Back pain. Part II. Diagnosis and pathogenesis of chronic cases

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Abstract

Chronic back pain is often a difficult issue for therapists. Imaging examinations are not always consistent with the clinical picture of condition and can generate false positive or false negative results. Therefore, functional tests are frequently more useful to establish the diagnosis. Their results can be used to monitor the rehabilitation process; moreover, they provide guidelines on the types of exercises that should be applied to compensate for the deficits detected. In order to avoid or eliminate back pain, it is essential to maintain spine stability, which can be impaired by the lack of muscle control.

Key words: back pain, functional tests, spine stability

Introduction

Back pain is one of the commonest complaints due to which patients have to search for medical assistance of therapists. At the acute onset of disease, diagnostic and therapeutic management is well known. A separate and often difficult problem is related to patients with the chronic course of disease. In such cases, imaging examinations do not always allow to establish an accurate diagnosis and therefore, special diagnostic methods are indicated.

Pathogenesis and diagnosis

The symptoms of musculoskeletal diseases depend on numerous factors: structural, biomechanical, psychosocial and neuropsychological [9, 16, 17, 25, 41].

Contrary to the hopes placed in the imaging tests introduced, the structural changes in patients with back pain often do not allow to determine the causes of complaints. Patients with severe diseases requiring immediate diagnosis and interventions, such as cancers, spine fractures, prolapsed intervertebral discs or inflammatory lesions (discussed in part I), who belong to the red-flag group, constitute only about 10 % of all individuals experiencing back pain [3, 5, 14, 15, 21, 22, 23]. The remaining 90% of individuals whose back pain is caused by non-specific mechanical factors (according to some therapists) form a relatively uniform group in which back pain is chronic and recurrent [11, 26, 42].

The International Association for the Study of Pain has defined chronic pain as the type of pain persisting longer than 6 months [35]. In the majority of patients, despite the subsidence of symptoms of a pain episode, frequent recurrences increase their dissatisfaction with the treatment applied. According to Liebenson [27], this situation is predominantly associated with overemphasis placed on structural diagnostic procedures, too long lying down and too hasty qualifications for surgery.

Since the structural cause of pain cannot be determined in the majority of chronic pain patients, the pain experienced should be considered a symptom of functional disorders. Failed surgical procedures in such cases often lead to depression

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and abnormal illness behaviour, i.e. abnormal protective reactions to physical symptoms, as defined by Pilowsky [36].

Many physicians overuse imaging tests due to their fear of overlooking some severe diseases, e.g. cancers, or belief that the structural changes found on examinations are highly correlated with symptoms. In numerous cases, imaging tests generate false positive results, as discopathy or degenerative lesions. The same images can be found in asymptomatic individuals [25, 28]. Bernstein [6] found radiologic signs of intervertebral disc displacement in 31% of completely healthy individuals.

The incidence of false positive results increases with patients` age. Thus, imaging examinations show high sensitivity (few false negative images) but low specificity (a high rate of false positive images) for the diagnosis of discopathies [27]. The studies have demonstrated that patients who underwent radiological tests were longer convinced that they were ill and also complained longer, as compared to patients subjected only to neurological examinations [3, 8, 23].

In view of unfavourable overuse of imaging tests, Simmons [39, 40] believes that physical performance tests are more useful for diagnosis. They enable quick, easy and quantitative evaluation of functional capacities of patients. Moreover, they are easy for patients as they are based on the activities of daily living, which can be impaired by back pain. For instance, bradykinesia (slow movements) is most commonly observed in such patients.

The set of tests to perform is as follows:

1. A repeated sit-to-stand task. A patient stands up 5 times as quickly as possible and after a short interval, the task is repeated. The times of both series are measured (fig.1). The average norm is 7.35 seconds (4.5 - 11.5 sec).

