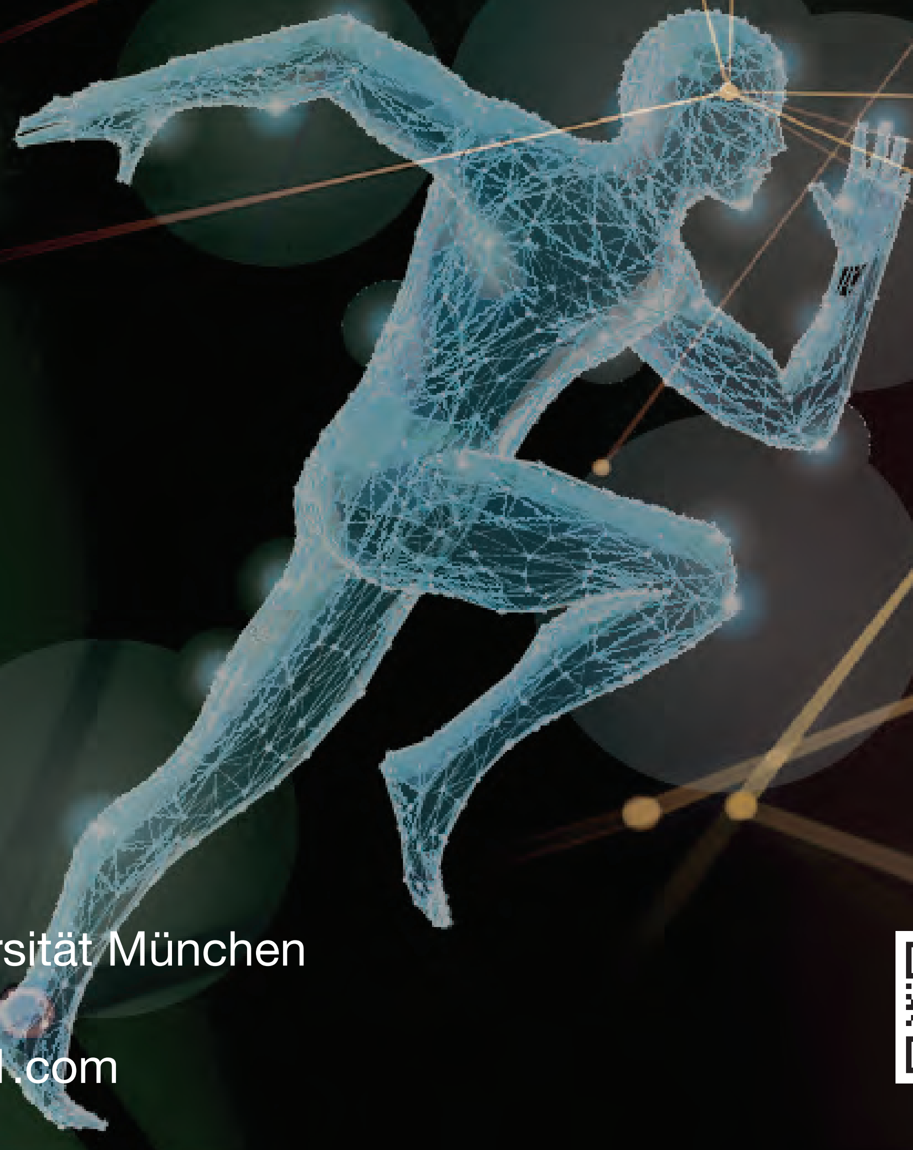
CONNECT **2021**

CONNECTIVE TISSUES IN SPORTS MEDICINE

3rd International Congress
March 26th / 27th, 2021

| Abstracts



Technische Universität München
Munich, Germany
www.connect2021.com

Contents

Greeting

Dear friends and colleagues,

Due to the actual international COVID 19–situation and the current hygienic restrictions, CONNECT 2021 will be held as an Online-Congress. After two successful congresses at the University of Ulm, the third CONNECT congress will be hosted by the Technical University of Munich.

Physical training not only strengthens the cardiovascular system, but also the musculoskeletal system. While skeletal muscles are intimately related to connective tissues, it is the fibrous connective tissue components, which often suffer pathology from athletic overload. Across many biological fields, including sports medicine, new research is highlighting the important role connective tissues play in health, well-being and disease.

The 3rd CONNECT Congress at TUM, draws research across a number of biological fields to focus on „Connective Tissues in Sports Medicine“. It explores emerging research on the role of fascia from a clinical, molecular and biomechanical standpoint, to strengthen the exchange and dialogue between all research fields.

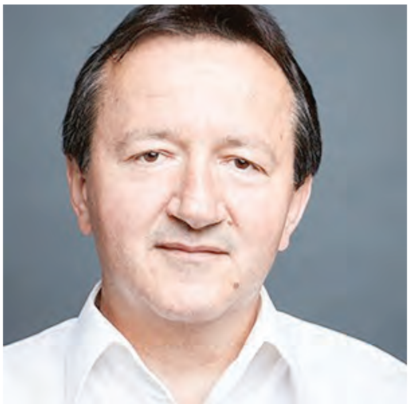
The Congress aims to CONNECT scientists, sports medicine practitioners, physicians, therapists coaches and sports administrators, to translate the latest scientific results findings into athletic and therapeutic practice.

With collegial greetings

Prof. Dr. med. Thomas Horstmann

Dr. Robert Schleip

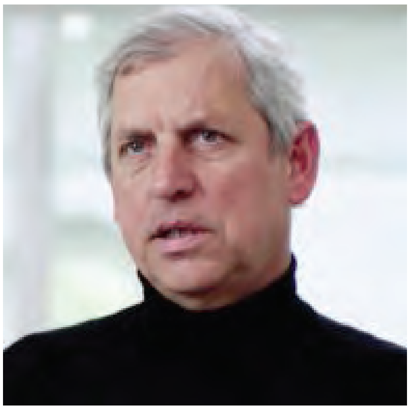
Keynote speaker



Prof. Adamantios Arampatzis | DEU
Prof. Arampatzis' research is focused on the adaptation of muscle-tendon-units, neuromuscular control, movement efficiency and dynamic stability control.

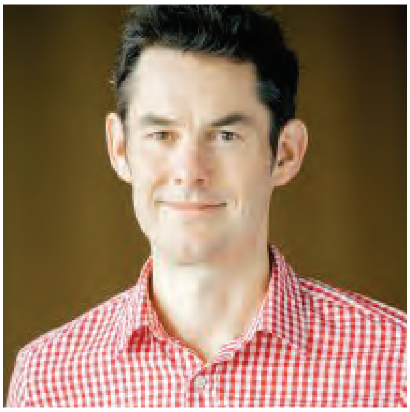
Prof. Keith Baar | USA
Prof. Baar is a researcher in the field of molecular determinants of musculoskeletal development and the role of exercise in improving health and performance.

