pressure within the disc therefore are unfavourable to the spine.

In the case of the examined group, trunk rotation decreased significantly ($p<0,001$) during horizontal lifting and turning and the movement-range of pelvis rotation increased ($p<0.001$). This indicates that patients executed the turning with significant decrease of the trunk rotation and with proper spine usage.ROM results of movement-elements not directly needed for turning, such as trunk flexion; lateral flexion; extension, significantly decreased ($p<0,001$). Patients in the examined group executed the movement properly.

In the control group, trunk rotation during horizontal lifting increased significantly ($p<001$), both after therapy and during examinations in the follow-up period. ROM result of pelvis rotation showed significant increase ($p<0.001$) during all the 3 examinations. Taking into consideration the mean value of differences, in the case of control group results were 11.75-12.0, while in the case of examined group those results were 30.11-30.24. In the case of control group a smaller but significant change could be seen. Patients adopted pelvis rotation and turning from the trunk to a greater extent so partially reducing the burden of the spine.

Automatism of spine-usage

We can deduce automatism of movement from the time-diagram curve of movement. Evenly running, uninterrupted curve indicates automatic movement. Unevenly running curve indicates consciously controlled, non-automatic execution of movement. In terms of efficient rehabilitation, automatic, properly executed movement is important. The survey done before the beginning of the therapy showed that 91.3-92.04% of patients did movements automatically of which 7.6-11.9% were properly executed movements. The second, after-therapy survey showed that 97.8% of the examined group did movements automatically and during lifting 90.2% of those and during horizontal lifting 97.8% of those were done properly. 51.1% of the control group executed the movements properly of which proper vertical lifting was done by 21.5% and horizontal lifting by25%. Kigmal and his colleagues examined 4 types of vertical lifting both symmetric and asymmetric ones (straddler technique: lifting with asymmetric footing, without the knees touching the ground; one-leg kneeling technique: lifting in cross straddling from kneeling; stoop technique: lifting with trunk flexion and with unbent knees; squat technique: lifting symmetrically from squat). 12 healthy men (26.1 years old) were examined after they had been asked to lift using a previously agreed on lifting technique. They were asked to lift 2 boxes-each 2kg, of different sizes: a 30 cm and a 60 cm wide respectively-from 2 different heights. Using Optotrak system Visual 3D software, rigid body markers, photogenic diodes, they did kinematic parameters (orbit graph),measuredground reaction dynamometer, did EMG and load of the lumbar spine (compression peak force, shearing force at L.V.-S.I. level) examination. According to their results, trunk flexion ROM was the highest at stoop technique and the lowest at one-leg kneeling technique. Kigmal and his colleagues found lateral flexion and rotation during vertical lifting. The point distance of the body and the box (L.V.-S.I) was

significantly shorter in case of knee-bending techniques. From the point of view of co-contraction, significantly better results were observed with one-leg kneeling technique ($p<0.001$) and less good with stoop technique. According to Kigmal and his colleagues` survey, flexion ROM is not determined by the weight of the box lifted, but by its dimensions (Kigmal 2006). In our research patients could execute lifting freestyle. They used stoop and squat techniques of vertical lifting styles. Similarly to Kigmal`s study, during our survey, we also experienced rotation and lateral flexion results during vertical lifting. In our research with the participants of back school program, ROM results of lateral flexion and rotation significantly decreased during vertical lifting. ROM results were of the similar order, differences could have been caused by different (optical and ultrasound based) measuring methods used during research.

Several authors have studied horizontal lifting along with vertical lifting. Gill and his colleagues at Metropolitan University have studied horizontal and vertical lifting styles regarding the entire lumbar section and also lower and upper lumbar region ROM. Patients were asked to lift 10 times, using any style, from 5 different heights. Among their results they found significant rotation at lumbar section. According to their study style and height of the lifting did not effect lower lumbar section but the throcalis spine and upper lumbar region. Horizontal lifting distance caused change in the applied lifting technique in the upper lumbar spine region. In the lower region shearing force causes damage of the disc, which is not effected by the height of the lifting (Gill 2007).

In our research we found significant rotation during horizontal lifting at pre-therapy measuring(4.21-4.31 degree). Degree results shown in biomechanical examinations are not, in each case, the same as anatomic results because of the placing of body-surface markers and the measuring method, that is, during biomechanical examinations spatial positions of the markers and their spatial coordinates are measured (Zsidai 1999, Kocsis 2007). Rotation component of horizontal lifting can lead to damage of the disc so it is to be avoided (T=th 1993, Kapanji 2008). In our research rotation ROM results of the horizontal lifting in the back school program significantly decreased both after therapy and in the follow-up period. The cause of differences in ROM results could bethe difference between measuring methods and techniques and markers used, dimensions of the boxes lifted, the examined patient`s

bodily proportions (trunk and lower limbs, trunk and upper limbs) and also the height of lifting.