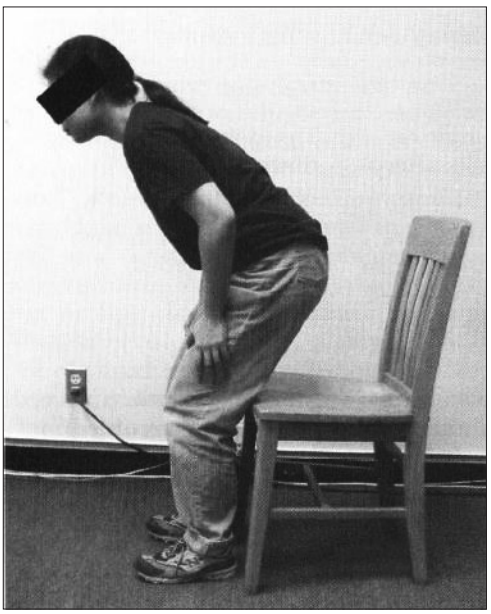

Fig. 1. Repeated sit-to-stand movements [40]

2. A repeated trunk flexion task. A patient bends forward and straightens up as quickly as his/her complaints allow - 5 times, which is repeated after a short break. The times of both series are measured (fig.2). The average norm is 7.44 seconds (5.2 - 9.6 sec) [40].

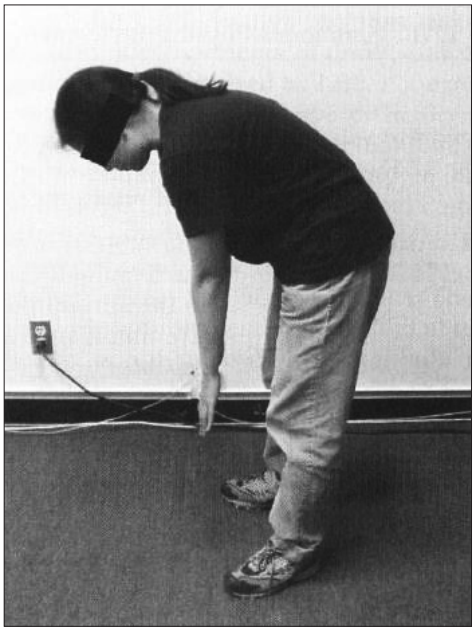

Fig. 2. A repeated trunk flexion task [40]

3. A loaded reach task. A patient stands by the wall where a horizontal centimetre ruler is placed

at the shoulder level. With a load constituting 5% of body weight (maximum 5 kg) in their hands, patients reach forward. The maximum distance is measured in centimetres (fig.3). The average norm is 67.6 cm (55.5 - 84cm).

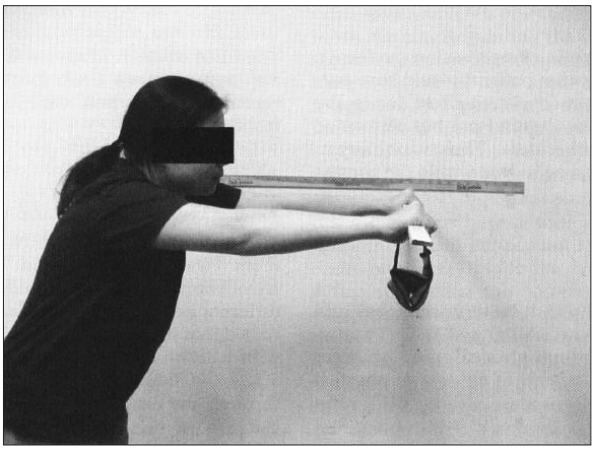

Fig. 3. A loaded forward reach task [40]

4. A 50-step walk task. A patient walks as quickly as possible 25 steps and returns to the starting point. The time needed to cover the distance is recorded. The average norm is 8.3 sec (6.8 - 10.7 sec).

5. A 5-minute walking task. A patient walks as quickly as possible for 5 minutes. The distance covered is recorded. The average norm is 514 m (28 - 683 m).

6. A full turn task. A patient in the dorsal recumbent position makes a full turn and after a short break turns again in the opposite direction. The times of both turns are recorded. The average norm 6.4 sec (4.1 - 10 sec).

7. A fatigue task. A patient lies supine stabilising the position with the thighs and calves, raises the upper trunk and maintains this position as long as possible. The time he/she becomes fatigued is recorded.

Novy et al. [32], studying the patients with lumbar pain using the above set of tasks have determined two factors, i.e. time/coordination tested with a 50-step walk, repeated sit-to-stand, trunk flexion followed by straightening as well as a full turn in the recumbent position and endurance/ strength tested with loaded reaching forward and a 5- minute walk.

The results can be used during rehabilitation and provide information which exercises should be performed to compensate for the deficits detected.

