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# The influence of lumbar degenerative disc disease with disc herniation on the range of movements in the hip joints

## *Wpływ przepukliny lędźwiowych krążków międzykręgowych na zakres ruchu stawów biodrowych*

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**Key words:** degenerative disc disease, hip joints, range of movement.

**Słowa kluczowe:** dyskopatia, stawy biodrowe, zakres ruchu.

**Summary**

**Background:** The study was to assess the influence of lumbar degenerative disc disease (DDD) with disc herniation on the range of passive and active movements in the hip joints. There are undoubtful biomechanical interdependences between hip joints and lumbar spine present also in pathological states. Recognition of those relationships could influence therapeutic procedures.

**Material and methods:** Study material consisted of 160 randomly assigned patients suffering from lumbar DDD with disc herniation and radicular pain syndrome. The diagnosis was confirmed by spinal MRI in every case. Passive and active movements in the hip joint on the side of radicular pain and on the opposite side were assessed with hand goniometer. The measurement of muscle strength in the hip joint was performed with use of chair measuring apparatus.

Condition of hip joints was assessed by radiological examinations. Results were sorted according to the body side and duration of radicular pain syndrome as well as the level of lumbar hernia.

**Results:** On the side of radicular pain there was decrease in range of passive extension (on average 10.85° at the painful side and 13.25° on the opposite side) and active extension (8.41° and 10.15°, respectively) as well as in range of passive abduction (33.1° and 36.4°, respectively).

Muscle strength of hip joint abductors was significantly lower on the side of radicular syndrome (126.5 N on the side of radicular syndrome and 151 N on the opposite side, $p < 0.0001$). Osteophytes on the acetabular edge were more frequent and

**Streszczenie**

**Wstęp:** Autorzy podjęli temat wpływu dyskopatii przepuklinowej lędźwiowego odcinka kręgosłupa na zakres ruchu stawów biodrowych. Związek ten w płaszczyźnie biomechanicznej ma także charakter patologiczny. Poznanie tego problemu może wzbogacić wiedzę potrzebną przy wyborze sposobów leczenia zachowawczego powikłań dyskopatii.

**Materiał i metoda:** Przebadano 160 wybranych losowo pacjentów z zespołem bólowo-korzeniowym w przebiegu dyskopatii lędźwiowego odcinka kręgosłupa. Wszyscy pacjenci mieli potwierdzone rozpoznanie kliniczne dyskopatii za pomocą badania metodą rezonansu magnetycznego (MRI). U tych pacjentów mierzono zakres ruchu biernego i czynnego stawów biodrowych za pomocą ręcznego goniometru, a siłę mięśni stawów biodrowych z użyciem fotelowego dynamometru. Zmiany zwyrodnieniowo-wytwórcze stawów biodrowych oceniano na podstawie badań radiologicznych. Pacjentów podzielono na grupy, stosując kryterium strony występowania zespołu korzeniowego, czasu trwania zespołu korzeniowego i poziomu występowania dyskopatii przepuklinowej.

**Wyniki:** Po stronie zespołu korzeniowego stwierdzono ograniczenie zakresu ruchu biernego prostowania stawu biodrowego biernego (po stronie zespołu korzeniowego śr. 10,85°, po stronie przeciwnej śr. 13,25°) i czynnego prostowania stawu biodrowego (odpowiednio 8,41° i 10,15°) oraz ruchu biernego odwodzenia (odpowiednio 33,1° i 36,4°).

Siła mięsni grupy odwodzicieli stawu biodrowego była istotnie statystycznie słabsza po stronie zespołu korzeniowego (po stronie zespołu korzeniowego śr. 126,5 N i po stronie przeciwnej

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larger on the side of radicular syndrome – they were present in 37% of persons and their mean size was 4.9 mm in comparison to the respective values of 23% and 2.6 mm on the opposite side.
**Conclusions:** 1. Lumbar DDD with disc herniation decreases range of movements in the hip joints.
2. Decrease in range of movement and muscle strength in the hip is observed on the side of radicular pain syndrome and increases with duration of the syndrome. These facts confirm pathogenic influence of lumbar DDD with disc herniation on the hip joint function and structure.

