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DEEP TISSUE MASSAGE AND FLEXIBILITY IN THE STRUCTURAL COMPONENTS OF THE SUPERFICIAL BACK LINE OF PROFESSIONAL VOLLEYBALL PLAYERS: A PILOT STUDY

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A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: Massage is a common treatment in physiotherapy, often used as a prophylaxis or during recovery following a musculoskeletal contusion. One form of therapeutic massage is deep tissue massage (DTM), which has become more popular in recent years as a way of performing targeted work with the myofascial system.

Aim of the study: The aim of the study was to examine the effectiveness of deep tissue massage on superficial back line flexibility (hip flexion and knee extension range of motion - ROM).

Material and methods: Elite volleyball players (n=15), age: 22.8 ± 4.41 years; mass: 82.67 ± 6.99 kg; height: 1.96 ± 0.08 m) were recruited for this study. Deep tissue massage of the myofascial superficial back line was performed from the plantar fascia through the gastrocnemius and soleus muscles, the hamstrings to the ischial tuberosity (based on Myers, 2014). Hip flexion and knee extension ROM were measured at rest both before and after DTM. The Wilcoxon signed-rank test was used to compare pre and post values during the intervention.

Results: Following deep tissue massage, there was significant improvement in superficial back line flexibility, demonstrated by an increase in hip flexion angle compared to pre-DTM values in both lower limbs. Right lower limb pre-DTM 1.86±0.66; post 2.79±0.43 ($p<0.005$), left lower limb pre-DTM 2.36±0.74; post 2.79±0.43 ($p<0.028$). There was also significant improvement in superficial back line flexibility demonstrated by an increase in knee extension angle post-DTM in both lower limbs. Right lower limb pre-DTM 69.79°±10.8; post 81.43°±6.06, left lower limb pre-DTM 73.07°±11.45, post 82.50°±8.39).

Conclusions: Deep tissue massage increases the flexibility of the superficial back line and can be used as a form of increasing range of motion in the hips and knees.

KEYWORDS: deep tissue massage, superficial back line, volleyball players

Background

Massage is a common treatment in physiotherapy. It can be used as a form of prophylaxis or during recovery following a musculoskeletal contusion [1]. One form of therapeutic massage is deep tissue massage (DTM), which has become more popular in recent years as a way of working with the myofascial system [2]. In deep tissue massage, techniques include myofascial release, trigger point pressure release and elements of structural bodywork such as structural integration/

Rolfing®. The essence of this therapy is to restore balance and proper function in the musculoskeletal system as a whole [3]. Physiotherapists work with soft tissue using their forearms, elbows, the palms of their hands or their knuckles without the addition of any oil or lotion. These are gentle techniques which must be used thoughtfully following an initial functional assessment of the patient [4,5]. For this reason, the term DTM is utilized here to describe a specific method of massage therapy, used specifically for the elimination of persistent abnormal tension and restrictions within the myofascial system by relaxing, lengthening, and releasing holding patterns [2,6]. Common indications for the use of DTM are locomotor and postural disorders accompanied by functional changes in the myofascial system. For example, this can include reduction of tissue flexibility (range of motion), myofascial trigger points (MTrPS), post-traumatic and post-surgical soft tissue dysfunction and any other disorders which stem from overstraining or compression [4,6]. DTM is commonly employed by sports medicine physiotherapists to improve athletes' physical capabilities and movement efficiency through an increased range of motion and muscular function [7].

