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Effectiveness of cranial osteopathy therapy on nociception in equine back as evaluated by pressure algometry

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Abstract

A horse needs to move in different gaits and carry a rider during riding. Therefore, the equine back must be in a good functional state. Preventing back disorders is one of the keys to ensuring a horse's health. This study aimed to assess cranial osteopathy therapy as a treatment and prevention method for preventing and reducing back pain. Thirty-two thoroughbred horses were categorised by their backs' functional status (16 without back pain and 16 with back pain). The mechanical nociceptive threshold was determined before and after osteopathic treatment by an algometer (pain test FPX 100) with pressure points between T14-T15, T18-L1, and L5-L6. The data were analysed with a significance of $P < 0.05$. The study found that cranial osteopathic therapy raised the mechanical nociceptive threshold average in 83.3% measured points for horses without back pain and in 50% measured points for those with back pain. This study revealed that both horses without back pain and horses with back pain had a positive response to cranial osteopathic therapy, as evidenced by the increased nociceptive threshold limits, indicating that osteopathic therapy can be used as a primary or additional treatment method for back dysfunction.

Horseback pain, manual therapy, mechanical nociceptive threshold

Back pain (BP) is a common condition in sports horses. Back pain can cause chronic pain, asymmetry, gait changes, and poor/reduced performance, resulting in behavioural problems. Equine BP is therefore a subject of concern for veterinarians and physiotherapists (Riccio et al. 2018). The diagnosis of pain in the thoracolumbar area can be challenging due to various possible clinical signs and the lack of objective indicators (Pongratz and Licka 2017). Palpation is an essential tool in the clinical examination of cases with suspected neck and back musculoskeletal dysfunction. Therefore, both equine veterinarians and physiotherapists have included palpation in their physical examination protocol (De Heus et al. 2010); however, this is limited by a significant degree of subjectivity (Pongratz and Licka 2017; Haussler 2020). Objective measures (OBJMs) are helpful tools for various variables: muscle strength, range of motion, gait assessment, fitness, and muscle growth, by helping to create data that can be recorded, followed up with treatment and rehabilitation plan/period and matched with the outcomes (Tabor and Williams 2020). The use of a pressure algometer (PA) is one such OBJM. It has been used to determine the mechanical nociceptive threshold (MNT) measures in horses during palpation (De Heus et al. 2010; Pongratz and Licka 2017; Tabor and Williams 2020). Higher MNTs indicate less pain, and lower MNT values indicate more sensitivity/pain. Moreover, it can help differentiate back pain side, while MNT differences by > 2.0 kg/cm² between left and right are clinically important in horses (Haussler 2020).

Many touch therapies that were developed for human musculoskeletal pain and dysfunction have been adapted for use in horses (Haussler 2010; 2018). Previously, a PA was used to evaluate the effectiveness of physiotherapy in horses, garnering positive results (De Heus et al. 2010). It has also been applied in chiropractic treatments

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(Haussler and Erb 2003) and a pilot study on electroacupuncture was completed (Noguera Delgado 2018). The effectiveness of equine osteopathy as a treatment method has been described in textbooks, but few case reports can be found. Osteopathy works with the body's structure (anatomy) and function (physiology). It is based on the principle that the well-being of an individual depends on the skeleton, muscles, ligaments, connective tissues ("osteopathic joint"), and liquid flow (blood, lymph, cerebrospinal fluid) functioning smoothly together. It contains three parts: structural, visceral, and cranial osteopathy. The last two are different from other manual therapies, as equine osteopaths do not stick just with structural (muscle, fascia, joint) parts (Pascal 2004). Even cranial and visceral osteopathic manipulative treatment is still controversial in some literature. New research using quantum physics reveals the osteopaths' ability to manipulate meninges through the skull (Bordoni et al. 2019).

It is also noticed that dura mater tension through the entire spinal cord can be released by restoring the primary respiratory mechanism (PRM) between the skull and sacrum (Ferguson 2003), the craniosacral system. A positive response to this treatment was found in humans with headaches and migraines (Cerriteli et al. 2017), sleeping disorders, fear, fibromyalgia, anxiety, asthma in children and adults, and various neurological conditions that affect the CNS (Kanik et al. 2017).