śr. 151 N, p < 0,0001). Osteofity brzegu panewki stawowej występowały częściej i miały większy wymiar po stronie zespołu korzeniowego (po stronie zespołu korzeniowego stwierdzono osteofity o średniej wielkości 4,9 mm u 37% pacjentów, a po stronie przeciwnej 2,6 mm u 23%).
**Wnioski:** 1. W przebiegu dyskopatii przepuklinowej lędźwiowego odcinka kręgosłupa może ulegać zmianie zakres ruchów stawów biodrowych.
2. Zmiany zakresu ruchów stawów biodrowych i niedowłady mięśni stawów biodrowych korelują z czasem trwania zespołu bólowo-korzeniowego, co może wskazywać na etiopatogenny związek dyskopatii przepuklinowej lędźwiowego odcinka kręgosłupa z zaburzeniami funkcji i struktury tych stawów.

## Background

Multidimentional functional interdependences between hip joints and lumbar spine are well recognised. Pathological relationships develop in disorders involving one of the above mentioned structures. In literature there are reports on disfunctional relations between hip joints and lumbar spine concerning its mobility, lordosis angle and scoliosis level [1-5]. Other types of connection between lumbar degenerative disc disease (DDD) with disc herniation and concomitant neurological deficits are: microcirculatory disregulation within bony parts of the hip and the lower extremity, pareses and increased muscle fatigability [6-13].

The above mentioned relations could adversely influence the function of hip joints, but they are only a part of complicated issue of mutual interrelations between spinal column and hip joints in pathological states [14-17]. The study was to assess the influence of lumbar DDD with disc herniation and hips muscles pareses on the range of passive and active movements and structural changes in the hip joint.

## Material and methods

One hundred and sixty randomly assigned patients, including 84 women, and 76 men aged 25-77 years (mean age 47 years) suffering from lumbar DDD with disc herniation and with radicular pain were qualified to the study and examined. In every case the diagnosis was confirmed with MRI scan of the spine.

Eight people were excluded from the study group because of injury of the hip joint region, hemiparesis in sequence of stroke, diabetic polyneuropathy, organic scoliosis and high grade gonarthrosis impairing walking. Duration of symptoms from their first manifestation was 1-550 months (mean 149.23 months).

Lumbar DDD with disc herniation at L3 -L4 level was present in 2 persons (1.31%), at L4-L5 level in 54 persons (35.6%), at L5-S1 level in 51 persons (33.6%), at L4-L5 and L5-S1 levels in 31 persons (20.3%), at L3-L4 and L4-L5 levels in 11 persons (7.22%) and at the three spine levels in 3 persons (1.97%). No statistically significant difference between numbers of patients with right and left-sided radicular pain syndrome was observed.

Research methods were divided into the following categories:

### 1. Clinical examination

Medical history taken from patients included especially profession character and other factors which could influence hip joints function. Physical examination included neurological assessment and segmental orthopaedic assessment.

Neurological examination was focused on deficit symptoms including sphincter symptoms, sensation impairments, deep reflexes, lower extremities muscle tone, thigh and shank circumferences as well as muscle strength of lower limbs [18]. Orthopaedic examination included Patrick, Thomas and Gensler signs, measurements of relative and absolute lengths of lower extremities, and physiological spinal curvatures. Functional state of sacroiliac joints was assessed with tests described by Lewit, Ostgaard and Buckup [19, 20].

### 2. Assessment of active and passive range of movements in the hip joints

Measurements were performed with hand goniometer in lying position, except for rotation measurement which was carried out in sitting position [18-20]. During measurements pelvis was stabilised with belts with special attention paid to avoid pelvic movements. To assess abduction and adduction the examined limb was lifted on hangers. In order to avoid inaccurate results multiple measurments were carried out and mean value from three tests was taken. Measurement result was accepted on account that the procedure did not provoke pain.

In the first ten patients measurements were repeated on the other day – repetability of measurments was confirmed.

### 3. Measurement of hip muscle strength

Measurements were performed with HMF 1 measuring station manufactured by JBA Staniak (Fig. 1). The station was equipped with electronic dynamometers synchronised with computer software. During the measurment patient was in sitting position on a chair which enabled stabilisation of pelvis and spine to avoid measurement errors. All measurements were performed with maintenance of constant distance between joint (movement axis) and the site of dynamometric assessment.

In the first 10 patients the measurements were repeated the next day and repeatability of results was confirmed.

### 4. Radiological examinations

Radiological imaging of pelvis and spine was performed to identify the cause of pain syndrome. Assessments included bilateral wideness measurements of superior, inferior and medial articular clefts of the hip joint, circumferential and marginal osteophytosis, subchondral sclerotisation as well as geodes of head and acetabulum of the hip joint. The assessments were carried out in a manner similar as in the studies of other authors [21]. During measurement, the patients were asked to stand in the same distance at the X-ray cassette, to position the hips paralell to the film, and to extend the knee to its maximum. Examination involved also sacroiliac joints.