Some physiotherapists question the value of fatigue tests since their results were found to be comparable in patients with and without pain [40].

The results of tests in patients with local lumbosacral pain and patients with pain radiating to the lower limbs were compared. The findings demonstrated that patients with radiating pain had bigger difficulties in tests with spine compression loading and quick movements. Pain radiating to the lower limbs affected also the symmetry of walking. The steps with a painful leg were substantially shorter than those on the opposite side. Impaired walking in patients with lumbosacral pain was also observed during the tasks of acceleration; i.e. patients accelerated the frequency of steps while healthy individuals lengthened their steps [40]. Moreover, physical loading affected walking. Walking was markedly slower when loads exceeded 20% of body weight [44].

Interesting observations were also provided by sit-to-stand tasks. Patients with sacral pain trying to stand up used fewer movements in the hip joints, compensating for this by upward movements in the knee joints. Noteworthy, individuals with pain and healthy controls performed the test slightly asymmetrically.

It was easy to anticipate that during the loaded reach tests, healthy individuals reached further and better tolerated higher loads. Evaluating the usefulness of the tests described above the effects of physical, perceptive and environmental factors should be considered [40].

Since there are no empirically determined norms, some therapists (especially orthopaedic

ones) attempted to "normalise" movements or symmetry of the spine, although such attempts are not scientifically grounded. In many cases, this "normalisation" is neither possible nor indicated; the strategy adopted by patients proves most beneficial and results in better prevention of pain [40].

According to the studies regarding the effects of pain on the range of activities, in many cases fear of pain resulted in more severe motor impairments than the major cause of spine disease [2, 19, 43, 46]. In chronic cases, such fears lead to abnormal illness behaviour in which despair, catastrophic attitudes towards coping with everyday life, anxiety and dependence on treatment predominate [26].

In order to understand the mechanisms causing chronic lumbar pain, it is essential to consider the notion of spine stability. The instability during flexion-extension, lateral bends and axial rotation have been well documented in animal studies, yet the research in human beings has been restrained by focusing on the effects of one-time high-strength overloading. However, the spine instability is found to be more commonly affected by slightly loaded yet long-term movements repeated multiple times. Besides compression, the lumbar spine joints are affected during work and exercises in the erect position by shear movements. They predominantly occur while carrying loads in hands when the chest shifts in relation to the pelvis with the shear movement in lumbar spine joints [31].

The study findings have demonstrated that when the spine is in the neutral position, the main dorsal extensors (longissimus thoracis and iliocostalis lumborum) prevent the shearing reaction. When, however, the individuals bend forward stretching posterior interspinous ligaments, the shearing forces start to work [29]. This involvements of ligaments weakens the action of lumbar muscles which are to support the spine during the action of shearing forces.

The mechanism described above explains why lifting of a load during bending forward leads to lumbar spine damage. The risk of spine overloading increases when bending is accompanied by turning.

Impaired spine stability is most commonly caused by the lack of muscle control and the passive spine structures are subjected to secondary damage [18, 25, 45]. Prolonged pain is associated with the development of atrophic lesions in the paravertebral muscles. In such cases the microscopic examinations show reduced density of muscular fibres and gradual conversion of type I fibres, which are to maintain posture, into type II fibres of lesser functional importance [12].

Depending on their function, muscles can be generally divided into superficial muscles responsible for voluntary cerebral cortex-dependent movements and deep muscles maintaining joint stability, whose activity relies on the subcortical system [4]. The majority of muscles of this region are involved in lumbar spine stability. The role of the individual groups of muscles changes depending on the function performed. At spine bending, the paravertebral muscles-extensors control the movement while at extension, the control is provided by antagonistic straight abdominal muscles [30].

