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# Conference of the International Academy of Manual/ Musculoskeletal Medicine (IAMMM)

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## WOMEN-UP – Horizon 2020 European Union funded project

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Serious game-enhanced biofeedback supported self-management vs. pelvic physiotherapy in women with mild to moderate stress urinary incontinence—a multinational, non-blinded randomized controlled trial

**Introduction:** Urinary incontinence is a common condition, with a prevalence ranging from 25–51%. An estimated 38% of these women suffer from stress urinary incontinence (SUI), a condition that can have a major impact on day-to-day life. Pelvic floor muscle training (PFMT) is recognised as a reliable conservative treatment of SUI, but a lot of patients do not adhere to this therapy. Adding biofeedback improves the outcome of PFMT, and as the role of the therapist seems to be more to motivate than controlling the exercises, a self-management system is developed in which patients can use biofeedback at home, combined with an application on smartphone/tablet and a web-portal, where training results can be uploaded and patients can interact with their health care professional.

**Objective:** The objective is to compare the self-management treatment to usual care PFMT in terms of clinical, economic and satisfaction outcomes.

**Study design:** A multicentre, multinational, non-blinded, randomized controlled trial

**Study population:** 300 adult women with mild or moderate stress urinary incontinence from three centres, Catalonia University Hospital (CUH), Amsterdam Medical Centre (AMC) and Kuopio University Hospital (KUH).

**Intervention:** Self-management system including:

- Standardized training/exercise schedule for PFMT
- Portable vaginal biofeedback device with an abdominal EMG-sensor
  - The vaginal biofeedback device can be placed intravaginally by the patient herself. Because of the light weight and shape of the device it will stay in place during the exercises without the need of securing it in any other way.
  - The abdominal sensor is mandatory to guarantee the correct execution of exercises.
  - Patients receive their own biofeedback device that can be cleaned properly (see user's manual for detailed cleaning instructions) and will not be recycled.
- Application for smartphone/tablet including the following functions:
  - Communication with biofeedback device/abdominal belt
  - Play serious games to support PFMT exercises
  - Communication with web-portal for data storage/reporting
  - Communication with therapist/supervisor for supervision of treatment
  - Generate notifications/reminders for training exercises/life style advice
  - Data capture (for clinical and research purposes)
- A web-portal intended to stimulate patients' adherence, check progress, monitor adverse events and interact with her therapist.

**Control group:** Usual care PFMT supervised by a therapist in clinical setting

**Main study parameters/endpoints:**

Primary endpoint:

- Patient reported improvement of SUI symptoms

Secondary endpoints:

- Patient reported cure of SUI symptoms
- Incontinence related quality of life
- Generic quality of life/Utility
- Indication for SUI-surgery during follow-up
- Patient satisfaction
- Resource Use/Costs
- Performance of pelvic floor
- Adherence to treatment
- Treatment-related adverse events
- Serious adverse device events (SADEs)

**Nature and extent of the burden and risks associated with participation, benefit and group relatedness:** During the trial patients will be asked to complete disease specific and generic QOL questionnaires at four different time-points. They undergo a pelvic examination at 12–14 weeks after randomization which would not happen outside of study conditions. Pelvic Floor Muscle Training (PFMT) does not have any notable side-effects or inherent risks, but as one study has shown 49% of patients with moderate to severe stress urinary incontinence (SUI) will switch from physiotherapy to surgery. In order to motivate patients and improve the performance in pelvic floor exercises this holistic self-management system was designed. Both pelvic floor muscle training as well as the aids used in the intervention (vaginal and abdominal biofeedback, application for smartphone/tablet and web-portal) are considered safe, without major complications or risks to be expected.

## Low back pain: fat related condition?

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Low back pain (LBP) and obesity are major public health concerns that affect people worldwide and whose prevalence continues to rise as well as medical expenses. Epidemiological studies show an increase in mortality associated with overweight and obesity. To date, the adipose tissue is considered as an endocrine organ able to produce various adipokines. Numerous studies have demonstrated a positive relationship between obesity and LBP, although barely several of them raised awareness of the role of fat cells and their negative endocrine impact via altered metabolism. Intervertebral discs, which are structures with nutrient supply at tissue level throughout the whole body, may suffer and gradually degenerate as a consequence of failure of nutrient supply to disc cells. Novel studies reported that disc degeneration was significantly associated with overweight and obesity, not only the lumbar region but also the cervical and thoracic regions. Overweight may lead to an increase in adipokine secretion; thus an intervertebral disc in entire spine may be influenced by pro-inflammatory cytokines. Various mechanisms may be involved in disc degeneration in the setting of overweight and obesity, but further research is needed to elucidate the mechanism through which overweight affects disc degeneration since both direct mechanical stress and indirect factors affect the intervertebral discs. Understanding the role of fat tissue in disc degeneration process may help in developing novel therapeutic strategies. Thereafter, recommendation

of specific exercises and weight loss program could be an important suitable treatment for LBP.