Kanik et al. (2017) researched craniosacral treatments, where 62 horses were enrolled in the study, and the efficacy was measured with a thermographic camera. Highly effective results (temperature changes) were present with significant impairment in circulation, muscular tension disorders, swelling, inflammation, and dislocation of vertebrae though no nociception was measured.

The aim of our study was to assess the efficacy of equine cranial osteopathic treatment by objectively evaluating MNT on horses' backs using pressure algometry.

Materials and Methods

This research was carried out under the provisions of the Law of the Republic of Lithuania, Order no. 8-500 on the Protection, Maintenance, and Use of Animals, of 6 November 1997 (the Official Gazette "Valstybės žinios" number 108-6595, dated 28 November 1997); Order no. 4-361 of 31 December 1998 of the State Veterinary Service of the Republic of Lithuania on the Breeding, Care, and Transportation of Laboratory Animals; and Order no. 4 of 18 January 1999 of the State Veterinary Service of the Republic of Lithuania on the Use of Laboratory Animals for Scientific Tests, study approval no. B6-(19)-1476.

Horses

A group of 32 thoroughbreds from one stable in Lithuania (55.39534, 23.07034) was enrolled in the study. None of the horses were currently participating in the racing sports season or intensive training. They were fed 3 × a day, a total food amount of about 2.5% of horse bodyweight (concentrate: forage ratio 30:70), and water was available all the time. The backpain (BP) group (n = 16) included eight mares and eight stallions; the group without back pain (WBP) was composed equally. The mean age for both groups was 6 years, and the median weight was 452 kg (range 400–550 kg). None of the horses had ever had osteopathic treatment before and they were measured and treated in their stables in order to reduce stress. The horses were assigned numbers to hide their identity. One day before the examination, the horses were not trained. No horses were excluded from the study.

Before osteopathic treatment, the horses underwent a clinical examination (auscultation of heart and lung, counting heart and breathing rate, capillary refill time, evaluating mucous membrane colour, body temperature). Back pain was determined using the back pain grading system (Mayaki et al. 2020). During the examination pain response, muscle hypertonicity, lameness, thoracolumbar joint stiffness, physical dysfunction were valued and graded: 0 (absence), 1 (mild), 2 (mild-moderate), 3 (moderate), 4 (severe), 5 (incapacitated). All the scores for each horse were calculated using the cumulative grading scores. Horses with a cumulative score of 0 were classified as normal and put in the WBP group and starting from mild (1–4), mild-moderate (5–8), moderate (9–12), marked (13–16) till incapacitated (17–20) went to the BP group. BP's average pain score was 8. No other abnormalities were found in either group during clinical examination and palpation.

Measurements

PA measurements were carried out using an electronic pain test FPX 100 algometer (Wagner Instruments Inc., Greenwich, CT, USA), which has a force gauge with a one cm^2 flat rubber tip which is thought to induce a sum-up of nociceptive responses within the superficial skin and underlying muscle or fascial layers (Haussler 2020).

It has a maximum reading of 50 kg, which has been determined to be suitable for measuring the MNT of large animals (Pongratz and Licka 2017). The calibration certificate has an accuracy of ± 0.3%, and the results were noted in kg/cm².

The measurements and treatments were performed in one stable over seven days from 9:00 to 13:00 h to avoid inaccuracy in the MNT results (De Heus et al. 2010). All algometric measurements were carried out by one person (S.N.), who was blinded to the study and always used the right hand to hold PA and the left one to fix the tip with the thumb and forefingers to avoid accidental slip (Haussler 2020). In random order, the horses (n = 32) were restrained quietly in their familiar stocks (stallions in their part of the stables, mares on their side) with crossties without sedation to take measurements before and after osteopathic therapy. Three measuring points on both sides of the back were chosen at T13/T14 (thoracic longissimus muscle at the 13th thoracic vertebral level, 2 cm lateral to the dorsal midline), T18/L1 (thoracic longissimus muscle at the 18th thoracic vertebral level, 2 cm lateral to the dorsal midline), and L5/L6 (mid-portion of the middle gluteal muscle at the 6th lumbar vertebral level), based on palpation of the dorsal spinous processes and muscles (Plate I, Fig. 1). All measuring points were adapted from Haussler and Erb (2003) and Pongratz and Licka (2017), and locations were marked with chalk to avoid inaccuracy.