### 5. Statistical analyses

Statistical analyses were performed in medical statistics laboratory with the use of SAS software (version 8). Statistical tests included T-Student test, Wilcoxon test, Kruskal-Wallis test, Duncan test and (ANOVA) analysis of variance when the distribution of the groups were normal. Statistical level of significance was $p < 0,05$.

## Results

Results were classified into subgroups where correlations were calculated. The main subject of the study was the assessment of difference between the range of movements and radiologic picture of the hip joints on the side of radicular syndrome and on the opposite side. To evaluate the influence of radicular syndrome duration on the range of movements and radiologic picture of the hip joints patients with disease duration of less than 10 years and more than 10 years were compared (Table I).

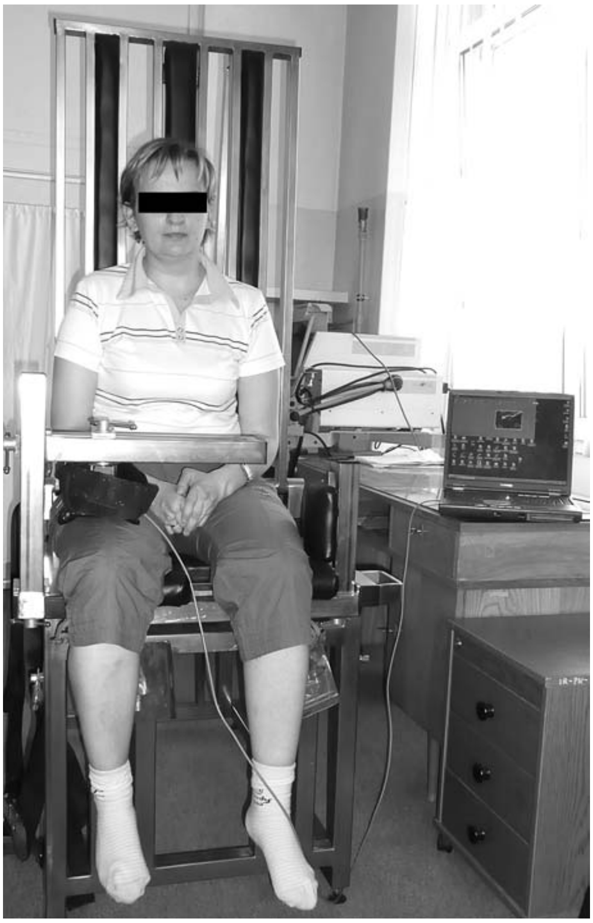

**Fig. 1.** Dynamometric assessment of hip flexors strength with use of measuring station.
***Ryc. 1.*** *Pomiar siły mięśni zginaczy stawu biodrowego na stanowisku pomiarowym.*

### 1. Assessment of the range of movements in the hip joints on the side of radicular syndrome and on the opposite side

Decrease in range of passive and active extension as well as passive hip abduction were observed on the painful side (Table II, III).

### 2. Assessment of the range of movements in the hip joints in patients with disease duration of less than 10 years and more than 10 years

There were statistically significant differences between active abduction on the painful and on the painless side between patients with disease duration of more than 10 years and less than 10 years, which were 4.9ş and 2, respectively. The range of movements

**Table I.** Differences in personal characteristics between patients with disease duration of less and more than 10 years
***Tabela I.*** *Różnice osobowe w grupach pacjentów chorujących do i powyżej 10 lat*

| Personal characteristics | | |
|---|---|---|
| | Patients with disease duration of less than 10 years | Patients with disease duration of more than 10 years |
| height [cm] | 168.6 | 171.8 |
| weight [kg] | 74.6 | 79.2 |

**Table II.** Range of active movements in the hip joint on the side of radicular pain and on the opposite side
***Tabela II.*** *Zakres ruchu czynnego po stronie zespołu korzeniowego i po stronie przeciwnej*

| Active movement direction | Range on the unaffected side (mean values for all examined patients) | Range on the symptomatic side (mean values for all examined patients) | Difference between ranges | P value |
|---|---|---|---|---|
| Abduction | 30.3° | 27.9° | 2.4° | > 0.05 |
| Adduction | 20.1° | 20.2° | –0.1° | > 0.05 |
| Flexion | 117.2° | 117.1° | 0.1° | > 0.05 |
| **Extention** | **10.2°** | **8.4°** | **1.7°** | **0.012** |
| External rotation | 32.9° | 32.2° | 0.8° | > 0.05 |
| Internal rotation | 31° | 29° | 2° | > 0.05 |