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**The neuromuscular efficiency of trunk muscles – sex and age-related differences**

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**Purpose:** Several measures are used to characterize the functional state of muscles. The maximum voluntary contraction (MVC) is most frequently used and considered the gold standard. A little understood and used measure is neuromuscular efficiency (NME) of muscles. Therefore, the present study was conducted to compare NME indices of several trunk muscles within healthy adults with respect to age and sex.

**Methods:** Overall 100 healthy Caucasian subjects (equally distributed in young (19–39 years) and elderly (48–71 years) and persons of both sexes, i. e. 25 subjects per age group and sex were investigated during sub-maximum and maximum isometric tasks of their trunk muscles in sagittal plane. Five major superficial trunk muscles were evaluated by means of Surface EMG (SEMG). From these data both NME and MVC values were extracted. NME was calculated using the inverse slope of the logarithmic transformation of the SEMG amplitude to torque relationships of the sub-maximum tests.

**Results:** The abdominal muscles showed no sex differences in NME. Moreover, these indices were always superior in the elderly groups. As could be expected MVC levels during flexion of men were higher but interestingly no age related MVC differences could be detected. However, for the back muscles NME showed no age related effects and during extension MVC was reduced with age. Also, males showed significantly higher NME indices and also higher MVC values. Absolute SEMG amplitudes levels of all investigated trunk muscles were always lower in the elderly subjects.

**Conclusions:** NME is a SEMG amplitude-independent parameter and may be applied to determine the functional state of (trunk) muscles as a complement to MVC measurements. It shows larger values with age for the abdominal muscles that are independent of sex, but no age dependency for the back muscles that always show larger values in men.

**Dynamometric measurement of handgrip in osteoporotic women**

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**Introduction:** Postmenopausal osteoporosis is a common, debilitating disease. The lifetime risk of a hip fracture in women is greater than the combined lifetime risks of breast, endometrial and ovarian cancers. Postmenopausal osteoporosis is also likely to become more common in the decades ahead as the life expectancy of the population increases. Early menopause, occurring either naturally, or because of surgery, increases the risk of the development of osteoporosis. In addition, various lifestyle factors are known to increase the risk of osteoporosis, including a life-long low calcium intake, smoking, over-use of alcohol, and the lack of exercise or chronic immobility. Osteoporosis that develops secondary to other pathologies, or to medications is considered to be postmenopausal in origin, although its severity is likely to increase after the menopause if appropriate measures are not taken.

**Aim:** The aim was to compare handgrip strength, measured by hydraulic dynamometer in the same women, at two different intervals: at the beginning of exercise program and after 6 months of active exercise program. We also

explored whether age and anthropometric parameters significantly predict the handgrip strength, prior to exercise and after 6 months of exercise.

**Patients and methods:** The research included women with diagnosed osteoporosis or osteopenia, mostly postmenopausal women ( $N=100$ ). Examinees are active participants of the project “Exercising and proper nutrition in fight against osteoporosis”. Anthropometric parameters were measured twice: at the time when women were just enrolled in project and after 6 months of exercise. Handgrip strength was measured by hydraulic dynamometer, at the same two intervals as the measures for anthropometric parameters were done. **Results:** We found that handgrip strength of the right hand was significantly higher in women, after 6 months of exercise, than it was prior to exercise ( $P=0.002$ ). Hip circumference after 6 months of exercise ( $R=0.37$ ,  $P=0.001$ ) and body height at the beginning of exercise ( $R=0.34$ ,  $P=0.005$ ) were directly correlated to the handgrip strength of the right hand, while waist circumference at the beginning of exercise was indirectly proportional to the handgrip strength of the right hand ( $R=-0.25$ ,  $P=0.04$ ). A similar result was observed when the handgrip strength of the left hand was analyzed, except for the variable hip circumference at the beginning of the exercise, which was inversely correlated to the handgrip strength of the left hand, after 6 months of exercise ( $R=-0.35$ ,  $P=0.004$ ).