Prof. Irene Davis | USA
Prof. Davis studies the relationship between lower extremity structure, mechanics and musculoskeletal injury with special focus on interventions to mitigate contributing facors to injury.

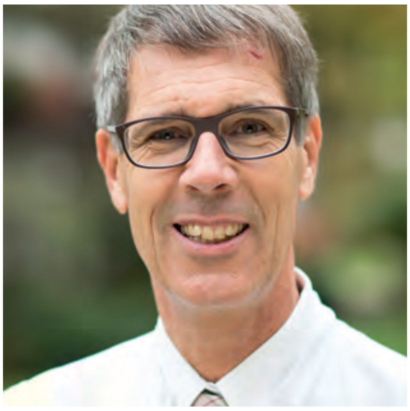


Prof. Martin Fischer | DEU
Prof. Fischer is a zoologist, evolutionary biologist and focuses on movement research. He is one of the founder of X-ray fluoroscopy.

Ass. Prof. Mette Hansen | DNK
Prof. Hansen's research is focused on the interplay between sex hormones, nutrition and physical activity/training on skeletal muscle and performance.



Prof. Paul Hodges | AUS
Prof. Hodges researches on movement control, pain and rehabilitation with an approach from molecular biology to brain physiology.



Prof. Thomas Horstmann | DEU
Prof. Horstmann is a specialist for orthopedics, traumatology and sports medicine and focuses his research on diagnostics and therapy.

Prof. Michael Kjær | DNK
Prof. Kjærs researches on the influence of mechanical loading or lack thereof upon the tendon tissue.

Prof. Daniel E. Lieberman | USA
Daniel Lieberman's major research foci include the evolution of long distance walking and running abilities, the effects of shoes on locomotor biomechanics and injury, and the evolution of the highly unusual human head.

Prof. Constantinos Maganaris | GBR
Prof. Maganaris' research interest lies on the mechanical properties of muscles and tendons and the way they interact to produce forces and movement

Ph.D Carles Pedret | ESP
Carles Pedret MD is a specialist in sports medicine and musculoskeletal ultrasound and external consultant of multiple professional football clubs.

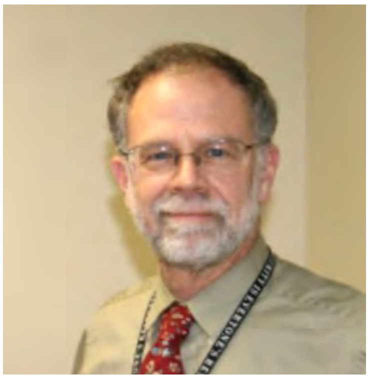
Dr. Robert Schleip | DEU
Dr. Schleip is a researcher in the field of connective tissues and the fascial network of the human body.

Prof. Olivier Seynnes | NOR
Prof. Seynnes is a researcher in the field of musculotendinous function and adaptations to exercise, disuse and ageing.

Prof. Carla Stecco | ITA
Prof. Stecco focuses her studies on the anatomy of the human fasciae from macroscopical, histological and physiopathological point of view.

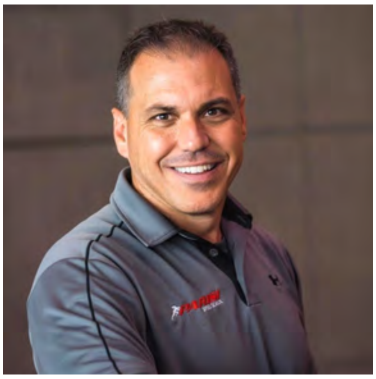
Prof. Jürgen Michael Steinacker | DEU
Prof. Steinacker is a specialist for internal sports medicine and sports cardiology with scientific focus on inflammation syndromes, muscle adaptation and performance.

Invited panel member



Prof. Thomas Findley I USA
Prof. Findley is professor of Physical Medicine and Rehabilitation at Rutgers University New Jersey Medical School and is an associate member of the Cancer Institute of New York.

Dr. Kurt Mosetter I Germany
Dr. Mosetter is a medical doctor and alternative practitioner. He was a long-time team doctor of the American soccer team and developed the Myorflex Therapy.



Bill Parisi I USA
Bill Parisi is the founder and CEO of the Parisi Speed School and author of Fascia Training: A Whole-System Approach. He is also founder of the Fascia Training Academy.

Programm

Friday, March 26th, 2021

Plenary session I
(10:30 - 12:00 CET)

10.30 Dr. Robert Schleip (opening & overview)
11:00 Prof. Adamantios Arampatzis
11:30 Prof. Jürgen Michael Steinacker

-- Health break --

Plenary session II
(15:30 - 17:00 CET)

15:30 Prof. Irene Davis
16:15 Prof. Martin Fischer

-- Health break --

Plenary session III
(17:30 - 19:00 CET)

17:30 Ass. Prof. Mette Hansen
18:00 Prof. Keith Baar
18:30 Clinical Panel
(Application of fascia research to athletic training)
19:00 Short Closure Panel

Saturday, March 27th, 2021

Plenary session IV
(10:30 - 12:00 CET)

10:30 Prof. Olivier Seynnes
11:00 Ph. D Carles Pedret
11:30 Prof. Constantinos Maganaris

-- Health break --

Plenary session V
(15:30 - 17:00 CET)