The algometer was used in a perpendicular orientation towards the back muscles and was applied in light contact with the skin for about 3 s to reduce side reactions. Afterwards, the pressure was gradually increased in 2–3 s (10 kg/cm²/s) intervals based on studies (Haussler 2020) to create smooth transitions in pressure points. Changes in horse behaviour indicated a positive reaction indicating that the MNT had been reached: a "pain face" (Gleerup et al. 2015), turning of the head to or stepping away from the examiner, hollowing of the back, sudden lifting of a limb or kicking (De Heus 2010; Haussler 2020), or other pain-related movements.

All measurements were repeated 3 × at 3–4 s intervals, and averages were derived. The MNT measurements were made in the same sequence from cranial to caudal on the left and right sides to reduce variability. The three successive pressure algometer measurements were not significantly different from one another. One round of MNT measurement took 6 min on average.

Osteopathic treatment

All horses (n = 32) were treated using standard equine cranial osteopathic techniques (Pascal 2004). The osteopathic treatment was performed directly after the first MNT measurements were taken. The average treatment time was 30 min. A professional EDO carried out all procedures (Equine Diplomat Osteopath G.V.-V.). No sedation was used during treatments.

According to Sutherland's key components, the restoration of the PRM protocol was created by EDO (Pascal 2004; Kanik et al. 2017) to restore the movement of the skull and release dura matter tensions and be subsequent in the treatment.

Statistical analysis

SPSS (Statistical Package for Social Science) version 24.0 was used for statistical analysis of the study data. MS Excel 2010 was used to represent the charts. Before performing the detailed statistical analysis, the data were re-checked for mechanically made input errors. Quantitative data are presented as the minimum value (min), maximum value (max), and mean and standard deviation (m ± SD). The assumption of normality of a continuous variable was verified using Shapiro-Wilk test, excess, and asymmetry indicators. Parametric Student's *t*-test was used to compare the quantitative values of the two independent groups. Parametric paired Student's *t*-test was applied to the quantitative dependent variables. It was considered significant when $P < 0.05$.

Results

In the BP group, the mean MNT value (Table 1) showed significant increases at three different points: T14-T15 left ($t = -3.474$; $P = 0.003$) and right ($t = -4.256$; $P = 0.001$) measure point and T18-L1 right side ($t = -3.121$; $P = 0.007$) measure point. At all the measure points, the minimal MNT value increased after the osteopathic therapy (OTh). Maximal value was decreased at four measure points on T18-L1 (right-left side) and on L5-L6 (right-left side).

In the WBP group, the MNT values (minimum, maximum) increased at all measure points (Table 2). The MNT showed significant increases at five different measure points after OTh: T14-T15 left ($t = -4.224$; $P = 0.001$) and right ($t = -3.645$; $P = 0.002$), T18-L1 left ($t = -3.708$; $P = 0.002$) and right side ($t = -2.377$; $P = 0.031$) and L5-L6 left ($t = -3.802$; $P = 0.002$).

Comparing the results (T14-T15) between the groups (Fig. 2), significant differences were found before the OTh ($t = -4.360$; $P < 0.001$) and after the OTh ($t = -8.986$; $P < 0.001$) on the left side and comparing the differences in changes ($t = 2.932$; $P = 0.009$).

Table 1. Mechanical nociceptive threshold values (kg/cm²) at six different points on the (L) left and (R) right sides on the horse back measured by a pressure algometer before and after the osteopathic treatment in the horse group with back pain (BP).

Measure point	Side	Measure time	Mean ± SD	Min	Max	*P*
T13-14	L	Before	7.01 ± 1.63	4 .16	9.53	
		After	8.69 ± 0.94	7.21	11.30	
		Mean increase	1.69 ± 1.94			0.003
	R	Before	6.59 ± 1.56	3.01	8.81	
		After	7.99 ± 1.15	5.48	10.14	
		Mean increase	1.40 ± 1.31			0.001
T18-L1	L	Before	6.67 ± 2.73	2.32	12.29	
		After	6.93 ± 1.61	2.95	9.12	
		Mean increase	0.26 ± 2.54			0.686
	R	Before	6.17 ± 2.24	0.41	8.28	
		After	7.58 ± 0.99	5.23	9.35	
		Mean increase	1.42 ± 1.81			0.007
L5-6	L	Before	6.80 ± 2.13	3.46	10.10	
		After	7.63 ± 1.25	3.75	8.98	
		Mean increase	0.83 ± 2.02			0.121
	R	Before	6.77 ± 2.69	0.36	10.28	
		After	7.58 ± 1.20	5.76	9.90	
		Mean increase	0.81 ± 2.66			0.245

Table 2. Mechanical nociceptive threshold values (kg/cm²) at six different points on the (L) left and (R) right sides on the horse back measured by a pressure algometer before and after the osteopathic treatment in the horse group without back pain (WBP).