**Table III.** Range of passive movements in the hip joint on the side of radicular pain and on the opposite side
***Tabela III.*** *Zakres ruchu biernego stawów biodrowych po stronie zespołu korzeniowego i po stronie przeciwnej*

| Passive movement direction | Range on the unaffected side (mean values for all examined patients) | Range on the symptomatic side (mean values for all examined patients) | Difference between ranges | P value |
|---|---|---|---|---|
| Abduction | **36.4°** | **33.1°** | **3.3°** | **0.0054** |
| Adduction | 23.1° | 23° | 0.1° | > 0.05 |
| Flexion | 130.6° | 131.9° | –1.3° | > 0.05 |
| Extention | **13.3°** | **10.9°** | **2.4°** | **0.031** |
| External rotation | 44.3° | 44.7° | –0.4° | > 0.05 |
| Internal rotation | 41° | 41.5° | –0.5° | > 0.05 |

was always lower on the side of radicular syndrome (Table IV).

### 3. Radiologic changes within hip joints on the side of radicular syndrome and on the opposite side

Analysis of the whole study group revealed the presence of osteophytes on the side of radicular syndrome in 37% of patients. Mean length of the osteophytes measured on radiologic slides was 4.9 mm. On the opposite side osteophytes localised on the superior edge of the iliac acetabulum were found in 23% of patients, and their mean length was 2.6 mm. Difference between osteophyte lengths on the symptomatic and asymptomatic side was statistically significant ($p < 0.01$) (Fig. 2a, b).

Osteophytes localised on the superior edge of the iliac acetabulum on symptomatic side were more frequent in patients with longer duration of the disease. In the group of patients suffering from the disease for less than 10 years osteophytes localised on the side of radicular syndrome were present in 26% of persons, and in the second group in 51% of persons. The difference was statistically significant ($p < 0.02$).

**Table IV.** Range of active movements in the hip joint on the side of radicular pain and on the opposite side in patients with disease duration of less and more than 10 years
***Tabela IV.*** *Zakres czynnego ruchu stawów biodrowych po stronie zespołu bólowo-korzeniowego i po stronie przeciwnej w grupie pacjentów chorujących do 10 i powyżej 10 lat*

| Active movement direction | Range on the unaffected side (mean values for all examined patients) | | Range on the symptomatic side (mean values for all examined patients) | |
|---|---|---|---|---|
| | DDD duration < 10 years | DDD duration > 10 years | DDD duration < 10 years | DDD duration > 10 years |
| Abduction | 31.8° | 30.1° | 29.8° | 25.2° |

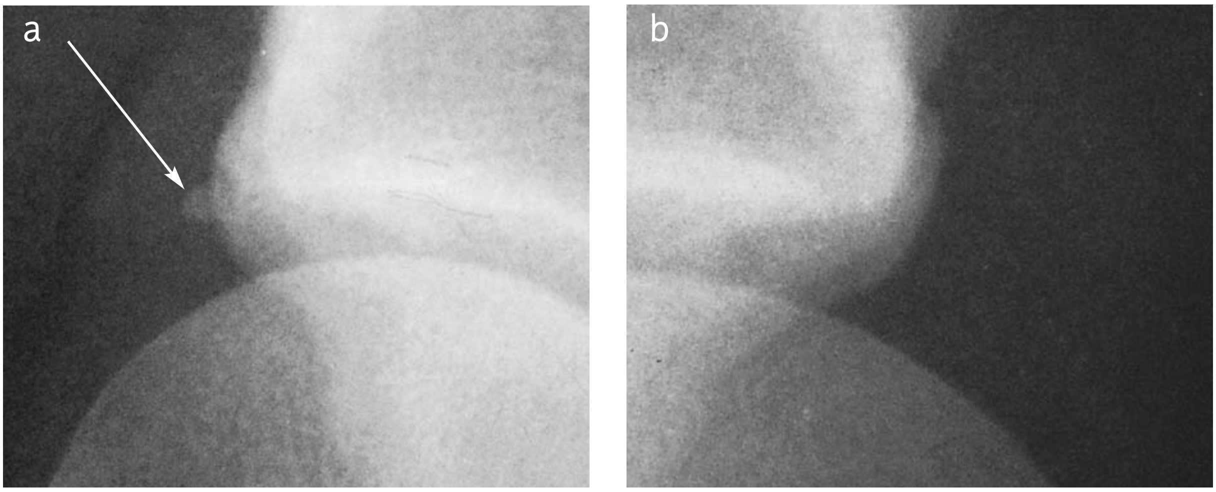


**Fig. 2a, b.** On the side of radicular syndrome (a) osteophyte developing at the edge of acetabulum is visible. On the opposite side similar lesion is not visible (b).
***Ryc. 2a, b.*** *Po stronie zespołu bólowo-korzeniowego* (*a*) *jest widoczny osteofit. Po stronie przeciwnej nie widać takich zmian* (*b*).