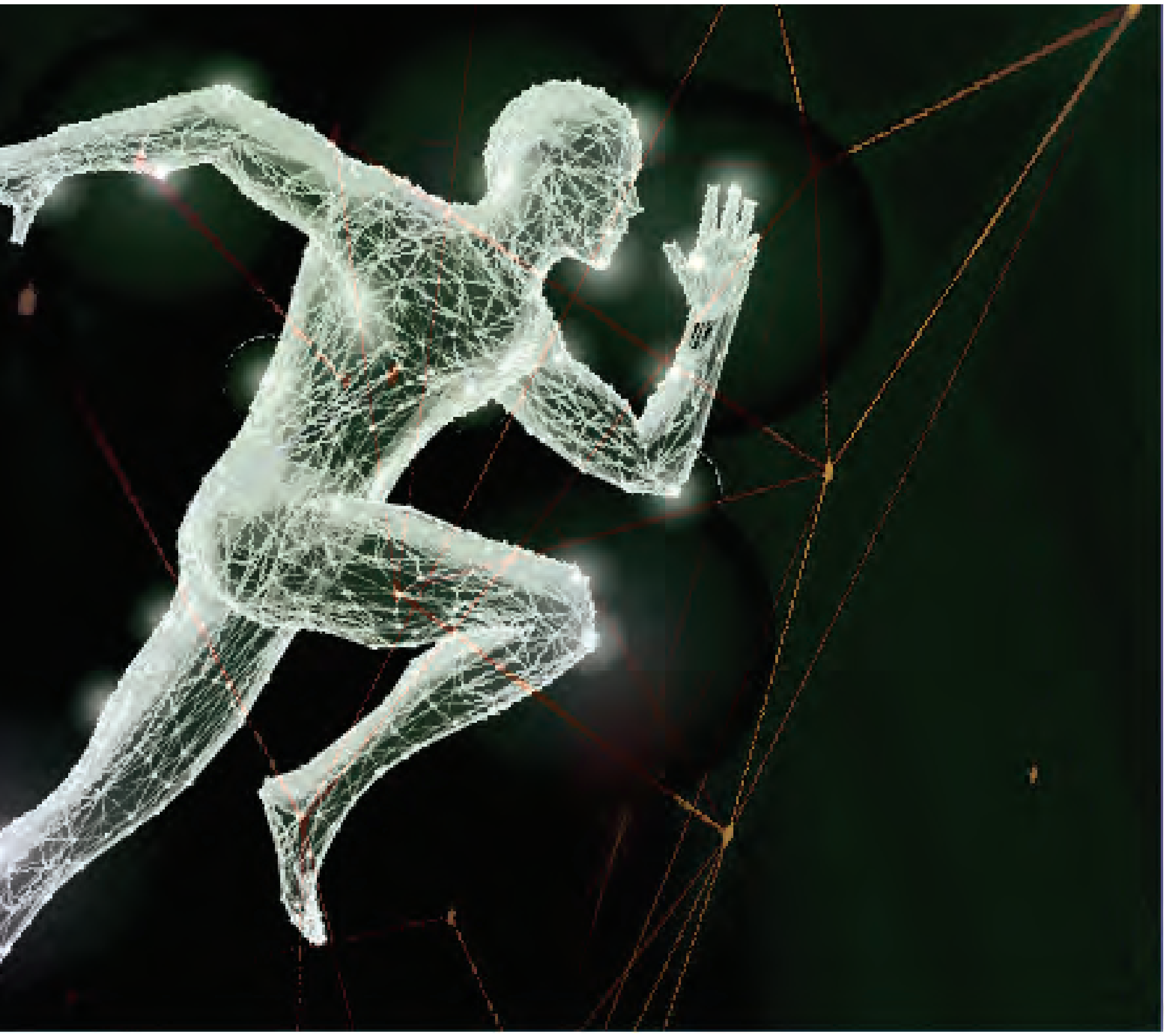
15:30 Prof. Carla Stecco
16:00 Prof. Michael Kjaer
16:30 Prof. Paul Hodges

-- Health break --

Plenary session VI
(17:30 - 19:00 CET)

17:30 Prof. Daniel E. Lieberman
18:15 Summary Panel & Closure

Abstracts



A Novel Large Area 2-D Shear Wave Elastography Approach to Assess the Physical Properties of Muscles and Fascias

Katharina Bauermeister[1] and Wolfgang Bauermeister[2]
[1]Technical University of Munich, [2]Kharkiv National Medical University

Introduction: High training loads can lead to adaptations in the myofascial system with increased fascia and muscle stiffness. This represents a potential risk factor for sports injuries, especially when the increase of stiffness is one-sided. The underlying pathophysiological mechanism could be related to the clinical characteristics of myofascial trigger points (MTrPs). Clinicians subjectively diagnose MTrPs non-quantitatively through manual palpation, with an experience dependent inter-rater reliability. A promising method to quantify MTrPs is shear wave elastography (SWE). However, to date, researchers mainly measure tissue stiffness values with SWE in small sites of only a few mm^2, excluding MTrPs. Therefore, the aim of the study is to quantify tissue stiffness analyzing defined areas of several cm^2, including present MTrPs, in athletes with high training loads, an asymmetric loading pattern and without a history of severe musculoskeletal injuries.

Research Questions: Is myofascial stiffness of the rectus femoris (RF) and biceps femoris (BF) different in the dominant (shooting leg) and non-dominant (standing) leg in young competitive athletes?

Methods: 20 competitive male soccer players (14.6±0.5 years, 177.5±6.3 cm, 65.7±6.5 kg, 9.2±1.9 training hrs per week) were examined. Youngs modulus E for the muscle (Em) and the fascia (Ef) using 2-D SWE (Resona7, Mindray Bio-Medical Electronics Co., China) was tested with an area of 8.25cm". RF was examined in the midpoint between the superior anterior iliac spine and the upper boarder of the patella and BF in the midpoint between the ischial tuberosity and the fibular head. E values were tested for normality using Shapiro-Wilk test and then evaluated using either paired t-test or Wilcoxon signed-rank test, effect size was calculated as Cohen‘s d or effect size r (alpha-level=0.05).

Results: There was no statistical difference for the Em and the Ef between the dominant and the non-dominant leg in the RF and the BF ($p>0.05$). Further results show that Em and Ef of the left RF (Em = 20.62+-8.34 kPa; Ef = 24.19(8.91) kPa) was higher than on the right side (Em = 17.36+-3.56 kPa,p=0.016,d=0.576; Ef = 20.46(9.02) kPa,p = 0.027, r=0.306). There was no side difference in the Em and Ef of the BF ($p>0.05$).

Discussion: SWE allows to differentiate stiffness patterns in side-to-side comparison where the subject serves as its own control. Young soccer players show one-sided patterns of increased muscle and fascia stiffness in the RF, independent of their shooting leg. A possible treatment target might be to equalize stiffness between both legs. Follow up studies could clarify, if increased stiffness measured with large area 2-D SWE including MTrPs can be related to higher incidence of overuse injuries.

Large Area Shear Wave Elastography for the Assessment of Muscle Stiffness

Wolfgang Bauermeister[1], Katharina Bauermeister[2], Gunda Slomka[3] and Michael Krämer[4]
[1]Kharkiv National Medical University, [2]Technical University of Munich, [3]University Hildesheim, [4]Technical University Darmstadt

Introduction: For athletes, the assessment of active and passive muscle stiffness is important, because high stiffness is associated with a propensity for overuse injuries and pain. Shear wave elastography (SWE) measures stiffness as Young's modulus of elasticity E in kPa, but it is unclear which E-values are associated with an increased risk for injury. Myofascial trigger points (MTrPs) are associated or even the cause of stiffness but so far, research has excluded them from the measurements. Results of SWE are obtained on small areas (SA-SWE) of only several mm^2 , large area (LA-SWE) can have a cross section of several cm^2. LA-SWE can include MTrPs in the measurements which might help to obtain more realistic E-values. They could be used in the future as a reference for diagnosis, treatment and prevention of overuse injuries and pain.

