

# Evaluation of transverse abdominal muscle thickness and the quality of life in patients undergoing rehabilitation due to disc-root conflict in the lumbo-sacral spine treated surgically using the spinal disc resection method

## Ocena grubości mięśnia poprzecznego brzucha oraz jakości życia u usprawnianych z powodu konfliktu korzeniowo-dyskowego kręgosłupa lędźwiowo-krzyżowego leczonych operacyjnie metodą resekcji krążka kręgowego

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### Key words

Quality of life, ultrasound, TrA muscle thickness, discectomy, central stability

### Abstract

**Purpose:** The aim of the study was to determine the relationship between the changes in abdominal transverse muscle thickness (TrA) after therapy that included elements of reeducation of central stabilisation, and pain reduction as well as quality of patients' life after intervertebral disc resection of lumbar spine.

**Material and methods:** The study group consisted of 30 patients (17 women and 13 men) aged 28-87 ( $58 \pm 15$ ) participating in a rehabilitation stay. All subjects underwent intervertebral disc resection (LS level) within the years 2012-2016. All subjects included in the study underwent ultrasound evaluation of the thickness of the TrA muscle, evaluation of activation ratio, percentage change in muscle thickness, evaluation of the quality of life with SF-36, assessment of pain components on the VAS scale and level of disability using the Barthel index. All the subjects were referred to a 3-week therapy programme combined with motor control re-education including deep muscle training. The tests were performed before and after the physiotherapy on the basis of the original exercise programme.

**Results and conclusions:** The percentage of TrA muscle thickness change in the first exam was  $15.84 \pm 0.1\%$ , and  $16.09 \pm 0.13\%$  after treatment. There were no statistically significant differences between the measurements. In the assessment of quality of life, patients in the first exam reached the score of  $113.23 \pm 28.07$  points, whereas in the second one -  $85.1 \pm 27.05$  points. The difference between the results was statistically significant ( $p < 0.001$ ). Pain components on the VAS scale were assessed at  $4.3 \pm 0.83$  points on average in the former exam, and  $2.83 \pm 1.04$  points in the latter one. The difference in measurements was statistically significant ( $p < 0.001$ ). The assessment of the level of disability using the Barthel scale with an average score of  $93.66 \pm 8.4$  points, conducted in the first exam, indicated that the studied persons were characterised by full efficiency. The original therapy, carried out among subjects operated on due to disc-root conflict of the LS spine, has a positive effect on the thickness of the TrA muscle both in contraction and at rest, and also reduces the level of pain while improving quality of life.

The individual division of this paper was as follows: a – research work project; B – data collection; C – statistical analysis; D – data interpretation; E – manuscript compilation; F – publication search

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**Słowa kluczowe**

jakość życia, USG, grubość m TrA, discektomia, stabilizacja centralna

**Streszczenie**

**Wstęp:** Celem pracy było określenie zależności pomiędzy zmianą grubości mięśnia poprzecznego brzucha (TrA) po przeprowadzonej terapii z elementami reedukacji stabilizacji centralnej, a zmniejszeniem dolegliwości bólowych i jakością życia u chorych po przebytej resekcji krążka międzykręgowego kręgosłupa LS.

**Material i metody:** Grupę badaną stanowiło 30 chorych (17 kobiet i 13 mężczyzn) w wieku 28-87 lat ( $58 \pm 15$  lat) przebywających na turnusie rehabilitacyjnym. Wszyscy badani przebyli resekcję krążka międzykręgowego na poziomie LS w latach od 2012 do 2016 roku. U wszystkich włączonych do badania dokonano oceny ultrasonograficznej grubości mięśnia TrA, współczynnika aktywacji, procentowej zmiany grubości mięśnia, oceny jakości życia SF-36, oceny komponenty bólowej w skali VAS oraz do oceny sprawności wykorzystano skalę Barthel. Wszyscy badani zostali skierowani na 3-tygodniową terapię połączoną z reedukacją kontroli motorycznej uwzględniającą trening mięśni głębokich. Badania wykonano przed i po przeprowadzonej fizjoterapii w oparciu o autorski program ćwiczeń.