Measure point	Side	Measure time	Mean ± SD	Min	Max	*P*
T13-14	L	Before	16.25 ± 8.33	6.39	28.26	
		After	22.52 ± 6.08	7.59	28.83	
		Mean increase	6.26 ± 5.93			0.001
	R	Before	18.39 ± 8.43	7.10	28.05	
		After	21.79 ± 6.70	8.34	29.37	
		Mean increase	3.40 ± 3.73			0.002
T18-L1	L	Before	18.90 ± 7.76	8.40	27.70	
		After	24.29 ± 4.39	12.40	29.60	
		Mean increased	5.39 ± 5.82			0.002
	R	Before	21.24 ± 7.73	6.83	28.11	
		After	23.89 ± 5.67	9.86	29.45	
		Mean increase	2.65 ± 4.45			0.031
L5-6	L	Before	20.76 ± 8.03	6.30	27.48	
		After	22.33 ± 6.88	8.90	29.80	
		Mean increase	1.57 ± 1.65			0.002
	R	Before	22.15 ± 7.26	6.13	29.39	
		After	24.71 ± 4.97	8.94	30.04	
		Mean increase	2.56 ± 5.12			0.064

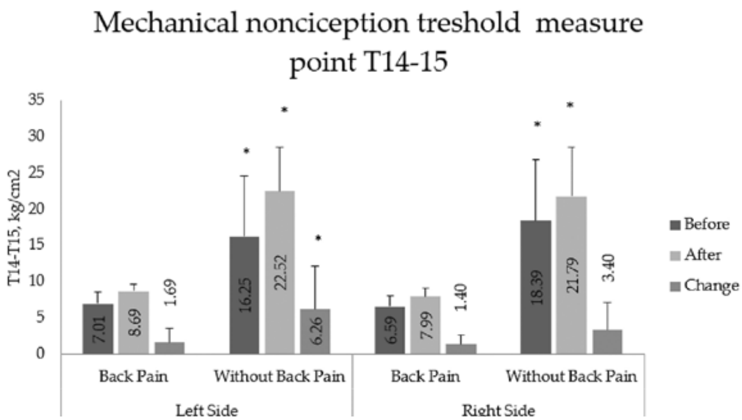

Fig. 2. Comparison of MNT (T14-T15 point) means in between the back pain (BP) and without back pain (WBP) groups; * significant difference at $P < 0.05$.

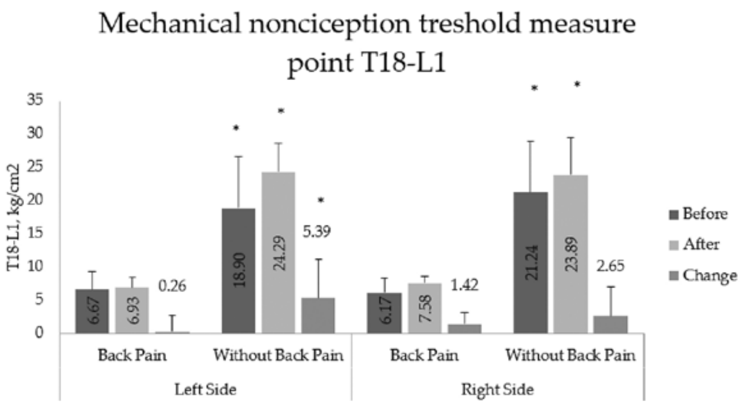

Fig. 3. Comparison of MNT (T18-L1 point) means between the back pain (BP) and without back pain (WBP) groups; * significant difference at $P < 0.05$.