Research questions: How does LA-SWE compare to SA-SWE stiffness measurements? Are stiffness values in the lower extremities for soccer players (SOC) different from members of a police tactical unit (SEK) with high physical demands?

Methods: 45 SEK members (age: 35.45±7.5yrs) with no recent injuries and 20 elite SOC (age: 14.6±0.5yrs) with no severe previous injuries were screened with a SWE ultrasound-system (Resona 7, Mindray, China) at 7 muscles. 630 E-measurements in the SEK- and 280 in the SOC-group were obtained as Median(IQR) and analyzed non-parametrically with the Wilcoxon-test, (α-level=0.05).

Results: Significantly higher E-values were found in the SOC- versus the SEK-group for: M.rectus femoris (REC) 15.00(6.00) and 18.11(6.35), M.biceps femoris (BF) 12.51(4.42) and 18.68 (4.50), M.gastrocnemius lateralis (GAL)13.00(5.00) and 19.44(6.04), M.gluteus maximus 9.0(3.77) and 21.25(7,71), M.gluteus medius 9.00(3.00) and 19.4(10.08). No significant difference was found for the M.adductor magnus 14.44(7.27) and 16.03(4.45) and M.tibialis anterior 36.00(9.00) and 34.17(7.34).

Discussion: In the literature, SA-SWE E-values were: (REC)10-38, (BF)34-35, (GAL)12-45, and (TIB)14-56, similar to those found with LA-SWE in the SEK and SOC groups. Since no other references are available, the significance of these findings needs to be studied further. The higher E-values in the SOC-group could be related to the sport specific demands. If these high values constitute an increased injury-risk needs to be addressed in follow up studies. However, the differences in mean age of the groups only allows a cautious interpretation of the results. Despite this limitation, LA-SWE has shown that the E of muscle can be investigated in large areas, and could possibly lead to an improvement of soft tissue diagnostics.

The Difference in the Upper Trapezius Deep Fascia Slide Between Individuals With and Without Myofascial Pain Syndrome: An Observational Case-Control Study

Valentin III Dones[1], Maria Teresita Dalusong[2], Chiong-Maya Arlene[1], Vergel Orpilla[1]
[1]University of Santo Tomas, [2]Pamantasan ng Lungsod ng Maynia

Introduction: Limited deep fascia slide due to hyaluronan changes is a possible source of musculoskeletal pain. A limited thoracolumbar fascia slide was found in patients with chronic low back pain compared to patients without low back pain. However, no reports have documented limited deep fascia slide of the upper trapezius in patients with myofascial pain syndrome (MPS). Aim. The study determined differences in upper trapezius‘ deep fascia slides between MPS and non-MPS participants.

Research question: What is the difference in the deep fascia slide of the upper trapezius between MPS and non-MPS participants?

Methods: MPS and non-MPS participants were recruited from January 2019 to August 2019 in Manila, Philippines. The PT-Sonographer scanned the deep fascia of the upper trapezius using an HS1 Konica Minolta ultrasound machine (Konica Minolta, Inc., Tokyo 100-7015, Japan) with a 5-14 MHz linear-array transducer head. Simultaneously, the participant performed active cervical flexion, extension, right lateral flexion, left lateral flexion, right rotation, and left rotation. Using the Tracker 5.0 © 2018, two blinded physiotherapists independently determined the fascia slide by calculating the cross-correlation between two distant x-axis points of the upper trapezius' deep fascia. The Tracker 5.0 © 2018, a free modeling tool using the Open Source Physics Java Framework operating system, was used to process the deep fascia slide MSUS videos. The multivariate analysis of variance determined differences in deep fascia slides where all six active cervical movements were included in the analysis. Pillai‘s Trace, ranging from 0 to 1, was used as the test statistic. Alpha-value was set at <0.05.

Results: Of the 327 participants (136 non-MPS: 191 MPS) examined, 203 were females ($p=0.01$). Of the 191 MPS participants, 101 had less than 1-year shoulder pain, and 103 had unilateral shoulder pain. We analyzed 2,988 musculoskeletal ultrasound videos. There is no difference in deep fascia slides in all active cervical movements between MPS and non-MPS groups (Pillai‘s Trace value= 0.004, $p= 0.94$). Laterality and chronicity of symptoms do not characterize MPS participants from non-MPS participants (Pillai‘s Trace values= 0.12, 0.02, $p >0.05$).

Discussion: A limited deep fascia slide does not characterize MPS participants from non-MPS participants. The laterality and chronicity of MPS do not restrict the deep fascia slide on the upper trapezius of individuals with MPS. Albeit limited deep fascia slide of the upper trapezius do not characterize MPS participants, improvements in MPS symptoms as an effect of myofascial release may still be explained by an improved fascia slide. A significant difference in the fascia slide measurements taken pre-and post-intervention should substantiate this assumption. No high-quality clinical trials have evaluated the myofascial release‘s effectiveness on individuals with MPS.

Forward head posture can be corrected with IASTM techniques and neuromuscular exercises, and this is associated with improved functionality in patients with mechanical neck pain: A randomized control study.

Konstantinos Mylonas[1], Pavlos Angelopoulos[1], Elias Tsepis[1], Evdokia Billis[1], Konstantinos Fousekis[1]
[1]University of Patras

Introduction: The forward head posture (FHP) is a myofascial pathological adaptation that gradually leads to cervical dysfunction and pain, creating a musculoskeletal syndrome with a high epidemiological incidence.

Research question: Is it possible to correct the FHP and improve the functionality of patients with mechanical neck pain through a combined application of Ergon instrument-assisted soft-tissue mobilization technique (IASTM) of the soft tissues of the cervical and thoracic spine (ER) and a program of therapeutic exercise of the same areas?

Methods: A total of 20 women, aged 41-62 years, had cervical syndrome with concomitant FHP [mean craniovertebral angle (CVA o) in sitting = 41.9 and standing = 46.5) participated in this study. The sample was randomly divided into 2 intervention groups receiving either targeted ERGON IASTM applications and strengthening exercises (Group A) of the neck and thoracic area or massage and the same exercises in the same regions (Group B). Eight treatment sessions were performed on all patients, two each week, while the strengthening exercises were implemented throughout the study (4 weeks). The study's outcomes included the assessment of the cervical vertebral angle (CVA) in standing and the neck disability (Neck disability index). FHP was evaluated after the 8th treatment session (after one month) while the cervical spine's functionality through the NDI questionnaire was evaluated before the eighth treatment session and at four weeks post-treatment.