Examination results of pain (VAS)

In our research pain experienced by patients in the examined group significantly decreased ($p<0.001$) both during therapy and in the 6 months ($p<0.001$) and 12 months ($p<0.001$) follow-up period. In case of the control group after therapy survey showed significant decrease ($p<0.001$) of pain but in the 6 and 12 months follow-up period no significant decrease could be found ($p<0.934$, $p<0.580$ respectively).

Hildebrant and his colleagues have surveyed 222 people during their randomized controlled 6-12 months follow-up examination. The group was given Caesar therapy while the control group received standard family doctor therapy (medicine and lifestyle-consultation). Intensity of lumbar pain was surveyed by a questionnaire and was based on recovery record taken down by each patient. Results of the 6 and 12 months follow-up period showed 80% decrease of pain in the group that received Caesar therapy and 47% in the family doctor treated group (Hildebrant 2000).

Soukup and his colleagues at Oslo University conducted randomized controlled survey of 77 cLBP patients with 5-12 months and 3 years follow-up. The group received a 13 weeks-long Mensendieck-therapy of 20 sessions which consisted of ergonomic training and physiotherapy. As a result of the therapy both 5 and 12 months follow-up showed significant decrease in the number of episodes of lumbar pain. Also the 3 years follow-up showed significant ($p=0.02$) decrease in the number of episodes of recidivist lumbar pain (Soukup 1999, Soukup 2000).

Mannion and colleagues at Neurological Department of Schulters Clinic conducted a research with 6-12 months follow-up on efficiency of active therapies in relation to pain. 132 people participated in the research and 127 (86%) in the follow-up. cLBP patients were divided into 3 groups. The first group received physiotherapy, the second one exercised in a gym and the third one did low impact aerobics. Each program lasted for 3 months, twice a week. In this examination intensity and frequency of lumbosacral pain was surveyed by questionnaires. Pain decreased significantly in all 3 groups during the 6 months follow-up examination. The 12 months follow-up examination showed significant ($p=0.03$) decrease of pain in case of the 2nd and 3rd groups. In case of the 1st group receiving physiotherapy during the 6-12 months period results declined (Mannion 2001). Conditioning exercisesand

aerobics-compared to physiotherapy consisting of traditional remedial exercises-later on can be maintained by patients for longer-term in forms of recreational exercise and fitness exercises therefore it is practical to apply sports therapy for post-rehabilitation, which later on become recreational sports or fitness exercises (Zatsiorsky2000, Jordan 2002).

In our research, after physiotherapy, during the last few sessions we did fitness exercises and sports-therapy to ensure easier sustainability of exercise- program.

In our research regarding decrease of the intensity of pain we found similar results during the 6 and 12 months follow-up examinations which showed 90.3-71.7% improvement of participants of Back School and physiotherapy. In the passive therapy group we found 88.5% improvement after-therapy and 0.6-1.2% decline during follow-up.

The following hypotheses of ours proved true:

1. Active physiotherapy methods have significant short-, and long term pain-relieving and posture improving effects among cLBP patients.
2. Passive physiotherapy methods have significant short-term pain-relieving effect but does not have a long-term one.
3. Patients in the active physiotherapy group applied automatic and proper spine usage both short-, and long-term.
4. Patients in the passive therapy group did not develop automatic, proper spine-usage and posture.

DEMONSTRATION OF NEW RESULTS

1. International physiotherapy protocols and guidelines as well as EBM has been recommending active physiotherapy methods (exercise-programs, lifestyle advises regarding spine-usage and posture, patient-training) for cLBP patients since the 90`s. Hungarian practise uses passive therapies (massage, electro-therapy, passive movements, manual therapy, traction treatment, thermo-therapy) predominantly. We have not found any comparative study of active and passive physiotherapies. In our research we have compared the effects of active and passive therapies and got similar results to that of the international ones.
2. There are several physiotherapy programs for cLBP patients with different exercise-content and theoretical background. We have not found any

exercise-program accompanying the full rehabilitation process of reducing pressure in the disc which was arranged according to biomechanical aspects. We have worked out a biomechanically based, 3 months long exercise-program, during which starting-points of exercises, exercise-content and tools used (unstable surfaces, resistance tools) were chosen so to reduce pressure within the disc.

3. Dynamic stereotype, developing movement automatism is an important part of training programs and it is the key to long-term efficiency. One task of cLBP patient-education is to teach and automate such posture and forms of motion which do not increase pressure within the disc. Automation of movements relieving the disc of pressure can be achieved by applying the methodology and exercise-theory of dynamic stereotype when developing patient-educationprogram. Efficiency of patient-education from the aspect of movement-automation has not been examined yet. We have worked out and surveyed the examination-protocol of movement-automationand examined the efficiency of education program from the aspect of movement-automation.
4. The exercise-program we have worked out for cLBP patients could be used for the program “Healing motion-role of exercise in primer and secondary prevention” by the Hungarian Sports-sciences Society.