**Wyniki i wnioski:** Procent zmiany grubości mięśnia TrA w pierwszym badaniu wynosił  $15,84 \pm 0,1$  %, natomiast po leczeniu  $16,09 \pm 0,13$  %. Między pomiarami nie odnotowano istotnie statystycznie różnic. W ocenie jakości życia pacjenci w pierwszym badaniu uzyskiwali średni wynik  $113,23 \pm 28,07$  pkt., natomiast w drugim  $85,1 \pm 27,05$  pkt. Różnica między wynikami była wysoce istotna statystycznie ( $p < 0,001$ ). Ocena komponenty bólowej w skali VAS wynosiła średnio w pierwszym badaniu  $4,3 \pm 0,83$  pkt., z kolei po interwencji  $2,83 \pm 1,04$  pkt. Różnica w pomiarach była wysoce istotna statystycznie ( $p < 0,001$ ). Ocena poziomu niepełnosprawności za pomocą skali Barthel ze średnim wynikiem  $93,66 \pm 8,4$  pkt. wykonana w badaniu pierwszym świadczyła o pełnej sprawności badanych osób. Przeprowadzona u chorych operowanych z powodu konfliktu korzeniowo-dyskowego kręgosłupa LS autorska terapia, wpływa korzystnie na zmianę grubości mięśnia TrA zarówno w skurczu jak i w spoczynku, wpływa również na obniżenie poziomu dolegliwości bólowych i poprawia jakość życia.

**INTRODUCTION**

Dysfunction in the lumbar-sacral (LS) region is one of the most common problems associated with the osteoarticular system. Pain in the lower part of the spine is experienced by 60-85% of the population at least once in a lifetime<sup>1</sup>. Their causes can be seen, among others, in the dynamic development of civilisation, which develops a “comfortable” lifestyle instead of one associated with movement, lacking transportation commodities and healthy eating. It introduces a number of changes in the social and economic sphere and directly affects the health of individuals<sup>2</sup>. In the etiology of spinal pain, postural control disorders are also described<sup>3</sup>. Both McGill et al.<sup>4</sup> and Page et al.<sup>5</sup> argue that weakened and delayed activation of the deep muscles is the cause of chronic pain and deterioration in physical fitness. With this in mind, many authors see the need to introduce deep muscle stabilisation training. Work on motor control is an important element regarding the recovery of normal muscle tone in the treatment process and in the prevention of spinal pain syndromes<sup>6,7</sup>. More and more often, authors emphasise the role of central stabilisation as well as pain education in the prevention and treatment of pain syndromes. The

treatment of pain in the area of the LS requires appropriate, differential diagnosis, and thus, precise determination of its etiology<sup>8,9</sup>.

**STUDY AIM**

The aim of the study was to determine the relationship between changes in transverse abdominal muscle (TrA) thickness after therapy with elements of central stabilisation re-education, pain reduction and quality of life in patients after the resection of the LS intervertebral disc.

To achieve the objective of this work, the following questions were posed:

1. Is there a relationship between the initial thickness of the TrA muscle and quality of life in patients operated on due to the disc-root conflict using the method of intervertebral disc resection?
2. Does the therapy proposed in combination with re-education of the deep muscles influence the change in transverse abdominal muscle thickness among patients operated on due to the disc-root conflict using the method of intervertebral disc resection?
3. Does and in what way does the proposed therapy combined with deep muscle re-education affect

the level of pain experienced by patients treated for disc-root conflict using the intervertebral disc resection method?

4. Does and in what way does the proposed therapy combined with deep muscle re-education affect the quality of life among patients treated for disc-root conflict using the intervertebral disc resection method?

**MATERIAL AND METHODS****Study group**

The study group consisted of 30 patients (17 females and 13 males) aged 28 to 87 years ( $58 \pm 15$  years), during a rehabilitation stay at the Department of Systemic Rehabilitation of the 5<sup>th</sup> Military Hospital with Polyclinic, Independent Public Health Care Center (SP ZOZ) in Krakow in 2016. All of the subjects underwent resection of the intervertebral disc at the LS level (lumbar-sacral discectomy), performed between 2012 and 2016.

The criteria for inclusion in the study were: previous intervertebral disc resection at LS level, no abdominal interventions, logical verbal contact, allo- and autopsychic level of patients with a minimum of 7 points on the Short Portable Mental State Questionnaire ac-

ording to Pfeiffer-SPMSQ and informed consent to participate in the proposed study.