**Conclusion:** Regular physical exercise is thought to reduce the risk of osteoporosis and delay the physiologic decrease of bone mineral density (BMD), which occurs with aging. With this investigation we have found that time period of 6 months of exercise significantly increases handgrip strength at the right hand, which suggests good muscle adaptation to exercise and is an important prerequisite for maintaining existing bone mass of our study participants.

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**Lumbar pain, irritable colon and probiotics**

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**Abstract:** In probiotic research we consider only patients with symptoms of irritable colon, with repetitive lumbar pain, caused by the dysfunction of the lumbosacral vertebral segment.

People included agreed to take probiotic therapy. At first they followed the probiotic recolonization of intestines and after that the treatment for irritable bowel disease (IBD), reduction of lumbar pain, release of muscle tension, and by despair's the vertebral dysfunction.

**Introduction:** Research question: Can subcutaneous inflammation of the intestine have an effect on lumbar problems.

Reducing the influence of sub-chronic inflammation of the intestine on the muscles of the low back pain.

10 patients with irritable colon, use probiotic to analyze their effect on the lumbar pain. Protocols used were based on the research effected by biologist on intestinal flora as a factor causing chronic diseases.

**Methods:** Irritable colon (irritable bowel disease), diverticulosis, constipation, represent always sub-chronic intestinal inflammation. The colon lays on the lumbar muscle.

We form a group of 8 patients who regularly come to the monthly manual treatment, and have problem of irritable colon. For 2 patients who came for the first visit and had irritable colon, it was suggested to take probiotics by screening without manipulation.

We used for treatment the research result achieved by biologists and pharmacists related to the intestinal flora conducted with the aim of reducing the effect of “leaky bowel” on chronic diseases such as diabetes, multiple sclerosis, dementia, depression, and also degenerative diseases like changes of connective tissue.

It is suggested that we start with the recolonization process consisting of:

1. Week in capsules: Enterococcus faecium
2. Week: Bifido bacteria

3. Week: *Lactobacillus rhamnosus*  
 4. Week 4: *Lactobacillus fermentum*, *Lactobacillus acidophilus*  
 After 1 month, for irritable colon the suggestion was the combination of: *Lactobacillus salivarius*, *Lactobacillus acidophilus* and *Bifidobacterium bifidum* and *Bifidobacterium lactis*, *Bifidobacterium breve* and *Bifidobacterium longum*.

**Results:** In all patients, muscular tension was significantly reduced, and back pain, dysfunction of L4/L5 and Th12/L1 were not found in the control. Two patients at first examination renounced manual treatment because after probiotic therapy they no longer had any pain.

### Documenting Quantifiable Changes and Pressures Used for Manual Diagnosis of the Cervical Spine and Treatment of Somatic Dysfunction at the Craniocervical Junction

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**Background:** Somatic dysfunction is diagnosed through the palpatory assessment of free or restricted motion patterns. Diagnostically, local soft tissues are compressed (pre-loaded) over the structure of interest followed by one or more test impulses to assess the quality of the “end-feel” motion in several planes. These barrier sensations are generally described qualitatively, but have yet to be objectively quantified. Non-invasive, tactile pressure sensors built into a digital palpation monitoring system (IsoTOUCH<sup>®</sup>; Neuromuscular Engineering; Nashville, TN) were used to document loading and impulse pressures for palpatory segmental diagnosis and the treatment of somatic dysfunction using High Velocity Low Amplitude (HVLA) osteopathic manipulative treatment (OMT) technique, which first engages and then quickly moves through a restrictive somatic dysfunction.

**Hypothesis:** Instrumented measures of palpatory pressures used in diagnosing and treating somatic dysfunction of the occipito-atlantal (OA) region using HVLA are possible and quantifiable.

**Materials and methods:** A subset of 25 subjects from a larger study were identified as having somatic dysfunction at the level of the OA and treated using HVLA. Each subject was monitored using the IsoTOUCH<sup>®</sup> system which quantified palpatory pressures applied during cervical spinal diagnosis and treatment. Subjects were first diagnosed from the level of the OA down to the seventh cervical vertebra (C7). After diagnosis each subject found to have OA somatic dysfunction was treated at this level using HVLA and then reassessed post-OMT by the same osteopathic physician.