The myofascial system is a network of interconnecting tissues that, when functioning correctly, work together effectively to allow for efficient movement. When muscles and fascia are subjected to some kind of strain or compression, fascial restrictions may alter normal muscular function through the development of myofascial trigger points and increased soft tissue stiffness. As a result, the range of motion in a person's joints may similarly decrease, and may be accompanied by altered neuromuscular properties and decreased muscle strength [7–9]. Current research suggests that the skeletal muscles of the human body are directly linked by fascia through myofascial chains. Because the fascia run in different directions, they are able to move and change form in concert with their surrounding tissues. For this reason, the myofascial system is believed to be one continuous piece of tissue working via connected "chains" as a tensegrity structure. Due to the increasing popularity of myofascial techniques, examining the functional relevance of these chains is critical in contemporary research. Further research into the transmission of strain along myofascial chains could provide a new way of understanding pain, along with a basis for developing holistic and evidence-based treatment strategies. Based on his anatomical dissection studies, Tom Myers proposed 6 myofascial meridians, of which one is the superficial back line [10–13].

Aim of the study

The aim of the study was to examine the effectiveness of deep tissue massage on superficial back line flexibility (hip flexion and knee extension range of motion).

Material and methods

Study design

Goniometric measurements were carried out twice on the volleyball players, both before and after deep tissue massage. Then, the results were compared.

Setting

Studies were conducted from November 2017 to March 2018.

Participants

Study participants included elite national level volleyball players (n=15). The criteria for inclusion were that the players were injury-free at the time of the study, 18 years of age or older, members of an elite volleyball team, and actively playing volleyball (training and/or matches). Players were excluded if they were found to have suffered a lower extremity injury or lumbar pathology, including back injury, in the previous six weeks. Information regarding age, body height and body weight was collected. Height was measured to the nearest 0.1 cm with the use of an anthropometer and body mass was measured to the nearest 0.1 kg with a calibrated digital scale. The general characteristics of the participants are as follows in Tab. 1.

Table 1. General characteristics of the participants, n=15

Descriptive statistics	Age [years]	Body height [cm]	Body mass [kg]
Mean	22,80	195,53	82,67
SD	4,41	8,07	6,99
median	22,00	194,00	84,00
max	33,00	210,00	98,00
min	18,00	187,00	73,00

The participants were given an explanation of the study's purpose and methods, and were required to provide informed consent. They were then instructed on how to perform the test movements with precision. Prior to conducting the study, the researchers obtained approval from the Bioethical Commission at the Opole Medical School (Nr KB/56/FI/2017).

Variables

Goniometric measurements were taken with a short arm goniometer for both the Active Straight Leg Raise test (ASLR) and the Active Knee Extension test (AKE). The measurements were carried out twice, both before and after deep tissue massage was performed with the participants lying in a supine position. The results were then compared.

Data sources/measurement

Active Straight Leg Raise test (ASLR)

Participants lay supine with the lower limb that was to be tested actively flexed and the knee fully extended.

During the movement, the contralateral limb was stabilized and fully extended on the ground. The movement stopped when the participant felt strong resistance or when researchers observed any pelvic movement. Then, the physiotherapist identified the midpoint between the anterior superior iliac spine and the patella of the other leg, and placed a dowel at this position, perpendicular to the ground. The participant received a score of 3 when the vertical line of the medial malleolus of the tested lower limb stood between the mid-thigh and the ASIS. The participant scored a 2 when the vertical line of the medial malleolus of the tested lower limb stood between the mid-thigh and the knee joint. The participant scored a 1 was when the vertical line of the medial malleolus of the tested lower limb stood below the knee joint. The other lower limb remained fully extended on the ground [14].

Active Knee Extension Test (AKE)

The participant was asked to perform an active extension movement at the knee joint (with the hip flexed at 90°), and was instructed to stop when they felt strong resistance to the movement. The tested limb was flexed at the hip until the thigh stood at a 90° angle with the table. The contralateral limb was fully extended and stabilized in neutral rotation. With the knee flexed at 90°, a goniometer was placed over the lateral femoral condyle, with 1 arm aligned with the thigh and the other arm aligned with the calf. From this position, the participant was instructed to extend the knee until they felt a strong resistance, and hold this final position for 2 to 3 seconds to allow the goniometric reading to be taken. The result was recorded in degrees of the knee-extension movement, starting from the initial test position (knee flexed at 90°). After the goniometric reading, the tested leg resumed the resting position, after which the same procedure was done with the second leg. Between the AKE and the ASLR measurements, subjects rested for 5 minutes.