Results: The combined application of ERGON IASTM and neuromuscular exercise contributed to a significantly greater improvement in FHP in standing ($p<0.001$) than the massage and application of the same exercises at the end of the treatment period (4 weeks) which statistically was not maintained at eight weeks. Disability improved in both groups ($p=0.05$). Nevertheless, this improvement was more evident in Group A than in group B both in 4 ($Z = -2.864$, $p = 0.004$) and eight weeks ($Z=-2.684$, $p=0.004$). A significant correlation was observed (rs (20)—0.667. $p=0.001$) between the two variables at eight weeks as the CVA decreased the functionality of the patients was increased, respectively.

Discussion: A combined application of IASTM and exercises for the cervical and thoracic area can induce positive postural adaptations, and this is associated with an improvement in the neck pain patient's functional status.

Biomechanic loads, jump performance, acute and chronic tissue adaptions

Jürgen Freiwald[1], Matthias Wilhelm Hoppe[2], Christian Baumgart[1], Raimund Forst[3], Moritz Hüttel[3], Rafael Heiß[3], Isabel Mayer[3], Christoph Lutter[4] und Thilo Hotfiel[5]
[1]Bergische University Wuppertal, [2]University Leipzig, [3]University Erlangen, [4]University Rostock, [5]Städtisches Klinikum Osnabrück

Introduction: There are scientific lacks concerning the acute and chronic effects of foam rolling (FR) on biomechanic loads, tissue adaptions, and performance. To answer these questions we conducted four studies.

Research Questions: (1) What are the mechanical loads on the underlying tissue for two popular FR exercises? (2) To what extent does FR affect jump height? (3)To what extent does FR affect arterial and venous blood flow? (4) To what extent does FR affect muscle-specific and connective tissue-specific parameters (stiffness) in recreational athletes with different FR experiences.

Methods: (1) With 20 males the vertical ground reaction forces (Kistler) were measured during FR. (2) With 20 males we tested in a randomized cross-over design on different days pre, post, and 15 and 30 min after two interventions (FR, Cycling) and resting (control) the jumping height. (3) With 21 participants we assessed the effect of FR on arterial blood flow of the lateral thigh. Arterial tissue perfusion was determined by spectral Doppler and power Doppler ultrasound. (4) With 40 participants, consisting of 20 experienced (EA) and 20 non-experienced athletes (NEA) we measured with acoustic radiation force impulse elastosonography values (shear wave velocity), obtained under resting conditions (t0) and several times after FR (0 min, 30 min, 6 h, 24 h).

Results: (1) During the FR exercises, a mean of 34% of body weight (BW) was applied to the calves and 32% thighs, respectively. The maxima of the individual mean forces were significantly higher with 51% to 55% BW. (2) Jump height did not change after FR, but increased after cycling. (3) Arterial blood flow of the lateral thigh increased significantly after foam rolling exercises compared with baseline ($p \leq 0.05$). (4) FR effects on tissue stiffness depend on the athletes' experience in FR. In EA, tissue stiffness of the iliotibial band revealed a significant decrease, in NEA not. Regarding muscle stiffness, after FR no significant changes were detected at any time for EA and NEA.

Discussion: FR leads to high pressure of the underlying tissue and increasing arterial blood flow. The greater blood flow to FR could be the result of damage to muscle tissue, as well as blood vessels with reactive increased blood flow. New and worthy of discussion is the finding that FR lead to different adaptations in experienced versus inexperienced athletes.

Force Transmission in Fascial Chains? Myofascial Release on the Plantar Surface Reduces Functional Performance of the Dorsal Kinetic Chain.

Anna Gabriel[1], Torsten Pohl[1], Anna Roidl[1], Jennifer Queisser[1], Robert Schleip[1] and Thomas Horstmann[1,2]
[1]Technical University of Munich, [2]Medical Park Bad Wiessee St. Hubertus

Introduction: Fascial structures can influence physical capacities like flexibility and strength, also in non-adjacent areas, which are connected via fascial chains. This has already been investigated in practical studies, where for example myofascial release interventions on the plantar surface increased the flexibility in the dorsal kinetic chain. It remains unclear whether myofascial release on the plantar surface also relevantly influences force transmission within the chain.

Research question: Does functional performance of the dorsal kinetic chain differ from before to after a myofascial release intervention on the plantar surface?

Methods: 17 healthy participants (nine female, eight male) between 18 and 30 years ((mean±SD) age, 25.0±3.2 years; height, 172.0±8.0 cm; weight, 66.8±11.4 kg) took part in this non-randomized controlled trial. Subjects performed a physical performance test, the Bunkie test, prior to and right after a self- and therapeutic myofascial release intervention on the plantar surface of the dominant leg. Therefore, participants did a reversed plank on a stool and then lifted the dominant leg to test the contralateral leg and vice versa while time to exhaustion was measured in seconds. The testing procedure was performed twice: with legs straight to test the posterior power line (PPL) and with knees 90° flexed to test the posterior stabilizing line (PSL). The main and interaction effects of the factors time and treatment were evaluated by comparing four linear models with an Analysis of Variance (α-level=0.05).

Results: The statistical analysis indicates a significant interaction between time and treatment for PPL and PSL ($p < 0.05$). Thereby, the performance of the treated leg in the Bunkie test decreased by 17.2% from 33.1±9.9 s to 27.4±11.1 s for the PPL and by 16.3% from 27.6±9.8 s to 23.1±11.7 s for the PSL. This is in contrast to the non-dominant leg where performance increased by 5.1% from 29.7±9.6 s to 31.1±8.9 s for the PPL and by 3.1% from 25.7±1.5 s to 26.5±1.7 s for the PSL.

Discussion: Our results might be of relevance for the field of sports and rehabilitation where myofascial release is frequently applied without considering this potential side effect. Therefore, timing of the treatment with regard to upcoming physical demands in the support of athletes should be considered. Still, the problem of lacking practical, specific and valid measurement methods for force transmission in fascial chains remains.

Why do we assess the Fascia Lata (the Fascia Profundis) when we assess Quadriceps extensibility?

Franck Germain[1], Arthur Mayet[2], Raphaël Perrin[1]
[1]SCM Kinéquipe, [2]Hôpital de Nord Franche-Comté

Introduction: When associating hip extension and knee bending in the sagittal plane, clinicians have traditionally considered this to be an assessment of rectus femoris extensibility. The fascia profundis (the fascia lata) is often neglected but as the thigh cover it may be involved in the stretch.