**Results:** Diagnostic palpatory pressures in this cohort, OA-C7, registered overall preload pressures averaging a 1.35 lbs (6N;  $p < 0.001$ ) and end-feel pressures averaging 2.64 lbs (11.74 N;  $p < 0.001$ ); demonstrating a 1.31 lbs (5.83 N) difference between preload and end-feel pressures ( $p < 0.001$ ). Overall treatment pressures for the OA averaged 2.89 lbs (12.86 N) preload ( $p < 0.001$ ), 4.05 lbs (18 N) final thrust level ( $p < 0.001$ ), with an HVLA activating force averaging 1.10 lbs (4.89 N;  $p < 0.001$ ).

**Conclusion:** In this population, intra-operator palpatory pressures used in cervical diagnosis were relatively consistent as measured by the IsoTOUCH<sup>®</sup> system during diagnosis and treatment of somatic dysfunction at the craniocervical junction.

### The Functional System of Motor Behaviour (FS)—a Model for Dysfunction and Pain

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The theory of “Functional System” (FS) of behavior was developed ca. 50 years ago by the physiologist P. Anohkin as an alternative to the predominant concept of reflex and gives a cybernetic view to motor behavior. The FS is applied in psychology, in special needs pedagogy and sports medicine.

The concept of FS may support our postulation from Padua last year, that dysfunction in the movement system may be developed before pain evolves.

The characteristics of the system are:

- the body is holistic with adaptive behavior,
- the system is self-organizing—non-linear,
- to provide homeostasis by behavior (hedonic system).

Key points of the FS of motor behavior are the afferent and efferent synthesis of information during motor behavior in dependency of history, motivation and state of activation. In the reafferent loop we can find also the principles of manual medicine. Functional entities can be compared and explained by the different components of the system: Janda’s principles of muscle tension, motor stereotype, sensorimotor facilitation, somatic dysfunction, control dysfunction, functional chaining.

It is proposed that the FS of motor behavior may be a model for diagnostic and therapeutic approaches in manual medicine:

The functional system may be a model

- to explain the core idea of MM to our colleagues in the different medical disciplines, to the patient and to insurance companies,
- to treat key functions before burning-in the loops as a step to prevention,
- to deliver rules to classify symptoms and syndromes,
- to take in consideration the psychic factors and energy supply,
- to build subgroups,
- to plan and to formulate questions for further research.

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### Muscle of the Spine Biometry

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**Introduction:** The spine is a complex polyarticulated structure, and the musculature allows both stabilization and mobilization of this structure. Muscles also play an essential role in limiting spine overloading, muscles being able to reduce shear loads, flexion and torsion moments, according to their arrangement. Interrelation between spine disorders, postural problems and muscledysfunction has been widely mentioned and several biomechanical models aim at better understanding of such interrelations. However, one of the major limitations of such investigations is the lack of knowledge regarding quantitative muscle anatomy. Even if qualitative description is well documented in anatomy handbooks, differences in basic descriptions exist, particularly for the deep muscles such as multifidus, where the insertion areas differ. Evolution towards functional and biomechanical descriptions has been performed since the 1960s. More recently the progress in imaging techniques allowed to collect data related to functional anatomy.

MRI provides valuable quantitative information, both on cross sectional area and muscle infiltration by non-contractile tissue, 3D reconstruction provides muscle volumes and global orientation, however the images do not provide anatomic details that can be relevant for modelling, such as fascicles differentiation or location of muscles insertion. Moreover, the mass of each muscle, which can be related to muscle force, cannot be directly measured, and can be estimated only considering volume estimation and assumption on density. A muscle mass index (ratio of the mass of a given muscle to the global body mass) could constitute relevant data related to muscle function. Therefore, direct measurements on cadaveric studies still provide essential data for muscle modelling. None of previous anatomic studies considered the mass of the muscles, and the limited number of cadavers and of muscles taken into consideration is still an issue for comprehensive description of spinal muscles.