Superficial back line deep tissue massage

Each participant received deep tissue massage from a certified physiotherapist for 30 minutes on both lower limbs in the prone position. The intervention was performed according to the following sequence: from the plantar fascia through the gastrocnemius and soleus muscles, the hamstrings (the semimembranosus, the semitendinosus, the biceps femoris long head and the biceps femoris short head) to the ischial tuberosity. The speed and depth of the DTM, along with a number of muscle repetitions, was selected individually for each player to maximize the therapeutic effect of the massage.

Bias

All procedures concerning data collection, measurements and deep tissue massage for a single player were executed in the same day and were done by the same physiotherapist.

Statistical methods

The arithmetic mean, standard deviation, median, minimum and maximum were calculated for the measurable variables. A non-parametric Wilcoxon signed-rank test was performed to compare the results between the values obtained before and after the intervention. The level of α=0.05 was assumed, and the obtained p values were rounded to three decimal places. Statistical analysis was performed using Statistica 12 under the license of Opole Medical School.

Results

The mean, standard deviation and p value for the ASLR and AKE in Table 2 and 3 were presented. An analysis of the data indicated that there were significant differences between the pre- and post-DTM measurements.

Tab. 2 shows significant immediate improvement in superficial back line flexibility which was demonstrated by an increase in the hip flexion angle from pre-DTM in both lower limbs. The right lower limb pre-DTM 1.86 mean score ±0.66; post 2.79 mean score ± 0.43 ($p<0.005$), left lower limb pre-DTM 2.36 ± 0.74; post 2.79 ± 0.43 ($p<0.028$).

Table 2. Active Straight Leg Raise test (ASLR) pre- and post-deep tissue massage (DTM) [Mean± SD]

ASLR	DTM	Mean (±SD)	p-value
Right lower limb	Pre	1.86±0.66	0.005
	Post	2.79±0.43	
Left lower limb	Pre	2.36±0.74	0.028
	Post	2.79±0.43	

Legend: ASLR – Active Straight Leg Raise, DTM – deep tissue massage, SD – standard deviation

Tab. 3 shows significant immediate improvement in superficial back line flexibility which was demonstrated by an increase in knee extension angle post-DTM in both lower limbs. Right lower limb pre-DTM 69,79°±10,8; post 81,43°±6,06, left lower limb pre-DTM 73,07°±11,45, post 82,50°±8,39).

Table 3. Active Knee Extension test (AKE) pre- and post-deep tissue massage (DTM) [Mean± SD]

AKE	DTM	Mean (±SD)	p-value
Right lower limb	Pre	70±11	0.001
	Post	81±60	
Left lower limb	Pre	73±11	0.001
	Post	83±80	

Legend: AKE – Active knee extension, DTM – deep tissue massage, SD – standard deviation

Tab. 4 shows the percentage of the active straight leg raise test with a 1, 2, and 3 point scoring system for the professional volleyball players before and after the DTM intervention. Before the intervention, more than

50% athletes achieved a score less than 3 for both the right and left lower limbs.

Table 4. The percent of active straight leg raise test with 1, 2, 3 point score in the professional volleyball players pre and post the DTM intervention.

n=15	% pre DTM		% post DTM	
Score	Right lower limb	Left lower limb	Right lower limb	Left lower limb
3	20	47	80	80
2	53	40	20	20
1	27	13	0	0