**4. Hip muscle pareses**

Pareses of hip joint muscles compatible with radical innervation were observed in studied patients. The most common type of paresis was associated with hip abductors. Muscle strength of hip joint abductors was 126.5 N at the side of radicular syndrome and 151 N at the opposite side. Statistically significant bilateral differences in strength of hip abductors was observed in 69.3% of patients.

## Analysis of results and discussion

The results revealed decrease in the range of passive and active extension on the side of radicular syndrome. Decrease in abduction on the painful side was limited to passive movements. I did not find any paper unequivocally describing these phenomena. There are authors, who seek causes of hip movements impairment in changes which involve sacroiliac joints [7].

The study revealed no statistically significant differences between pain or radiologically assessed structural changes in sacroiliac joints and the range of movements in hip joints. This inspired us to search for other causes responsible for described impairments of hip mobility.

Domination and subsequent contracture of muscles uninvolved by pareses, additional, long-lasting compulsory hip flexion in patients with sciatic neuralgia could impair the range of extension or abduction.

Indirect proof of the above described is the decrease in strength of hip abductors in examined patients demonstrated by measurements with use of HMF 1 electronic chair dynamometer.

This type of pareses was consistent with damage to the radices in course of lumbar DDD with disc herniation. Muscular pareses and/or local trophic changes resulting from impairment of neurogenic control over microcirculation could be responsible for changes in soft tissues sourrounding joints (muscles, ligaments and articular capsule), which manifest through decreased range of movement in hip joints, especially, that muscle groups innervated from those levels often play antagonistic roles (extensors-flexors, adductors-abductors) [8, 9, 12]. Besides factors resulting from pathology of periarticular tissues, there are factors that lead to decrease in range of movements resulting from degenarative changes of bony articular structures [9]. Our study revealed discrete osteoarthrotic changes of hip joints on the side of radicular syndrome, especially more frequent (statistically significant) occurrence of osteophytes localised at the edge of the iliac acetabulum affected by radicular syndrome. This fact may indicate greater importance of ligaments in articular stabilisation in patients with pareses. Osteophytes localised at the superior edge of the iliac acetabulum develop at the site of attachment of iliac joint capsule. Abductors pareses may be responsible for stretching of the capsule due to pelvic drop as in the mechanism underlying the Trendelenburg sign. This may affect iliac abduction range in terminal phase of the movement.

An interesting finding is correlation between disease duration and the decrease in range of movements concerning active and passive hip abduction on the side of radicular syndrome.

Gradual development of functional impairments, e.g.: decrease in range of hip movements on the side of radicular syndrome seems to be natural element of disease progression or persistence of its consequences [2, 11]. Described changes were reflected in physical examination of patients. On the side of radicular syndrome Patrick sign was observed in 37% of patients (5.5% on the opposite side). Longer duration of disease predisposed to the presence of Patrick sign on the side of radicular syndrome (46.2% in patients with longer disease duration, and 35% in patients with shorter disease duration).

The results indicate negative influence of lumbar DDD with disc herniation on cooperation of biomechanical chain elements, leading to disorders most clearly visible on the side of radicular syndrome [2]. Davis, Farfan and other authors think, that all collective movements of spine, hips and sacroiliac joints have their specific ranges and that the movements develop in physiological sequence [22, 23]. Describing those phenomena, Cailliet introduced even a term for interrelations between spinal and pelvic movements called "lumbar-pelvic rhythm" [24]. On the other side many authors point at disruption of those biomechanical relations in patients with lumbar spine pain syndrome [25, 26].

## Conclusions

Lumbar DDD with disc herniation causes decrease in range of hip joint movements.

Decrease in range of hip joint movements is always present on the side of radicular pain syndrome, and increases with duration of the syndrome, which demonstrates pathogenic influence of lumbar DDD with disc herniation on hip joints function.

Changes in the course of disc herniation may influence the rate of iliac osteoarthrosis development. The conclusion requires further investigation.