**Aim:** The aim of this study is to provide an extensive characterization of the 35 main muscles of the spine, and to investigate their variation on 10 ca-



**Table 1**

Name of muscles	Weight (g)	Extreme values (en g)	Standard deviation	Muscle mass index (MW/BW)
Obliquus Externus Abdominis	180	109–297	51.5	0.245
Longissimus Thoracis	178	131–254	42	0.242
Psoas (Major et Minor)	144	90–275	48.2	0.192
Rectus Abdominis	132	51–237	51.7	0.173
Obliquus Internus Abdominis	108	49–178	34	0.143
Longissimus Lumborum	90	50–127	21.7	0.122
Ilio-Costalis Lumborum	80	48–130	22.3	0.107
Transversus Abdominis	71	47–125	24.3	0.094
Sterno-Cleïdo-Mastoïdeus	55	41–92	12.5	0.073
Semi-Spinalis Capitis	52	35–76	12.7	0.069
Quadratus Lumborum	46	26–79	12.7	0.062
Levator Scapulae	42	25–68	11.9	0.055
Semi-Spinalis Cervicis et Thoracis	36	21–55	10.7	0.047
Splenius Capitis	31	18–47	8	0.04
Serratus Posterior et Inferior	25	8.0–48	10.7	0.033
Splenius Cervicis	18	13.5–27	4.4	0.024
Ilio-Costalis Thoracis	17	9.027	5.3	0.022
Scalenus Medius	16	7.0–24	4	0.021
Spinalis Thoracis	15	6.0–30	6.4	0.019
Serratus Posterior et Superior	14	8.0–23	4.7	0.018
Longissimus Cervicis	12	4.5–17	4.3	0.015
Longus Colli	10	5.0–16.5	2.8	0.013
Rectus Capitis Anterior Major	9.5	6.0–14	2.6	0.012
Scalenus Anterior	9	4.0–15	2.9	0.011
Longissimus Capitis	8.5	4.0–15	3.1	0.011
Ilio-Costalis Cervicis	8	5.0–13	2.4	0.01
Obliquus Capitis Inferior	7.5	5.2–10	1.7	0.01
Inter-Transversarii Lumborum	6.5	3.0–10	2.1	0.008
Scalenus Posterior	6	2.5–12	2.3	0.007
Rectus Capitis Posterior Major	4.5	2.5–8.7	1.3	0.005
Obliquus Superior	3.5	2.2–5	0.9	0.004
Inter-Spinales Cervicis	3	0.5–4.4	1	0.003
Rectus Capitis Posterior Minor	2.5	1.5–4	0.6	0.003
Inter-Transversarii Cervicis	1.5	0.5–4	1	0.001
Rectus Capitis Anterior Minor	1	0.6–2	0.5	0.001

divers, in order to complement existing data in the literature, particularly related to fascicle differentiations and mass measurements.

**Method:** For each muscle, measurements were performed immediately after dissection: Mass was measured using a precision balance (0.2 g). The muscle mass index (MMI) was defined as the percentage of muscle mass to the global body mass, and 3 groups of muscles were defined according to the value of the MMI.

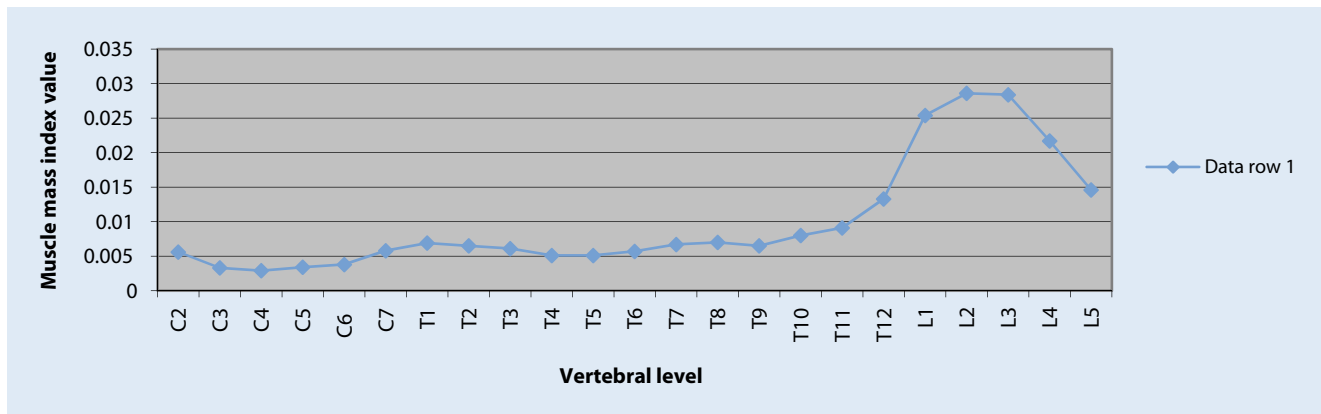
For the multifidus, the mass index was calculated both for the whole muscle and for each fascicle.