Discussion

Key results

This study investigated aspects of the effects of deep tissue massage on the flexibility of the superficial back line through an Active Straight Leg Raise test (ASLR) and Active Knee Extension test (AKE). The ASLR test assesses the ability to disassociate the lower extremity from the trunk while maintaining stability in the torso, as well as tests superficial back line flexibility while maintaining a stable pelvis and trunk [14]. When a patient achieves a score less than 3, the limiting factor must be identified by the physiotherapist. Clinical documentation of limitations can be obtained by using other tests such as the Thomas test or a sit and reach test. When a patient achieves a score of 2, there is a possibility of asymmetric hip mobility limitations, unilateral muscle tightness or stability dysfunction of the non-moving limb and trunk. When an athlete scores a 1 or less, hip mobility limitations are common [14]. In this study, before the intervention, more than 50% of the athletes achieved a score less than 3 for the right and left lower limbs (Tab. 4). Poor performance during ASLR tests can be the result of many factors. First, and most importantly in this study, the athlete may lack a functional hamstring muscle group or functional gastrocnemius in terms of fascial flexibility. Moreover, the athlete may have inadequate mobility in the opposite hip, which may be associated with psoas major muscle inflexibility and an anteriorly tilted pelvis [14]. Immediately after the intervention, 80% of the athletes achieve a score of 3 for both lower limbs (Table 4). According to our data (Tab. 2), a significant increase in hip angle, which correlates with a 3 point score in the ASLR, suggests that deep tissue massage induces greater range of motion and flexibility of the superficial back line, possibly through an increased stretch tolerance or an increased compliance of the superficial back line muscle group. Other researchers have reached similar conclusions [15,16].

Interpretation

The Active Knee Extension test is one of the most commonly used measures for the assessment of flexibility and hamstring length changes [17–20]. The result of this study showed that DTM increases immediate post intervention knee range of motion. It is worth noting that knee range of motion (ROM) is necessary for both sports and daily activities, and loss of full ROM can have detrimental effects on the function of the entirety of the lower limbs. For example, decreased extension ROM can cause an altered gait pattern, which can affect the ankle and hip and cause difficulty with running or jumping. Moreover, the loss of knee extension can result in anterior cruciate ligament reconstructions, total knee arthroplasties and other musculoskeletal injuries involving the knee joint [21]. Deep tissue massage is the commonly used treatment for improving ROM in physiotherapy, though little is known about its efficacy, especially in lower limb flexibility. Eriksson Crommert et al. described the effects after a seven-minute medial gastrocnemius massage in which researchers observed a decrease in muscle stiffness, measured via elastography, immediately post intervention. It is interesting that this effect was short and returned to baseline values quickly after cessation of the massage [22]. Recent research about injury prevention in athletes suggests that increased flexibility in the hamstring muscle group is one of the modifiable risk factors for the most common musculoskeletal injuries in the lower limbs [23– 25]. Literature suggests that DTM, and a related reduction of restriction or fibrous adhesion between layers of myofascial tissue, can contribute to muscle strain and other pathological processes such as TrPs [26,27]. These facts are clinically important to physiotherapists who specialize in sports medicine and musculoskeletal conditions, especially when evidence-based treatment strategies are required.

Generalizability

Flexibility is an important physical parameter often related to both muscle injury and athletic opportunities. Therefore, poor flexibility of the myofascial chains, especially affecting the hamstring muscle group, has been considered as a contributor not only to muscle strains but also to other conditions such as patella tendinopathy or back pain [17,23,28]. Clinicians routinely assess superficial back line muscle group length in patients with injuries to their musculoskeletal system, as well as in athletes when judging readiness to return to sports following an injury. They conduct this assessment using methods including the Straight Leg Raise test (SLR), the Passive Knee Extension test (PKE) or the Active Knee Extension test (AKE) [18]. Recent research suggests massage may have a positive effect and be a way of improving the recovery process after physical exercise, both in sports and in rehabilitation contexts [29]. Massage as a recovery technique may increase muscular blood flow and reduce muscle edema in delayed onset muscle soreness, reduce perceived fatigue and concentrations of cytokines in the blood after exercise, aid normalization of the autonomic nervous system, increase the secretion of certain hormones and lower blood pressure [1,15,30–32].