## Research methods and tools

For all the included study participants, ultrasound assessment of TrA muscle thickness was performed. The SF-36 quality of life questionnaire was also used, the pain component was assessed on the 11-grade VAS scale and the Barthel scale was used for fitness evaluation. The SF-36 questionnaire, VAS scale and ultrasound examination were performed during the qualification of patients and after the rehabilitation period, while the Barthel scale was only used during the 1<sup>st</sup> examination. All subjects obtained referral for 3-week therapy combined with motor control re-education, including deep muscle training.

Rehabilitative Ultrasound Imaging – RUSI, of the TrA was performed using the Mindray DP 50 apparatus with a linear wand. The basis for performing the test was to teach the patient to properly contract the transverse abdominal muscle under the control of the monitor. The measurements provided information on the thickness of the tested TrA muscle both at rest and during contraction. In addition, it allowed to determine the activation ratio (1) and percentage change in muscle thickness (2) according to the following formulas<sup>10</sup>:

(1) Activation ratio = muscle thickness during contraction / muscle thickness at rest;

(2) Percentage of muscle size change = (muscle thickness during contraction – muscle thickness at rest) / muscle thickness at rest.

Ultrasound examination (USG) was always performed by the same examiner, using the same device in order to minimise measurement error. Patients were examined about 2-3 hours after consuming breakfast. During the test, the probe was placed transversely with respect to the iliac plate, the measurement was performed 3 centimetres to-

wards the body axis from the upper front iliac spine, during rest and during activation.

The SF-36 Questionnaire (Short Form of Health Questionnaire) consists of 11 questions related to 36 statements in the field of physical and mental health. The sum of the obtained points allows to conduct assessment. The Polish version of the questionnaire assumes that the highest value of the obtained points means the lowest quality of life assessment, while 171 points is the maximum number of points that can be achieved.

Pain component was evaluated on the 11-point VAS point scale, from 0 to 10 as subjective pain sensation assessment, where 0 means no pain, and 10 means the pain is impossible for the patient to bear.

The Barthel scale rating determines the patient's level of independence and efficiency. The scale evaluates 10 activities: eating, transfer (from bed to chair and back/sitting), maintaining personal hygiene, using the toilet, washing and bathing the whole body, moving on flat surfaces, going up and down stairs, dressing and undressing, bladder and stool control (anal sphincter, urinary control). The point value is within the range of 0-15 points, where the value of 0 means that the activity cannot be carried out, and the value 15 means independence. An obtained point value from 0 to 20 points means dependence, from 20 to 80 - independence to a certain degree, from 80 to 100 - total independence.

The implemented 3-week training plan together with patient education was divided into 2 stages. The first (lasting up to 7 days) included learning how assume proper initial position, learning breathing patterns and correct and conscious activation of deep spine stabilisers. Exercises inducing abdominal muscle contraction were also used. The second consisted in using the learned positions to perform more advanced exercises to activate the transverse, multifidus and oblique abdominal muscles. The exercises used different initial positions:

standing, supported kneeling, supine, lying on one's side, sitting on a gym ball.

The study was planned and carried out in accordance with the 1964 Declaration of Helsinki. Those included in the study were informed verbally and in writing about the course of all procedures and provided informed consent for participation. Funds for the purchase of equipment were obtained from the Statutory Research Project of the University of Physical Education in Krakow No. 86/BS/KRK/2016.

Statistical analysis was performed using the MS EXCEL 2016 Analysis ToolPak and the Statistica 13 programme. The results are presented in the form of arithmetic means together with the standard deviation for a 95% confidence interval. Statistical significance was assumed at a *p*-value below 0.05. Differences between individual exams in the group and between groups were checked using the *t* test. Pearson's correlation coefficient and its statistical significance were additionally determined.

## RESULTS

The obtained results indicate that the average TrA muscle thickness measured at rest was  $0.42 \pm 0.18$  mm in the 1<sup>st</sup> exam, in turn, after the intervention, it totalled  $0.39 \pm 0.11$  mm. Its mean thickness during the 1<sup>st</sup> exam was  $0.35 \pm 0.14$  mm measured during contraction, and in the 2<sup>nd</sup>,  $0.31 \pm 0.07$  mm. There were no statistically significant differences between the measurements. The value of the contraction activation ratio determined on the basis of the measurements was, on average,  $0.84 \pm 0.1$  for the 1<sup>st</sup> exam, and  $0.83 \pm 0.08$  in the case of the 2<sup>nd</sup> one. No statistical significance was found between the measurements. The percentage change in muscle thickness during the 1<sup>st</sup> exam was  $15.62 \pm 0.1\%$ , while after treatment; it equalled  $16.09 \pm 0.13\%$ . There were no statistically significant differences be-