The spine stability can be affected by disturbed breathing as the majority of respiratory muscles function also as spine stabilisers [34]. The main respiratory muscles are the diaphragm, intercostal, scalene, abdominal transverse, pelvic fundus and deep spinal muscles [20]. The most active respiratory muscle, i.e. the diaphragm, is internally attached to six lower ribs, the posterior surface of the xiphoid process as well as to the bodies and 1-4 discs in the lumbar spine. During contraction and movement towards the abdominal cavity, the pressure in the thorax decreases enabling the inspiration; its shifting upward facilitates the expiration. The upper ribs start to move at the

final phase of inspiration, in which scalene are parasternal muscles are involved. The movement is slight at rest and increases substantially on increased oxygen requirements, i.e. during physical efforts and in many metabolic disorders leading to respiratory failure. In cases of dyspnoea, the work of accessory muscles is also observed: trapezius and levator scapulae. In such situations, the clavicular grooves deepen. Under normal conditions, the expiration is a passive movement caused by the elastic structure of the abdominal wall, costal cartilages and lungs. In cases of abnormal expiration, the air is not completely expelled from the lungs, the movement of ribs is reduced and paradoxical breathing can develop during which the abdominal wall raises instead of falling down.

Respiratory disorders can induce lumbar spine pain. The impaired function of the diaphragm disturbs the movement of ribs and other respiratory muscles- abdominal transverse and deep spinal muscles, i.e. the muscles responsible for spine stabilisation [34].

The impact of disturbed muscular coordination on impaired spine stability has been documented in an interesting study with deepening of respirations induced by inhaling the gas mixture with 10% CO_2. The results have demonstrated that forced respiration deepening caused lumbar spine pain in individuals keeping the load in their hands in the reaching out position. This resulted in a conflict between rhythmic respiratory action of abdominal muscles and the diaphragm and the isometric action stabilising the spine [10].

Proper muscle control and suitable positioning of the spine allow harmless lifting of large loads, e.g. by weightlifters; however, when they are impaired, the complaints can develop even during lifting a piece of paper from the floor.

Furthermore, static loading by long-term maintenance of improper position, such as an inappropriate sitting position, should be taken into account. During changes from the standing position into relaxing sitting, lumbar lordosis decreases [13]. Brüger [7] has revealed that the spine is a part of the linkage system and explained how the improper position(sunken sitting) changes the lumbi/pelvis relations as well as thorax, nape and head relations (cogweel mechanism). This disturbs the function of the spine as the muscles, which serve to maintain the position shorten while the antagonistic muscles lengthen (fig. 4)

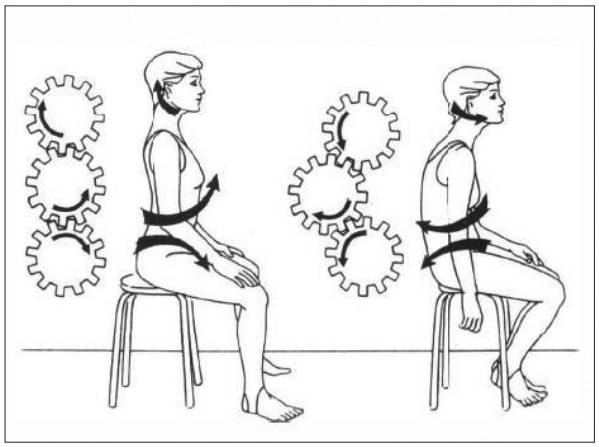

Fig. 4. The cogwheel mechanism accoridng to Brüger [26]

In his holistic approach, Brüger introduced the concept of central motor regulation which is disturbed when the musculoskeletal system is impaired. The nociceptive stimuli from the peripheral regions induce adaptive reactions at the level of the spinal cord and then in the sub-cortical system, which leads to changes in posture and movements; the changes can become fixed at this high level of the nervous system. If the protective mechanisms are impaired, the new incoming stimuli will be experienced as painful [7].

The improvement after rehabilitation cannot be expected if the patient shows abnormal motor activities in everyday life [24, 30, 38]. Some researchers have demonstrated that the risk of spine injuries is associated with gender and age. The spinal loading endurance in women constitutes 2.3 of the endurance in men The same proportions

have been found comparing the spine endurance of a 60-year-old individual and a 20-year-old individual [30].

Summing up the above considerations, it should be accepted that the risk of damage to spinal structures is a function of the size and direction of loading, repetitions of harmful movements, positioning of the spine, movement control, current stability, as well as individual age and gender[1].

Conclusions

1. The incidence of chronic back pain is significantly higher than of acute back pain, in which quick imaging diagnostic procedures and often surgical interventions are required.