Massage is also utilized to improve flexibility or reduce stiffness in myofascial tissue through the stimulation of mechanoreceptors [33]. However, there is a lack of supporting evidence that such mechanical effects occur and future research is still needed [34].

Limitations

Further studies on the effectiveness of deep tissue massage should be conducted with a larger number of participants, randomized control, objective measurements and a follow-up study.

Conclusions

Deep tissue massage increases flexibility of the superficial back line and can be used as a form of increasing hip and knee range of motion. However, this study design limits the interpretation of these findings.

References

1. Ratajczak-Wielgomas K, Kassolik K, Grzegrzolka J, Halski T, Piotrowska A, Mieszala K, et al. Effects of massage on the expression of proangiogenic markers in rat skin. Folia Histochem Cytobiol 2018; 1(2): 83–91.
2. Koren Y, Kalichman L. Deep tissue massage: what are we talking about? J Body Mov Ther 2018; 22: 247–251.
3. Uryzaj R, Kuklińska A, Cabak A. The effect of deep tissue massage on tension reduction in the structural components of the superficial back line. Polish J Sport Med 2016; 2(4); 32: 157–163.
4. Wytrążek M, Chochowska M, Marcinkowski JT. Masaż tkanek głębokich – konieczne podejście terapeutyczne wobec narastającej epidemii chorób narządu ruchu. Probl Hig Epidemiol 2013; 94(3): 428–434. (In Polish).
5. Urbaniak M, Milańczyk A, Smoter M, Zarzycki A, Mroczek D, Kawczyński A. The effect of deep tissue massage therapy on delayed onset muscle soreness of the lower extremity in karatekas – a preliminary study. J Combat Sports Martial Arts 2015; 6(1): 7–13.
6. Riggs, A. Masaż tkanek głębokich. Wizualny przewodnik po technikach. Kielce: CRM Terapeuta; 2008. (In Polish).
7. Mauntel TC, Clark MA, Padua DA. Effectiveness of myofascial release therapies on physical performance measurements: a systematic review. Athletic Training & Sports Health Care 2014; 6: 189–196.
8. Schleip R, Müller DG. Training principles for fascial connective tissues: scientific foundation and suggested practical applications. J Bodyw Mov Ther 2013; 17: 103–115.
9. Stecco C, Schleip R. A fascia and the fascial system. J Bodyw Mov Ther 2016; 20: 139–140.
10. McKenney K, Elder AS, Elder C, Hutchins A. Myofascial release as a treatment for orthopaedic conditions: a systematic review. J Athl Train 2013; 48: 522–527.
11. Myers T. Taśmy anatomiczne: meridiany mięśniowo-powięziowe dla terapeutów manualnych i specjalistów leczenia ruchem. Warszawa: DB Publishing; 2010. (In Polish).
12. Swanson RL. Biotensegrity: a unifying theory of biological architecture with applications to osteopathic practice, education, and research—a review and analysis. J Am Osteopath Assoc 2013; 113(1): 34–52.
13. Wilke J, Krause F, Vogt L, Banzer W. What is evidence-based about myofascial chains: a systematic review. Arch Phys Med Rehabil 2016; 97: 454–461.
14. Cook G, Burton L, Hoogenboom BJ, Voight M. Functional movement screening: the use of fundamental movements as an assessment of function-part 2. Int J Sports Phys Ther 2014; 9: 549–563.
15. Boora M, Sharma S. Study on effectiveness of static stretching and massage on hamstring flexibility in normal adults. IOSR JSPE 2016; 3: 1–5.
16. Huang SY, Di Santo M, Wadden KP, Cappa DF, Alkanani T, Behm DG. Short-duration massage at the hamstrings musculotendinous junction induces greater range of motion. J Strength Cond Res 2010; 24(7): 1917–1924.
17. Neto T, Jacobsohn L, Carita AI, Oliveira R. Reliability of the active-knee-extension and straight-leg-raise tests in subjects with flexibility deficits. J Sport Rehabil 2015; 3;24(4): 2014–2020.
18. Kim C, Gwak G, Kwon O. Reliability of the active knee extension test with a pressure biofeedback unit. Physl Ther Korea 2017; 24(3): 40–46.
19. Gajdosik RL, Rieck MA, Sullivan DK, Wightman SE. Comparison of four clinical tests for assessing hamstring muscle length. J Orthop Sports Phys Ther 1993; 18: 614–618.
20. Samant R, Vishal K, D'silva C. A comparison between active knee extension test and back-saver sit-and-reach test in assessing hamstring flexibility among healthy schoolchildren in India. Int J Ther Rehabil 2016; 23: 158–163.
21. Shah N. Increasing knee range of motion using a unique sustained method. N Am J Sports Phys Ther 2008; 3(2): 110–113.
22. Eriksson Crommert M, Lacourpaille L, Heales LJ, Tucker K, Hug F. Massage induces an immediate, albeit short-term, reduction in muscle stiffness. Scand J Med Sci Sports 2015; 25(5): e490-496.
23. James L, Kelly V, Beckman E. Injury risk management plan for volleyball. Sports Medicine 2014; 44: 1185–1195.
24. Gouttebarge V, van Sluis M, Verhagen E, Zwerver J. The prevention of musculoskeletal injuries in volleyball: the systematic development of an intervention and its feasibility. Inj Epidemiol 2017: 4; 25.
25. Petersen J, Hölmich P. Evidence based prevention of hamstring injuries in sport. B J Sport Med 2005; 39(6): 319–323.
26. Romanowski MW, Špiritović M, Rutkowski R, Dudek A, Samborski W, Straburzyńska-Lupa A. Comparison of deep tissue massage and therapeutic massage for lower back pain, disease activity, and functional capacity of ankylosing spondylitis patients: a randomized clinical pilot study. Evid Based Complement Alternat Med 2017; 6: 1–7.
27. Kaye AD, Kaye AJ, Swinford J, Baluch A, Bawcom BA, Lambert TJ, et al. The effect of deep-tissue massage therapy on blood pressure and heart rate. J Altern Complement Med 2008 Mar; 14(2): 125–128.
28. Yasuda M, Nishimoto K, Hori M, Noguchi T, Takasaki H. The effect of active knee extension in sitting on lumbopelvic cur-