tween the measurements. In quality of life assessment, the patients obtained the average score of  $113.23 \pm 28.07$  points for the 1<sup>st</sup> exam and  $85.1 \pm 27.05$  points for the 2<sup>nd</sup> one. The difference between the results was highly statistically significant ( $p < 0.001$ ). The assessment of the pain component on a scale from 0 to 10 was, on average,  $4.3 \pm 0.83$  points in the case of the 1<sup>st</sup> exam, and in turn, the result was  $2.83 \pm 1.04$  points after its completion. The difference in measurements was highly statistically significant ( $p < 0.001$ ).

Assessment of disability level using the Barthel scale with the average score of  $93.66 \pm 8.4$  points carried out in the 1<sup>st</sup> exam demonstrates full efficiency of the subjects.

Statistical analysis showed that in the 1<sup>st</sup> exam, TrA muscle thickness at rest had a strong and statistically significant positive correlation with TrA muscle thickness measured during contraction,  $r = 0.95$  ( $p < 0.05$ ). At the same level, TrA

thickness had a weak and negative statistically significant correlation with the contraction activation ratio and percentage change in thickness of the TrA muscle,  $r = -0.38$ . The larger the measurement of TrA muscle thickness, the weaker the contraction ratio, as well as the percentage of muscle thickness change. A significant, weak negative correlation was also found between TrA muscle thickness at rest and quality of life,  $r = -0.37$ . Along with the increase in muscle thickness, the obtained point value in SF-36 assessment decreased, demonstrating higher perception of the quality of life. The other parameters did not demonstrate statistically significant correlations. In turn, in the 2<sup>nd</sup> exam, it was shown that there was a statistically significant, moderate, positive correlation between the thickness of TrA at rest and its thickness measured during contraction,  $r = 0.62$ . Furthermore, in the 2<sup>nd</sup> exam, the same level of statistically significant, moderate, negative correlation was observed be-

tween TrA muscle thickness and the contraction activation ratio as well as the percentage change in thickness of the TrA muscle,  $r = -0.63$ . The remaining parameters did not significantly correlate statistically (Table 2).

## DISCUSSION

The role of central stabilisation lies within the neuromuscular control needed to maintain the lumbar-pelvic-iliac complex. According to Brukner and Khan<sup>13</sup>, the proper function of the muscular corset is to keep the lower trunk and spine in an optimal position in static and dynamic conditions. The muscles responsible for core stability are: the abdominal muscles constituting the front of the cylinder, paraspinal and buttocks muscles closing it from the back, the diaphragm located at the top of the muscular cylinder, and from the bottom, the pelvic floor muscles and those of the iliac rim, rotators and abductors that direct-

Table 1

Comparison of TrA muscle property measurements, quality of life and pain components in the study			
TrA muscle	Exam 1	Exam 2	p
Muscle thickness at rest [mm]	$0.42 \pm 0.18$	$0.39 \pm 0.11$	$p > 0.05$
Muscle thickness during contraction [mm]	$0.35 \pm 0.14$	$0.31 \pm 0.07$	$p > 0.05$
Difference in muscle thickness rest – contraction [mm]	$0.07 \pm 0.06$	$0.07 \pm 0.08$	$p > 0.05$
Activation ratio	$0.84 \pm 0.1$	$0.83 \pm 0.13$	$p > 0.05$
Percentage change in muscle thickness [%]	$15.84 \pm 0.1$	$16.09 \pm 0.13$	$p > 0.05$
Quality of life assessment [pts]	$113.23 \pm 28.07$	$85.1 \pm 27.05$	$p < 0.001$
Pain component [pts]	$4.3 \pm 0.83$	$2.86 \pm 1.04$	$p < 0.001$

Table 2

Correlations between TrA muscle thickness measured at rest during both exams and the tested parameters		
Badane parametry	Grubość m TrA w spoczynku Badanie I	Grubość m TrA w spoczynku Badanie II
TrA muscle thickness during contraction	<b>0.95*</b>	<b>0.62*</b>
TrA muscle contraction activation ratio	<b>- 0.38*</b>	<b>- 0.63*</b>
Percentage change in thickness of TrA muscle	<b>- 0.38*</b>	<b>- 0.63*</b>
Quality of life	<b>- 0.37*</b>	- 0.26
Pain component	- 0.24	- 0.11
Barthel scale	-0.26	no measurement