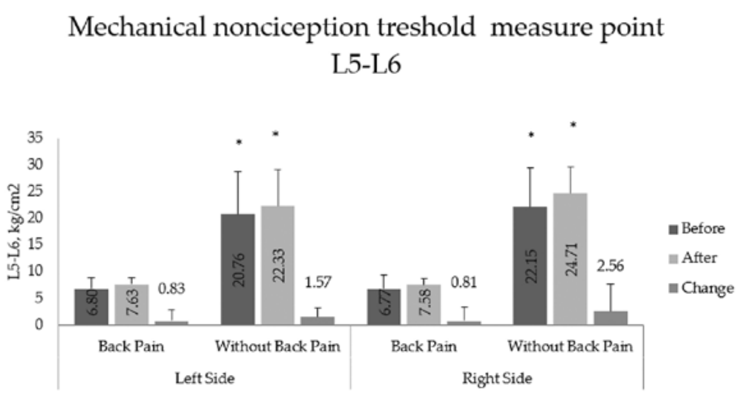

Fig. 4. Comparison of MNT (L5-L6 point) means between the back pain (BP) and without back pain (WBP) groups; * significant difference at $P < 0.05$.

On the right side, a significant difference was found before OTh ($t = -5.503$; $P < 0.001$) and after OTh ($t = -8.126$; $P < 0.001$); but no significant difference was found when comparing the differences in changes ($t = 2.029$; $P = 0.057$).

Comparing the results (T18-L1) between the groups (Fig. 3), significant differences were found both on the left side before the procedures ($t = -5.945$; $P < 0.001$), after the procedures ($t = -14.859$; $P < 0.001$), and when comparing the differences in changes ($t = 3.233$; $P = 0.004$) and on the right side before procedures ($t = -7.491$; $P < 0.001$) and after procedures ($t = -11.330$; $P < 0.001$), but no significant difference was found when comparing differences in changes ($t = 1.023$; $P = 0.314$).

Comparing the results (L5-L6) between the groups (Fig. 4), significant differences were found on both sides. On the left side before the procedures ($t = -6.722$; $P < 0.001$) and after the procedures ($t = -8.408$; $P < 0.001$), but no significant difference was found when comparing the differences ($t = 1.133$; $P = 0.266$) as P was > 0.05. On the right side, significant differences were found on the right side before the procedures ($t = -7.950$; $P < 0.001$) and after the procedures ($t = -13.412$; $P < 0.001$), and no differences were found in the comparison of changes ($t = 1.212$; $P = 0.235$) because P was > 0.05.

Discussion

It has been noted that younger horses (< 13 years) have a higher MNT value (Haussler and Erb 2006). So, the difference between MNT means between the groups (16.25 to 22.15 kg/cm² in the WBP group vs. 6.17 to 7.01 kg/cm² in the BP group) at measure points before manual therapy is a strong pain indication. In comparison with other authors, the average score for healthy horses was 12–13 kg/cm² in the thoracic area, and 13–16 kg/cm² in the lumbar area. Horses with an average measurement of pain tolerance lower than 5 kg/cm² were considered as in pain (Haussler and Erb 2003; De Heus et al. 2010; Haussler 2020).

After osteopathic therapy, MNT increased at all measure points by 3.82 kg/cm² for horses WBP and by 0.8 kg/cm² for horses with BP. Compared to De Heus et al. (2010), where the threshold for pain tolerance was raised by 1.3 kg/cm² after manual therapy for healthy horses, cranial osteopathy had better results with increased nociception. So, all nociception changes indicate that directly or indirectly targeting various anatomical structures can influence biomechanical, neurophysiological, and psychological factors as treatment mediators. Manual therapy may be effective by eliciting an analgesic effect (Haussler and Erb 2003; Haussler 2010; Bishop et al. 2015; Haussler 2018; Pongratz and Licka 2017; Mayaki et al. 2019). Most of the treated horses (84.38%) presented as relaxed, and drowsiness, yawning, blinking and chewing were present.

This study also discovered that the left side was more painful than the right side for all horses. Measurements on the left side were 3.04 kg/cm² lower than measurements on the right side before osteopathic treatment and 2.83 kg/cm² lower than measurements on the right side after osteopathic treatment, but no significant difference was found. However, other authors did not observe any differences between the left and right sides (Haussler and Erb 2003; Bishop et al. 2015; Haussler 2020). It could be suggested that lower MNT values in horses on one side can be influenced by horse laterality or the rider's sidedness (Byström et al. 2020), but further investigation is needed to confirm the hypothesis.