2. Imaging examinations in chronic pain cases often generate false results.

3. Functional tests can prove extremely useful for diagnosis.

4. To avoid pain, it is essential to maintain proper spine stability.

References

1. Alan D.B., Waddel G. An historical perspective on low back pain and disability. Acta Orthop Scand Suppl 1989; 60: 1
2. Arendt-Nielson L., Graven-Nielson T., Swarrer H., Svenson P. The influence of low back pain on muscle activity and coordination during gait Pain 1995; 64: 231-240.
3. Balague F., Mannion A., Pellise F., Cedroschi C. Non-specific low back pain. The Lancet 2012; 379: 482-491.
4. Bergmark A. Stability of the lumbar spine. Acta Orthop Scand 1989; 230: 20-24.
5. Bogduk N. Wat's in a name? The labeling of back pain. Med J Aust 2000; 173: 400-401.
6. Borrstein D.G., O'Mara J.W., Boden S. T. et al. The value of magnetic resonance imaging the lumbar spine to predict low back pain in asymptomatic subjects. J Bone and Joint Surg 2001;83A:1306-1311
7. Brugger A. Lehrbuch der functionellen Storungen des Bewegungssystem . Zollinkon/Beglen Brugger Verlag. 2000: 150.
8. Carayannopoulos A. Identification of the pain patient. In:S.M. Falowski, J.E Pope (ed) Integrating pain treatment into your spine practice. Springer Internat Publ. Switzerland 2016.
9. Chapman J.R., Narvell D.C., Hermsmeyer J.T. et al. Evaluating common outcomes for measuring treatment success for chronic low back pain. Spine 2011; 36 Supl 21:54-68.
10. Cholewicki J., McGill S.M. Mechanical stability of the lumbar spine: Implications for injury and chronic low back pain. Clin Biomech 1996; 11:1-15.
11. Croft P.R., Macforlane G.J., Papageorgiu A.C. et al Outcome of low back pain in general practice. BMJ 1998; 316: 1356-1359.
12. Demoulin C., Crielaagard J.M., Vanderhommen M. Spinal muscle evolution in healthy individuals and low back pain patients. Joint Bone Spine 2007; 74: 9-13.
13. Drza-Grabiec J., Truszczyńska A., Fabiańska K.G., Trzaskoma Z. Changes of the body posture parameters in the standing versus relaxed sitting and corrected sitting position. J Back Musculoskeletal Rehabil 2016; Aug 27:29(2):211-2017
14. Falowski S.M. Integration of specialtes . In: S.M. Falowski, J.M. Pope (ed) Integrating pain treatment in your practice. Switzerland 2016:85-88.
15. Ghobrial G.M.,Vaccaro A., Harrop J. Role of spinal surgery in pain management. In: S.M. Falowski, J.E. Pope (ed) Integrating pain treatment into your spine practice. Springer Internat Publ Switzerland 2016: 11-18.
16. Goode A.P., Carey T.S., Jordan J.M. Low back pain and lumbar spine osteoarthritis: How are they related? Current Rheumatol Rep. 2013; 15: 305-310.
17. Grabois M. Management of chronic low back pain. Am J Phys Med Rehabil 2005; 84: S 29-S 41
18. Hodges P.W., Richardos C.A. Inefficient muscular stabilization of the lumbar spine associated with low back pain. Spine 1996; 21: 2640-2650.
19. Hooten W.M. Interdisciplinary pain rehabilitation. Pain Medicine 2011; 12:152-153.
20. Hruska J. Influence of dysfunctional respiratory mechanics on orofacial pain. J Orofacial Pain Related Dis. 1997; 41: 21-27.
21. Jarvik J.G., Hollingworth W., Heagerty P. et al. The longitudinal assessment of imaging and disability of the back study . Spine 2001; 26: 1158-1166.

[1] Rehabilitation-related issues in cases of chronic spine pain will be discussed in the third part of work.

22. Jarvik J.G. Editorial. Don't duck the evidence. Spine 2001; 26: 1306-1307.

23. Kendrick D., Fielding K., Bentler E. et al. Radiography of the lumbar spine in primary care patients with low back pain. BMJ 2001; 322: 400-405.

24. Koes B.W., Tulder M., Lin C.C. et al. An updated overview of clinical guidelines for the management of non-specific low back pain in primary care. Europ Spine J 2010; 19: 2075-2094.

25. Liebenson C. Active care: its place in the management of spinal disorders. In: C. Liebenson (ed) Rehabilitation of the spine. Lippincot Wiliams & Wilkins. Baltimoren2007: 3-29.