Research questions: Stretching of the front thigh involves two layers of tissue, the rectus femoris and its cover, the fascia lata. Our aim was to find out which structure is assessed when clinicians measure quadriceps extensibility. Is the participants' perception consistent with the physics of reaction forces and the coordinates of the stretched structures calculated by the tendon travel method?

Methods: The pelvis of 11 men and 5 women were stabilised with a stretching device we built ourselves in order to assess the front thigh passive reaction force. Reaction forces directions and intensities were analysed, average values and standard deviation were calculated. The patella travel was used to calculate the average coordinates and the standard deviations of the stretch structures at hip level. We recorded the reaction force of a patient with a complete tear of his left rectus femoris during a 10 minutes static stretching session to compare it with the healthy leg. Participants were asked to point out the stretched area at 90° and 120° of knee bending and the barycenter of these areas were calculated.The pelvis was stabilized with a stretching device in order to assess the front thigh passive reaction force during the experiment. Reaction forces direction was analysed in order to determine which structure was tightest. This reaction force was recorded with and without rectus femoris during a 10 minutes static stretching session to assess the role of rectus femoris in stretching. Considering the well documented patella travel the coordinates of the stretch structure were calculated at hip level. Participants were asked to point out the stretched area during the experiment and the barycenter of this area was calculated.

Results: The reaction force of the thigh is orientated 33° (SD: 6°) sideway and its intensity was 60 Nm (SD: 19 Nm). The barycenter coordinates of all the stretched structures is very stable (X=17.0 mm SD: 1.2 mm, Y=43.2 mm SD: 3.0 mm. The average external rotational torque of 6 Nm (SD: 3.7 Nm) registered can only be mediated by fascia lata. The reaction force of the rectus femoris appeared to be about 25% of the total reaction force during a 10 minutes static stretching. Participants reported perception was that the stretched area could be anywhere on the fascia lata and not necessarily localized on the rectus femoris.

Discussion: Clinicians typically assess the fascia lata when assessing quadriceps extensibility. When knee bending is over 70° and the hip is extended, the fascia lata seems to store and release elastic energy like a wide elastic. Participants perceptions are consistants with the physics of the front thigh.

Myofascial points treatment with extracorporeal shock waves: a novel approach for plantar fasciitis

Lucrezia Tognolo[1], Federico Giordani[1], Andrea Bernini[1], Carlo Biz[1], Anna Chiara Frigo[1], Pietro Ruggieri[1], Carla Stecco[1] and Stefano Masiero[1]
[1]University of Padova

Introduction: Plantar fasciitis (PF) is a common cause of heel pain. Since the plantar fascia is anatomically connected with the lower limb's fascial system, they should be considered as a unique structure. Recent studies suggest that PF may be a consequence of myofascial impairment proximal to the pain area with a biomechanical disequilibrium of the entire limb and pelvis. Among the several conservative treatment options, Extracorporeal Shock Wave Therapy (ESWT) is proposed as the standard therapy. Additionally, Fascial Manipulation (FM) is a manual therapy that aims at restoring the correct fascial gliding to regain biomechanical equilibrium.

Research question: By combining FM and ESWT, the purpose of this study was to evaluate the effectiveness of ESWT on the impaired myofascial trigger points of the limbs and pelvis on subjects with PF and compare this treatment to the ESWT traditional approach.

Methods: Thirty patients suffering from PF were randomly assigned to an Experimental treatment Group (EG) and a Traditional treatment Group (TG). EG received a focused ESWT on myofascial trigger points selected according to FM method, while TG patients were treated with the focused ESWT traditional approach on the medial calcaneal tubercle. Every patient underwent a 3-sessions program (once a week) and follow-ups after 1 and 4 months. For each session, 1500 shocks per point (0.05-0.167 mJ/mm2, 5 Hz) to EG and 2000 shocks (0.32 mJ/mm2, 5 Hz) to TG were administered. Before treatments and follow-ups, outcome measures (Italian Foot Functional Index, 17-iFFI; Foot and Ankle Outcome Score, FAOS) were recorded. Mixed-model statistical analysis was performed considering the difference between each session and the baseline values (first session's score).

Results: 17-iFFi and FAOS were observed to improve following the treatments in both groups; this was confirmed during follow ups. Comparing to baseline, 17-iFFI significantly decreased over the course of the sessions (time effect $p < 0.0001$), while FAOS increased accordingly (time effect $p < 0.0001$). The EG performed best both for 17-iFFI (treatment group effect $p = 0.0016$) and FAOS (treatment group effect $p = 0.0072$) starting from the third treatment.

Discussion: ESWT on the myofascial trigger points reduced heel pain in patients with PF by restoring the correct gliding and biomechanical equilibrium of the fascial system. It could represent an interesting alternative with better outcomes in terms of recovery time compared to traditional ESWT for the conservative management of PF.

Decompression Typed Kinesiology Taping Increased Blood Circulation and Improved Sensory function

Tomonori Kawai[1], Koichi Takamoto1 and Itsumu Bito[1]
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Introduction: Kinesiology Taping is a therapeutic procedure that is considered to facilitate fascial unloading by reducing tension in the fascial layers. The exact mechanisms of Kinesiology taping have been unproven. The physical decompression theory explains subcutaneous space and fascia caused by decompressed taping which may offload sensory nerve endings and promote the removal of exudate substances. Therefore, the application of decompression taping may improve circulation and sensory function. The purpose of this study was to determine if the decompression typed Kinesiology taping affects blood circulation and sensory function.

Research question: 1, Can decompression Kinesiology taping method influence blood circulation? 2, Does decompression Kinesiology taping method affect sensory function? 3, Do any undesirable effects occur during the application or after?

Methods: Eight healthy male recreational weightlifters were selected (age 29.9±5.8yrs, BMI 24.2±2.5 kg/m²) for this study. Palmar artery pulsation (PAP) was evaluated by an ultrasonic doppler measurement device (Hadeco,Inc.). The participants have also assessed touch sensation on the hand region by using VAS (Visual Analog Scale) before and after the application. Decompression kinesiology taping was taken place on the unilateral side of the forearm area for 15 minutes. The side-to-side difference was analyzed by paired t-test before and after application.

Results: PAP (+4.4±1.5 beats/min) and sensory function (3.25±0.71 mm VAS) were increased on the applicated side (p=0.007 and p=0.02), while no significant change was found on the un-applicated side (+0.13±1.2 beats/min) and sensory function (0.75±0.7 mm VAS), (p=0.78 and p=0.12).

Discussion: Decompression typed kinesiology tape increases blood circulation and sensory function which indicates decompression taping method may affect facilitating fascial unloading.