Possibilities of practical application

1. In physiotherapy it is practical to use active therapies (exercise-program, lifestyle-consultation, patient - education) predominantly not the passive ones (massage, electrotherapy, passive moving, manual therapy, traction treatments, thermotherapy). Passive therapies can be used efficiently with relatively narrow indication area for certain cLBP subdivisions (piriformis syndrome, pseudo-secular syndrome).
2. The joint use of exercise-program and patient-education programs, ergonomic trainings can make rehabilitation more efficient on the long run. Physiotherapeutic treatment of cLBP could be more effective if, according to international practise, “back school” would be integral part of spinal-exercises. Education programs are efficient if patient-educationincludes subjects such as body-mechanism, spinal biomechanics, patho-mechanism of

spinal disorders, causes of pain and its remedial possibilities, proper posture and proper spine-usage. Efficient patient-education programs are efficient if there are at least 2 sessions per week for at least 6 weeks.

3. It would be practical to use exercise-theory background and methodology of dynamic stereotypes applied in physical education and sports-sciences in physiotherapy when developing motion-automatism of spinal-friendly forms of motion.

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CATALOGUE OF OWN PUBLICATIONS AND CONFERENCE PAPERS

Subject article

Jaromi M, Nemeth A, Kranicz J, Laczko T, Betlehem J. (2012)

Treatment and ergonomics training of work-related lower back pain and body posture problems for nurses. Journal of Clinical Nursing,

21;11-12:1776-1784

IF:1,228

Járomi M, Betlehem J: For the physical fitness of public health workers, Nővér, 2005. 18, 2.21-23.

Járomi M, Palkó A.: Zebris WinSpine examination of education for proper posture and spine-usage, Mozgásterápia, 2006. 15. 4. 10-13.

Gangel L, **Járomi M**: Climbing-wall therapy treatment for children suffering from spinal curvature

Gál N, Tihanyi J, Kívés Zs, Oláh A, Betlehem J, Marton-Simora J, Németh K, Müller Á, **Járomi M:**Application of passive and active therapies and examination of connection between posture changes and sense of pain among chronic low back pain syndrome patients, Nővér, 2009, 22.6.3-13.

Book, chapters

Járomi M (editor): Wellness basics II. PTE ETK, Pécs, 2007.

Járomi M: Alternative froms of motion, In: Járomi M(editor): Wellness basics II.PTE ETK, Pécs, 2007.

Járomi M: Fitness trends, aerobic styles, In: Járomi M(editor): Wellness basics II. PTE ETK, Pécs, 2007.

Járomi M: Sports recreation, In: Járomi M(editor): Wellness basics II. PTE ETK, Pécs, 2007.

Oláh A, Müller Á, **Járomi M,** Gál N, Raskovicsné Cs M, Váradyné HA, Fuller N: Protective and safety requirements II. Immobility syndrome. Hospital care, In: Oláh A(editor): Coursebook on Science of Nursing, Medicina, 2012

Oláh A, Müller Á, **Járomi M,** Gál Raskovicsné Cs M, Váradyné HA, Fuller N: Protective and safety requirements I. Lying, laying, tools for comfort and moving. Basics of body-mechanics. Patient-moving. In: Oláh A (editor): Coursebook on Science of Nursing, Medicina 2012.

Járomi M: Pyisiotherapy basics, In: Oláh A (editor): Coursebook on Science of Nursing, Medicina, 2012.

Papers, posters

Járomi M: Study on efficiency of physiotherapy during rehabilitation of sportspeople suffering from slipped disc, International Sports physician Conference, Budapest, 23rd-25th of October, 2005.

Járomi M: Examination of spine-usage automatism with Zebris WinSpine ultrasound-based motion-analyser system. Scientific meeting of the Working Committee of the Pécs Academic Committee, 16th of December. 2011, Pécs

Járomi M: Rehabilitation of slipped disc, case studies, MGYT Regional Conference, 09.09.2006.

Járomi M, Palkó: Biomechanical analysis of upright tilting from the trunk, spherical bending from the trunk and elongation exercises, Society of Hungarian Physiotherapists V. Congress, 18.11.2005. (poster, abstract no.: P6)

Járomi M: Conservative treatment of slipped disc and study of the efficiency of the therapy , ORFMT Youth Forum, 23-25 of October 2005, Nyíregyháza (abstract no.: A-0003)

Járomi M: Examination of spinal-movements with Zebris Winspine motion-analyser system, 47th Congress ofHungarian Orthopaedic Society, 9-12 of June 2004. (abstract no.: 099)

Járomi M: Examination of spinal-movements with Zebris ultrasound-based motion-analyser system, Regional Conference of MGYT Organization of County Baranya, 06.02.2004.

Járomi M: Examination of possible physiotherapeutic treatments of-, and their efficiency for slipped disc, MGYT IV. Congress, 16-18.October, 2003, Keszthely