### References

1. Di Fabio RP. Reliability of computerized surface electromyography for determining the onset of muscle activity. Phys Ther 1987; 67: 43-48.
2. Fogel GR, Esses SI. Hip spine syndrome: management of coexisting radiculopathy and arthritis of the lower extremity. Spine J 2003; 3: 238-241.
3. Ostgaard HC, Zetherström G, Roos-Hansson E. The posterior pelvic pain provocation test in pregnant women. Eur Spine J 1994; 3: 258-260.
4. Typpö T. Osteoarthritis of the hip. Radiologic findings and etiology. Ann Chir Gynaecol Suppl 1985; 201: 1-38.
5. Van Dillen LR, Gombatto SP, Collins DR, et al. Symmetry of timing of hip and lumbopelvic rotation motion in 2 different subgroups of people with low back pain. Arch Phys Med Rehabil 2007; 88: 351-360.
6. Bland H. The reversibility of osteoarthritis. Am J Med 1983; 14: 16-21.
7. Cibulka MT, Sinacore DR, Cromer GS, Delitto A. Unilateral hip rotation range of motion asymmetry in patients with sacroiliac joint regional pain. Spine (Phila Pa 1976) 1998; 23: 1009-1014.
8. Frymoyer JW, Ducker TB, Hadler MN, et al. The Adult Spine. Raven Press, New York 1991.
9. Kellgren J, Lawrence J. Osteo-arthrosis and disc degeneration in an urban population. Ann Rheum Dis 1958;17:388.
10. Pauwels F. Biomechanics of the normal and diseased hip. Springer-Verlag; Berlin Heidelberg New York 1976.
11. Shum GL, Crosbie J, Lee RY. Effect of low back pain on the kinematics and joint coordination of the lumbar spine and hip during sit-to-stand and stand-to-sit. Spine (Phila Pa 1976) 2005; 30: 1998-2004.
12. Shum GL, Crosbie J, Lee RY. Movement coordination of the lumbar spine and hip during a picking up activity in low back pain subjects. Eur Spine J 2007; 16: 749-758.
13. Sparto PJ, Parnianpour M, Reinsel TE, Simon S. The effect of fatigue on multijoint kinematics, coordination, and postural stability during a repetitive lifting test. J Orthop Sports Phys Ther 1997; 25: 3-12.
14. Bouche K, Stevens V, Cambier D, et al. Comparison of postural control in unilateral stance between healthy controls and lumbar discectomy patients with and without pain. Eur Spine J 2006; 15: 423-432.
15. Grifka J, Ogilvie-Harris DJ. Osteoarthrirtis. Springer-Verlag, Berlin Heidelberg 2000.

16. Michelsson JE, Videman T, Langenskiöld A. Changes in bone formation during immobilization and development of experimental osteoarthritis. Acta Orthop Scand 1977; 48: 443-449.
17. Milosavljevic S, Pal P, Bain D, Johnson G. Kinematic and temporal interactions of the lumbar spine and hip during trunk extension in healthy male subjects. Eur Spine J 2008; 17: 122-128.
18. Kankaanpää M, Taimela S, Laaksonen D, et al. Back and hip extensor fatigability in chronic low back pain patients and controls. Arch Phys Med Rehabil 1998; 79: 412-417.
19. Buckup K. Testy kliniczne w badaniu kości, stawów i mięśni. Wydawnictwo Lekarskie PZWL, Warszawa 1998.
20. Offierski CM, MacNab I. Hip-spine syndrome. Spine (Phila Pa 1976) 1983; 8: 316-321.
21. Styczyński T. Rozprawa doktorska: Ocena zaburzeń krążenia obwodowego w kończynach dolnych u chorych na przepuklinę jądra miażdżystego w lędźwiowym odcinku kręgosłupa. Warszawa 1973.
22. Davis PR, Troup JDG, Burnard JH. Movements of the thoracic and lumbar spine when lifting. J Anat 1965; 99: 13-26.
23. Farfan HF. The biomechanical advantage of lordosis and hip extension for upright activity. Man as compared with other anthropoids. Spine (Phila Pa 1976) 1978; 3: 336-342.
24. Cailliet R. Low back pain syndrome. FA Davis Company, Philadelphia 1991.
25. RA The Spine. Rothman RH, Simeone FA, Herkowitz HN, et al. (eds). Third Edition. W.B. Saunders Company, Philadelphia 1998.
26. White AA, Panjabi MM. Clinical biomechanics of the spine. Second edition. Lippincott Williams and Wilkins, Philadelphia 1990.