\* – level of statistical significance at  $p < 0.05$

ly or indirectly bind with the thoracolumbar fascia and the spine<sup>13</sup>. The transverse abdominal muscle is the most deeply located flat abdominal muscle. It forms a closed cylinder around the corpus, narrows the lower part of the chest, produces the abdominal press and pulls the abdominal wall transversely<sup>14</sup>. Innervated by the L1 and partly by the L2 roots (iliac-hypogastric nerve), it is supplied with nerve signals in a normal way, without pathological changes within this area. In patients with lumbar spine dysfunctions, the innervated area of the muscle may be disturbed causing uneven growth/increase in muscle thickness during stabilisation training<sup>15</sup>.

The most important role of the local muscles is their even activation in order to ensure proper motor patterns with proximal stability in functional ranges. In the situation of weakening or delaying the activation time of these muscles, the polyarticular and superficial muscles are compensatively activated leading to the loss of local stability<sup>3</sup>. According to Sumit and Sohan<sup>16</sup>, in patients with spinal pain syndromes, delayed activity and weakening of the deep muscles are observed, which results in insufficient stabilisation and reduction in motor control. This causes the occurrence of spinal pain and deterioration in the efficiency<sup>16</sup>. Work on motor control is an important element regarding the reproduction of normal muscle tone in prevention and during the treatment of spinal pain syndromes, and it is a starting point in building trunk stability. The reconstruction of proper movement patterns becomes possible through the activation and integration of many muscular, ligament and fascia components. The concept of transgression postulated by Meyers, referring to the fascial continuity of the whole body, proves that the change in tension of any of these elements influences the change in the tonus of other elements of the system<sup>17</sup>.

Numerous methods are used to assess abdominal muscles in clinical practice: ultrasound, electro-

myography or functional magnetic resonance. Ultrasound examination is a non-invasive and increasingly popular method allowing to evaluate the morphology and function of muscles in real time. This method often used in functional diagnostics or while monitoring the rehabilitation process. Literature accepts different methods of performing an ultrasound examination. There are many scientific reports confirming its reliability and credibility in the assessment of TrA muscle morphology<sup>18</sup>. In the presented study, evaluation of the effects of the conducted therapy was performed thanks to ultrasound examination, assessing the thickness of the TrA muscle. Analysis of the results of the 1<sup>st</sup> and 2<sup>nd</sup> examinations showed that TrA muscle thickness has a strong and statistically significant positive correlation with the thickness of the TrA muscle measured during contraction, while weakly and negatively correlating with the contraction activation ratio and the percentage change in TrA muscle thickness. Similar results to ours were obtained by Chen et al.<sup>19</sup>, pointing to the reliability and reproducibility of ultrasound measurements. These authors assessed the thickness of the TrA muscle after deep muscle training. They also suggest a relationship between the level of experienced pain and the increase in the transverse abdominal muscle. Significant changes in the thickness of the muscle were noticed among people with minor pain in the LS spinal region. Huang et al.<sup>20</sup> subjected patients to training using – PNF or NJF methods. In the study group where PNF techniques were applied, the level of pain on the VAS scale was recorded at an average level of 3.1 points, while in the NJF group, the level of pain was 2.3. In the group with a lower level of perceived pain, there was a significantly greater increase in the transverse abdominal muscle after therapy, while the level of perceived pain decreased in both groups of patients. Convergent research results regarding this subject were obtained by Golec J. et al.<sup>21</sup>.

A similar stance is also presented by Chung and Young<sup>22</sup>. They point out that the functional limitation and weakening of the TrA and multifidi muscles are the cause of spinal pain (LBP). These authors emphasise that the TrA muscle plays a key role in LS stabilisation, and in people with pain complaints located in this area, this muscle is not as thick as in healthy people. The above results are also confirmed in reports by Ehsani et al.<sup>23</sup>.