**Results:** Table 1 provides the global information related to the quantitative data for all the dissected muscles, together with their classification

regarding muscle mass index (MMI), either high (greater than 0.08%), medium (from 0.01% to 0.08%) or low (lower than 0.01%).

The table illustrates the localization of the muscles according to their MMI. The high MMI muscles were mainly the axial muscles, i.e. the psoas, longissimus and multifidus. The medium muscles were mainly the head neck activators, and the quadratus lumborum. The low MMI muscles are mainly monosegmental muscles such as the obliquus capitis or the intertransversary lumborum.

We can observe, for synergetic muscles, at the cervical level, the MMI of the sternocleidomastoids, (0.073%) was close to the sum of the splenius capitis, cervicis and obliquus inferior MMI (0.074%).



**Fig. 1** ▲ Multifidus Muscle Mass Index

**Fig. 1** provides detailed information related to each fascicle of the multifidus. The mass index was lower than 0.01 from C2 to T11 and increased at the lumbar level to reach a maximum close to 0.03 at L2 and L3 levels.

### A reproducibility study of a lumbar test according to the Marsman method: a second try after correction of pitfalls

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**Objectives:** We expect that scientific studies can only be realized in university-based structures. After the study done in 2016, we modified the protocol and we realized a new reproducibility study of a rotation test in standing.

**Method:** Two examiners, naive for Musculoskeletal Medicine (MSK), blinded to each others results, tested 40 subjects after a study phase to obtain 80% overall agreement. The subjects, athletes of stadium, were tested for their rotation mobility of their lumbar spine and lower extremities (Rutte, 2007) according to the IAMMM protocol for reproducibility studies (Patijn, 2012).

**Results:** After the formation phase, we obtain an overall agreement of 90%, the study phase showed an overall agreement of 0.80 and Kappa of 0.6 (Cohen, 1960).

**Discussion:** Our study tried to prove at first that a reproducible MSK-study could be realised with not many persons and small financial needs. Besides we will show in our presentation the complete structure of our study, our pitfalls and recommendations, as we will use in our next study.

#### References

- Jacob Patijn (2012) Reproducibility and Validity: Protocols for diagnostic procedures in musculoskeletal medicine (french version). IAMMM
- Sjef Rutte (2007) Examination course lumbar spine, Marsman method (french version). Marsman Stichting, Haarlem, p 33
- Jacob Cohen (1960) A coefficient of agreement for nominal scales. Educational and Psychological Measurement 20(1):37–46. <https://doi.org/10.1177/001316446002000104>

### Preliminary findings on the utilization of osteopathic manipulative medicine: outcomes during the formation of the practice-based research network, DO-Touch.NET

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**Context:** Few studies have assessed the utilization of osteopathic manipulative treatment (OMT) and subsequent patient-reported outcomes.

**Objective:** To assess the current utilization of OMT and associated patient-reported outcomes during the formation of the practice-based research network, DO-Touch.NET.

**Methods:** Adult patients aged 18 years and older who were expected to receive OMT during their office visit were recruited by office personnel just prior to seeing their physician. Patient demographics, history of chief complaints, severity level of symptoms, current and past treatments, interference of symptoms with quality of life, physical examination findings, diagnoses, OMT performed, and immediate patient response to OMT were collected from the patient participants and physicians. Patient participants also provided symptom severity and frequency data and other concurrent treatments daily for the 7 days following treatment. On day 7, symptom interference with quality of life was reassessed. Further, at two university sites, a 1-year chart review was performed to identify conditions being treated with OMT. **Results:** Data from 299 office visits (patients aged 18–93 years) were collected from 12 osteopathic physicians at 4 clinics. The most common symptoms (66%) and medical diagnoses (78%) treated with OMT were primarily related to musculoskeletal conditions. This finding is consistent with findings from the 1-year chart review. Immediately following OMT, 92% (271/296) of patient participants reported they felt better or much better; 2% felt worse. After 7 days, 72% (126/175) felt better or much better, and 6% felt worse. Daily worst and mean symptom severity decreased until post-OMT day 5 when levels leveled off. Comparing quality of life levels prior to OMT with 7 days after OMT, there was significant improvement (decreased interference with quality of life from chief complaints) in usual/general activities, sleep, mood, and enjoyment of life (all  $P < .001$ ). **Conclusions:** These results provide important information about the utilization of OMT as it is currently practiced. Determining efficacy requires data from more patients and physicians to generate meaningful conclusions. Continued surveillance of DO-Touch.NET member practice characteristics can provide current evidence useful in identifying priorities for osteopathic research and define useful standards for establishing meaningful skills in OMT.