26. Liebenson C. Quoality assurance: The scope problem & modern attempt to manage it. In:C. Liebenson (ed) Rehabilitation of the spine. Lippincot Williams & Wilkins Baltimore 2007: 51-71.

27. Liebenson C. Putting the biopsychosocial model into practice. In: C.Liebenson (ed) Rehabilitation of the Spine. Lippincot Williams & Wilkins . Baltimore 2007: 72-90.

28. Matheson L., Mooney V. Employment screening and functional capacity evaluation to determine safe return to work. In: C. Liebenson (ed) Rehabilitation of the spine. Lippincot Williams & Wilkins. Baltimore 2007: 276-292.

29. McGill S.M., Kippers V. Transfer of loads between lumbar tissues during the flexion - relaxation phenomenon. Spine 1994; 19: 190-219.

30. Mc Gill S.M. Lumbar spine stability: Mechanism of injury and restabilization. In: C. Liebenson (ed) Rehabilitation of the Spine. Lippincot Williams & Wilkins . Baltimore 2007:93-111.

31. Norman R.W., Wells R., Neuman P. et al. A comparison of peak vs cumulative physical work exposure risk factors for the reporting of low back pain in the automotive industry. Cli Biomech 1998; 13: 561-573.

32. Novy D.M., Simmons M.J., Olson S.L. et al. Physical performance tasks: What are the underlying constructs? Arch Phys Med Rehabil 2002; 81:44-47.

33. Oxland T.R.,Panjabi M.M., Southern E.P. An anatomic basis for spine instability: A porcine trauma model. J Orthop Res 1991; 9: 452-462.

34. Perri M. Rehabilitation of the breathing pattern disorders. In: C. Liebenson (ed) Rehabilitation of the Spine. Lippincot Williams & Wilkins . Baltimore 2007:369-387.

35. Pope J.E. Referral networks . In:S.M. Falowski, J.E. Pope (ed) Integrating treatment in your spine practice. Springer Internat Publ . Switzeland 2016: 77-84.

36. Pilowski I. A general classification of abnormal illness behavior. Br J Med Psychol 1979; 51:51-131

37. Rozenberg S. French multicenter prospective randomized, open study comparison advice to stay active and bed rest in acute low back pain. Annual Meeting of the International Society for the study of the Lumbar Spine. Edinburgh 2001.

38. Scoco A., Miller J.P., Sweet J.A. Revision surgery and alternative treatment options for recurrent pain following spinal surgery. In: S.M. Falowski, J.E. Pope (ed) Integrating pain treatment into your spine practice. Springer Internat Publ. Switzerland 2016: 45-57.

39. Simmonds M.J., Lee C.E. The Sorensen endurance test. Phoenix, AZ: American Pain Society 2001.

40. Simmonds M.J., LEE e. Physical performance tests: An expanded model of assessment and outcome. In: C.Liebenson (ed) Rehabilitation of the spine. Lippincot Williams & Wilkins Baltimore 2007: 260-275.

41. Tough E., White A., Richards S., Campbel J. Variability of criteria used to diagnose myofacial trigger point pain syndrome . Clin J Pain 2007; 23: 278-286.

42. Turk D.C., Wilson H.D., Cahana A. Treatment of chronic non-cancer pain. The Lancet 2011; 377: 2226-2235.

43. Townsend C.O.,Bruce B.K., Hooten W.M. The role of mental health professionals in multidisciplinary pain rehabilitation programs. J Clin Psychol 2006; 62: 1433-1443.

44. Ukachukwu O.A., Wisdom O.U., Osita N. Effect of backpack strap patterns on gait parameters in young adults at self-selected normal and fast walking speeds. http://dx.doi.org/10.1016/j.pmrj.2016.10.010.

45. Ullrich P.F.jr.Lower back pain symptoms and causes.www.spine-health.com/conditions/lower-back- pain/lower-back-pain symptoms-and-causes. updated 06/16/2015.

46. Waddel G., Newton M., Henderson L et al. A fear-avoidance beliefs questionnaire and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain 1993; 52: 157-168.

47. Zderkiewicz E. Back pain. Part I: causes, symptoms, immediate treatment. Arch Physiother Glob Res 2016; 20 (4): 7-16.

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