Hoseinpoor et al.<sup>24</sup> conducted tests under conditions of axial loading and relieving the spine. The thickness of abdominal muscles was examined – including transverse abdominal muscle (TrA), internal oblique (OI) and external oblique (EO) abdominal muscles. These authors emphasise that ultrasound imaging can provide critical information on the effects of fatigue on the activation of the spinal muscles, and thus, on its stability. They define the imaging method as a useful and easy technique that can be implemented by ergonomists in assessing the musculoskeletal system among populations at risk of spinal overloading disease.

LS spinal dysfunctions cause a number of limitations in professional and social life. In the physical dimension, they cause pain and discomfort, fatigue and weakness of the whole body. In the mental sphere, they initiate negative feelings and deterioration of self-evaluation. They reduce the independence of a person, making them dependent on the help of others, on pharmacological agents. They impair social relations, reduce physical security and affect the emotional dimension<sup>25</sup>. A number of these factors have clear impact on the deterioration of comfort and quality of life.

In the presented work, the SF-36 questionnaire was used to assess the quality of life. Both mental and physical spheres were evaluated. Analysis of the results indicates definite improvement in quality of life after the therapy. The difference between the initial and final assessment after the 3-week physiotherapy was, on average, 28 points. Also, the differ-

ence in the perception of pain over during analysed period of time, assessed by the VAS scale, indicated significant improvement. Research by Wróblewska et al.<sup>26</sup> proved that the use of different methods of rehabilitation results in the improvement of the well-being of patients with degenerative spinal diseases. From among the 100 subjects examined, as many as 98% of them declared satisfaction with the effects of the performed rehabilitation programme and improvement in subjective quality of life assessment. Therefore, it can be concluded that conducting systemic rehabilitation, such as rehabilitation focused on building local stability in people suffering from LS spinal pain, also improves quality of life.

Rantonen et al.<sup>27</sup> draw attention to the impact of spinal pain, stating the effects of physical disability on quality of life, as well as the frequency of sick-leaves among employees at the workplace. After the first occurrence of spine pain (LBP), the risk of its recurrence increases. Disability associated with pain episodes leads to serious social and economic consequences for an employee, as well as personal ones. In the opinion of these authors, treatment should focus on facilitating the return to professional activity<sup>27</sup>. In the presented studies, the group of patients are also professionally active people who are currently unable to work. It seems reasonable to extend future research within the aspect of absenteeism and the possibility of returning to work among people with spinal dysfunction. The level of physical activity determines the ability to perform everyday activities.

According to McGill et al.<sup>4</sup>, the occurrence of chronic pain and deterioration of physical fitness may be the result of a significant weakening of the deep muscles. Evensen et al.<sup>28</sup> conducted a study among a group of 48 patients hospitalised at the University Hospital in Trondheim, Norway. Research on the level of functional activity based, among others, on the Barthel scale, was conducted a few days after discharge from the hospital. The research results showed that the independence index amounted to

16.4 points on average, indicating significant reduction in the performance of everyday activities. Perhaps this was due to the lack of physical activity during hospitalisation. In the presented work, the study group was subjected to 3-week rehabilitation during hospitalisation, for, on average, 3 hours a day, 6 days a week. The essence of rehabilitation for people suffering from LS spinal pain due to resection of the intervertebral disc is the possibility of unimpeded functioning in a home environment and the ability to perform everyday activities. Reducing the level of LS spinal pain gives the patient the possibility of unrestrained movement and functioning during everyday activities. In the presented studies, the assessment of the level of disability using the Barthel scale showed full efficiency of the subjects, obtaining an average score of  $93.66 \pm 8.4$  points. The occurrence of LS spine pain in the group of subjects did not limit the ability to perform everyday activities. Spinal pain, according to Rabini et al.<sup>27</sup>, reduces the possibility of self-care. Aprile et al.<sup>30</sup> emphasise that improving the quality of life and independence in the area of one's immediate environment testifies to the effectiveness of rehabilitation among patients.

## CONCLUSIONS

1. Baseline TrA muscle thickness measured at rest in patients after resection of the intervertebral LS disc clearly correlates with quality of life.
2. The therapy implemented in patients operated on due to disc-root conflict at the LS level influences changes in TrA muscle thickness both during contraction and at rest.
3. The authors' specially created therapeutic programme for patients treated surgically due to disc-root pain in the LS spine, combined with deep muscle re-education, has a positive effect on reducing the level of experienced pain by patients.
4. The treatment performed in patients after intervertebral disc re-

section at the LS level, combined with deep muscle re-education, significantly improves quality of life.

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