Children Running in Conventional Shoes have a Lower Peak Loading Rate but greater Asymmetry than in Minimalist Shoes

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Introduction: Peak vertical force loading rates (PLR's) during shod running have been implicated in the development of lower limb injuries in adults. While "cushioning" properties of shoes remain a prime candidate for lowering PLR's, surprisingly little research has investigated the effect of footwear on PLR's and their symmetry between limbs of children during running.

Research Question: This study compared the magnitude and symmetry of PLRs in children during running in conventional and minimalist running shoes. It was hypothesized, that (1) as shown in adults, a conventional shoe would result in a significantly lower PLR in children during running than a minimalist shoe, and (2) there would be no difference in symmetry of PLR between shoes.

Methods: Eight healthy children (10.4±1.3 years, 1.45±0.06 m and 37±6 kg) ran at a matched, self-selected speed on an instrumented treadmill (FDM-THM-S, Zebris Medical GMbH, Germany) while shod with either a conventional (New Balance KR680) or minimalist (New Balance WT10) (Minimalist Index score 72%) running shoe. Shoes were of identical size (US male 6) but the conventional shoe was heavier (248g vs 168g), had a thicker (30mm vs 23mm), softer midsole (Shore A, 46±1.7 vs 49±1.9), and a steeper heel pitch (13mm vs 3mm). Following acclimatization, vertical ground reaction force and temporospatial gait data were recorded at 120 Hz during steady–state running. Shoe order was counterbalanced between children. Foot–strike patterns were determined by visual inspection of pressure distribution at initial contact for each electronic footprint. Peak vertical ground reaction force and PLR, defined as the peak instantaneous force differential during the loading phase of gait, was calculated. Gait asymmetry was assessed using the symmetry index. Paired t-tests were used to compare differences between shod conditions (α=.05).

Results: All children adopted a rearfoot foot–strike pattern during shod treadmill running. Running in conventional shoes was characterised by a significantly lower PLR (≈15%, t_7=3.07, $P < .01$), but higher PLR asymmetry (≈183%, t_7=4.01, $P < .01$) than running in minimalist shoes.

Conclusions: PLR was lower in children when running in conventional compared to minimalist shoes but resulted in a greater PLR asymmetry. While the findings tend to support the growing body of evidence that conventional running shoes are more effective at reducing peak vertical loading rates than minimalist shoes, they also highlight, for the first time, a potentially detrimental effect of conventional running shoes on PLR asymmetry in children, which may have implications for running-related injury.

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Effects of myofascial release and strenuous exercise in epigenetic modulation in Muay Thai athletes.

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Introduction: It is well established that fascia is innervated as well as some types of fascial techniques that can modulate the neural pathways and mechanotransduction can lead to cellular activity. It has been pointed out that manual therapy might modify tissue differentiation by modulating the expression of specific genes through epigenetic change. However, the molecular mechanisms involved in this response are not elucidated. A growing body of evidence reported that Brain-derived neurotrophic factor (BDNF), a protein known to promote neuronal protection, survival, remodel axonal and dendritic growth and synaptogenesis is up-regulated in response to therapeutic interventions such as massage and physical exercise. Additionally, it has been pointed out that manual therapy might modify tissue differentiation by modulating the expression of specific genes through epigenetic change.

Research question: Can manual myofascial release (MR) before or after a single bout of exercise influence epigenetic modulation and BDNF levels in Muay Thai (MT) athletes?

Methods: The study included seven male MT Athletes (n=7) aged 18-45 years old practicing the sport for at least 1 year and often practice at least twice a week. They were first submitted to the MR and after a single bout of strenuous exercise training on the treadmill (MR + EXE). Seven days after they performed initially the single bout of exercise and subsequently received the MR (EXE + MR). For biomarkers analysis, blood collections previous and post-interventions are made. Data were tested for normality with the Shapiro-Wilk test. Quantitative data were presented as mean ± standard deviation and categorical data through relative frequency. The analysis of variance of repeated two-way measurements, taking time and group as main factors, followed by a Bonferroni post-test was used for multiple comparisons. Relative differences were calculated with the baseline value and compared between groups using a t-Student test for independent data. The level of statistical significance was set at $p < 0.05$.

Results: BDNF plasma levels were not altered after intervention in both groups ($p>0.05$). Regarding the epigenetic analysis, a significant increase in global histone H4 acetylation levels was found only in the MR + EXE group after an intervention (p0.049□). However, no significant changes were observed on global histone H3 acetylation levels ($p>0.05$). Our data demonstrated that a single session of manual MR associated with exercise-induced epigenetic changes, specifically histone H4 hyperacetylation levels, an indication of increased gene expression, without altering BDNF levels in MT athletes.

Discussion: It was demonstrated a significant increase in BDNF levels after a 4-week-aromatherapy massage program twice per week (totaling 8 sessions) in adult subjects, suggesting a role of this in neurotrophin response. Thus, we may suggest that a single manual MR is insufficient to modulate BDNF levels, and possibly a longer period of intervention is necessary to influence this response. We showed a significant histone H4 hyperacetylation status after a single bout of strenuous exercise in MT athletes. Importantly, this result was observed only in the MR + EXE group, suggesting that manual MR before training is mandatory for this response. Corroborating this idea, it was previously proposed that manual therapy changing the extracellular matrix might promote mechanical signals that are crucial regulators of cell behavior and tissue differentiation by affecting gene regulation through epigenetic modulation. These findings might contribute to elucidate the complete and exact epigenetic pathways involved in the MR associated to exercise impact in MT athletes.

The distribution of connective tissue in humans

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Introduction: Why are collagenous connective tissues of special interest to us? Previous reconstructions of the musculature have revealed gaps between the individual muscle fascicles. However, there are no gaps in the body, but regions filled with connective tissue or interstitial liquid. The knowledge about the distribution and composition is important for simulation accuracy. This is the only way to deduce the transmission of forces correctly, e.g. between muscles or organs.

Research question: How is the connective tissue distributed within the body? Is it possible to distinguish fibrous, planar, or spherical structures? Can the myofascial chains be identified?

Methods: We used the available data set of a male body donor (38 years) of the Visible Human Project® (VHP) and digital image processing to reconstruct the collagenous structures. Connective tissue can be distinguished from the surrounding tissue by its specific RGB color values. Based on this, a three-dimensional model was created as the first step. We were interested in the distribution, thickness, and orientation of the connective tissue in the different regions of the body. For density and thickness measurements we used our free software tool imageXd. A new technique to determine fiber orientation (anisotropy) was additionally implemented in imageXd.