Our results showed that a change in the nociception value could be visible immediately after the first osteopathic treatment session. Still, it would be informative to ascertain the benefits of long-term osteopathic therapy sessions for horses in future studies (Haussler 2010; Kanik 2017; Tabor and Williams 2020). Research by Ghroubi et al. (2007) showed positive results regarding reducing local back pain in humans by 22% and radiating pain by 35% via manual therapy over six months. Other authors have also concluded that manual treatment is clinically effective in treating patients with back pain in the short term

(Senna and Machalyn 2011). Still, therapy sessions should be repeated at least every two weeks (De Heus et al. 2010; Haussler 2010; Senna and Machalyn 2011; Haussler 2020).

Moreover, adding a sham group to the study (Haussler 2020) and choosing more MNT measuring points would provide better information about soft tissue and bony landmark nociception changes by applying cranial osteopathy as a treatment method.

In conclusion, our study suggests that cranial osteopathic therapy can be an excellent primary or complementary treatment or prevention for functional disorders in horse backs. It is a non-invasive method that does not require additional medications or equipment, can be easily performed in stables, and positive results can be seen immediately.

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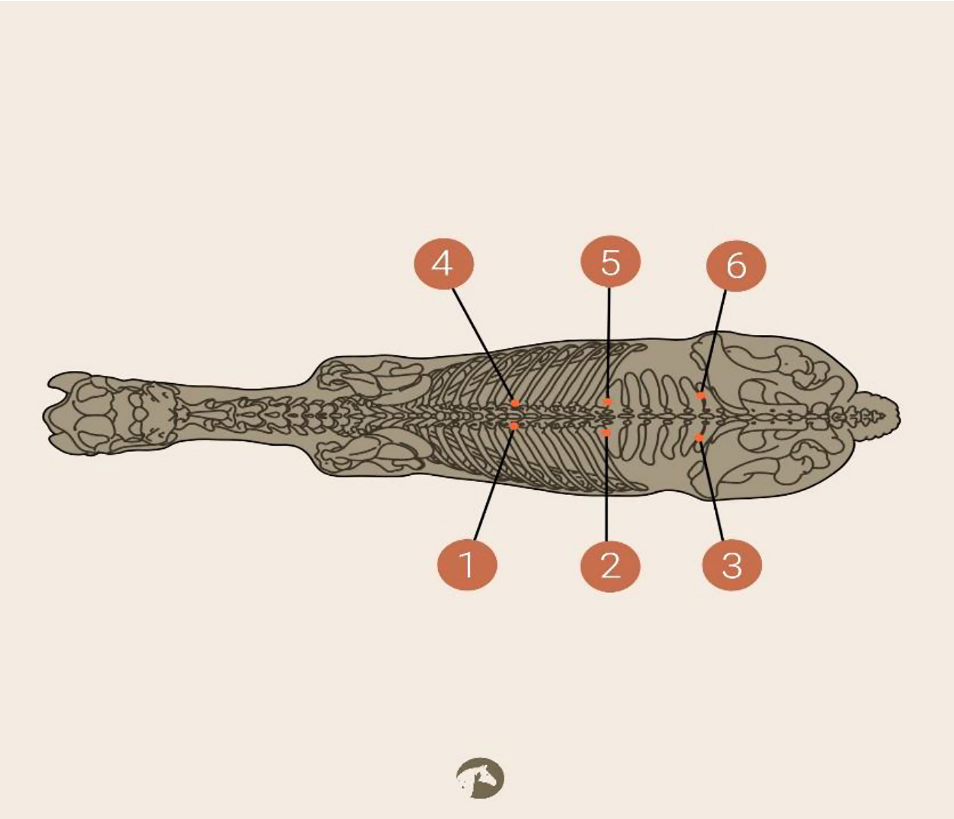

Fig. 1. Schematic landmarks of measuring points and order (from left to right and from cranial to caudal); left side: 1 - level of thoracic longissimus muscle T13/T14, 2 - T18/L1, 3 - - L5/L6; right side: 4 - level of thoracic longissimus muscle T13/T14, 5 - T18/L1, and 6 - level of gluteal muscle L5/L6.