vature in individuals with clinically tight hamstring muscles: a cross-sectional reliability study. Open J Ther Rehabil 2017; 5: 139–147.

29. Dupuy O, Douzi W, Theurot D, Bosquet L. Dugué B. An evidence-based approach for choosing post-exercise recovery techniques to reduce markers of muscle damage, soreness, fatigue, and inflammation: a systematic review with meta-analysis. Front Physiol 2018; 26(9): 403.

30. Guo J, Li L, Gong Y, Zhu R, Xu J, Zou J, et al. Massage alleviates delayed onset muscle soreness after strenuous exercise: a systematic review and meta-analysis. Front Physiol 2017; 27(8): 747.

31. Visconti L, Capra G, Carta G, Forni C, Janin D. Effect of massage on DOMS in ultramarathon runners: a pilot study. J Bodyw Mov Ther 2015; 19: 458–463.

32. Ogai R, Yamane M, Matsumoto T, Kosaka M. Effects of petrissage massage on fatigue and exercise performance following intensive cycle pedalling. Br J Sports Med 2008; 42: 834–838.

33. Jeong HM, Shim JH, Suh HR. The passive stretching, massage, and muscle energy technique effects on range of motion, strength, and pressure pain threshold in musculoskeletal neck pain of young adults. Physical Ther Rehabil Sci 2017; 6: 196–201.

34. Thomson D, Gupta A, Arundell J, Crosbie J. Deep soft-tissue massage applied to healthy calf muscle has no effect on passive mechanical properties: a randomized, single-blind, cross-over study. BMC Sport Sci Med Rehabil 2015; 101(1): 497–498.

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