Results: In the reconstruction of the collagenous connective tissue structures, the larger structural connections and the fine branching can be seen. The interrelations across organs are visualized. Maxima of connective tissue thickness were found at the joints. This is explicable by the necessity to support and control the joints. In addition, high thickness values occur at the thorax. Here connective tissue plays an important role in the transmission of force between and among the arms and the legs.

Discussion: In this study, the connective tissue distribution in humans could be determined in detail. In a second step, this information will be transferred into a biomechanical model to investigate the interactions between different structures. Especially for the knee, Dhaher et al. (2010) showed that new biomechanical interactions can be revealed when such additional material properties are incorporated into a model. These data can also be useful to elucidate the role of inter-organ relationships in pathological conditions and to develop more effective clinical interventions.

High Intra-rater Variability in Applied Peak Force during Maitland's Grade IV Anteroposterior Ankle Mobilisation

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Introduction: Ankle mobilisation techniques are often used by clinicians in the management of ankle dysfunction and pathology. Grade IV mobilisations, in particular, which incorporate small amplitude rhythmic oscillations at the end the range of movement are often used to stretch the joint capsule and passive soft tissues which support and stabilise the joint to improve joint movement. Variability in the force applied during ankle mobilisation, however, is poorly understood and may explain discrepancies in clinical outcomes reported with these techniques.

Research question: This study quantified the variability in the force applied by an experienced practitioner during 20 cycles of Maitland's grade IV anteroposterior ankle mobilisation measured on two occasions separated by 1 week.

Methods: Thirteen healthy adults (mean age 25±5 years; height, 170±7 cm; weight, 71±16 kg) received 20 cycles of a Maitland's grade IV ankle mobilisation performed by single practitioner on two sessions separated by one week. A six degree-of-freedom force transducer was used to measure the peak force, loading rate and impulse applied during each antero-posteriorly directed load cycle. Absolute reliability of the force applied during each 20-cycle mobilisation session was estimated using the mean within-session Coefficient of Variation (CoV) and stand error of measurement. Agreement between repeated mobilisation sessions was estimated using 95% level of agreement (95% LOA) and a paired t-test.

Results: The mean within-session CoV in peak force, loading rate and impulse applied during 20 loading cycles of talar mobilisation was 10-13%, 15% and 27-30% %, respectively. There was a significant difference in the mean peak force (-17%, t_{12} = 2.45, p = 0.03) and impulse (-51%, t_{12} = 2.31, p = 0.04) between sessions, with the 95% LOA in the applied peak force (±33N) and impulse (±128 Ns) large compared to their mean values (≈±50% and ~±110%, respectively).

Discussion: The large variability in the force applied during a Maitland's grade IV AP talar mobilisation, particularly between mobilisation sessions, may underpin the differential clinical effects reported within the joint mobilisation literature. Clinicians should be aware that peak forces applied during ankle mobilisation may vary by as much as 50% between mobilisation sessions. The findings of the current study highlight the need for strategies that standardise the application of force during talar mobilisation.

The Acute Mechanism of the Self-Massage-Induced Effects of using a Foam Roller

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Introduction: Maintaining flexibility, often defined as range of motion (ROM), is important. Recently, self-massage using a foam roller (FR) has been used to improve ROM effectively and immediately in clinical or athletic populations. Many studies found that ROM increased significantly following the FR intervention. However, if local tissue or autonomic nervous system responses, or both, are the responsible for the underlying mechanism of the effect is unclear.

Research question: What is the mechanism of ROM effects following the FR intervention?

Methods: The study design was a crossover study with a comparison between control (CON trial: left leg) and intervention (FR trial: right leg) groups. 7 males and 7 female volunteers (age 23.1±2.8 y) participated. Nine outcomes (passive maximum ankle ROM, tissue hardness, skin temperature, water contents, circumference, blood flow velocity, pressure pain threshold, autonomic nervous system, and heart rate) were investigated before (PRE) and after (POST) the intervention.
Results: Impedance (PRE: 54.7Ω, POST: 61.1Ω), and circumference (PRE: 35.2cm, POST: 35.1cm) changed significantly following the intervention, and increased ROM was observed (PRE: 15.0°, POST: 19.6°) in the FR trial.

Discussion: Although we found that the FR intervention influenced skin temperature, impedance, circumference, and ROM, adaptability to the intervention may differ depending on an individual's characteristics. Females and/or individuals with a high body water content could obtain greater positive ROM effects than males and/or individuals with a low body water content.

Conclusion: The FR intervention may be an effective method to improve ROM, with alterations of skin temperature, impedance, and circumference.

Instrument-assisted soft tissue mobilization, tissue flossing, and kinesiology taping, when applied functionally, can improve shoulder performance in overhead athletes: A randomized control study.

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Introduction: In recent years, several innovative therapeutic approaches have been proposed in sports science to enhance athletes' performance. Such therapeutic techniques include myofascial techniques such as instrument-assisted soft-tissue mobilization (IASTM) techniques, muscle flossing and kinesiology taping applications. The above therapeutic interventions, that aim to improve athletic performance through the soft tissue mobilization and activation, are applied either passively or in combination with exercise.

Research question: Is the functional application of IASTM, muscle flossing, and kinesiology taping capable of increasing the shoulder girdle's range of motion, isokinetic strength, and functional performance in amateur athletes?

Methods: 80 amateur male overhead athletes (mean ± SD: age, 23.03 ± 1.89; weight, 78.36 ± 5.32; and height, 1.77 ± .11) were randomly divided into four equally sized research subgroups (n=20) receiving either IASTM (ERGON IASTM Technique), muscle flossing technique (Kinetic flossing), kinesiology taping or a combined application of IASTM and muscle flossing interventions in combination with movement simulating a shoulder throw on their dominant shoulder. Study outcomes included the evaluation of the range of motion (ROM) and the isokinetic strength of shoulder joint rotation. Additionally, the functional throwing performance index of both shoulders, before, immediately after the application of the above therapeutic interventions was measured. The non-dominant shoulder received no treatment serving as control extremity. The "Repeated Measures ANOVA" (RM-ANOVA) method was used to compare the effectiveness of intervention programs applied.

Results: All four therapeutic interventions improved isokinetic strength of the shoulder rotators, the internal shoulder rotation ROM, and the shoulder's functional performance of the shoulder that received the treatment compared to the shoulder that did not. IASTM and Muscle Flossing's combined application contributed to a significantly greater shoulder internal rotation ROM than Kinesiology taping applications.

Discussion: The present study's findings support the use of innovative soft tissue techniques to improve amateur athletes' shoulder functional capacity. Those interventions can improve myofascial sliding, elasticity, and activation, which can ultimately enhance the shoulder girdle's function in amateur overhead athletes and enhance their performance.

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