### Advancing the clinical identification and quantification of musculoskeletal pain

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**Aim of Investigation:** Current evidence often indicates poor reliability in identifying tender and trigger points between manual palpation and pressure algometry. Reasons for this poor reliability have not been determined. The purpose of this study was to evaluate the relationship between pressure-pain threshold (PPT) and objective characteristics of manual palpation and algometry used to determine the PPT.

**Methods:** Three physicians palpated the supraspinatus muscles of 3 male and 1 female adults (mean [SD] age 23.8 [1.3] years; mean [SD] body mass index, 21.6 [2.1]) who had at least one painful shoulder. Each examiner identified, in a blinded fashion, up to 3 discrete points for testing on each shoulder. Overlapping points were identified as a single point for testing.

Reflective markers were placed on standardized reference locations on the participant's skin, thumbs of the examiner, and the algometer (Wagner FDIX, Greenwich, CT). Motion of these markers during testing was recorded using an infrared camera motion capturing system (Vicon Peak MCam2, Los Angeles, CA). In a random order, each of the 3 physicians and a 4th examiner using algometry pressed on the points identified for testing through a flexible pressure sensor pad (Novel pliance-X, Munich, Germany) until pain was elicited (PPT). Each point was tested 1–2 times by each examiner. Customized software was used to evaluate the mean rate at which force was applied, angle of the thumb or algometer relative to the skin surface, and location of the thumb or algometer at the end of palpation relative to the starting point. Variability in the ending location of the test between examiners was quantified as the mean distance of the examiners' ending locations from the center of those locations. The standard deviation of the PPTs at a specific point was used to quantify variability in PPT. The mean and standard deviation (variability) of the angle of the thumb or algometer to the skin within each test by each examiner were calculated as objective characteristics of the testing. Pearson correlations were used to test the relationship of variability in the ending location and variability in PPT. General linear mixed models were used to examine how well PPT was predicted by the mean angle relative to the skin, variability in the angle during the test, and mean rate at which the force was applied, as well as the examiner. **Results:** The variability in the ending location was significantly related to variability in PPT ( $r=0.49$ ,  $P=.005$ ). Variability in the angle of the thumb or algometer to the skin was significantly related to PPT ( $b=2.0$ ,  $P=.01$ ). A 1st degree increase in the variability in the angle was associated with a 2.0N increase in PPT. The mean rate at which force was applied was significantly related to PPT ( $b=2.1$ ,  $P=.004$ ). A 1 N/s increase in the force rate was associated with a 2.1N increase in PPT. After accounting for the variability in the angle and the force rate, examiner and mean angle of the thumb or algometer relative to the skin were not significantly related to PPT.

**Conclusion:** Variations in examination technique, specifically the force rate, angle relative to the skin, and location of the thumb or algometer tip at the time the PPT was reached, was related to variability in PPTs when testing is performed from the same discrete point on the skin surface. These findings may be factors underlying the poor reliability in identifying tender points as described in the literature. Further research is needed to determine if this study's findings are reproducible in other muscles of the body with the goal of establishing procedures for algometry and palpation that produce reliable identification of tender points and PPT measurements.

### Characterizing adverse events reported immediately after osteopathic manipulative treatment

Brian F. Degenhardt

Still University, Kirksville, United States of America

**Context:** Although adverse events in manual therapy have been previously investigated, little is known about the incidence and types of adverse events that occur after osteopathic manipulative treatment (OMT).

**Objective:** To estimate the incidence and characterize the types of adverse events that patients report after OMT and prior to leaving the office to increase the likelihood of identifying adverse events caused by OMT.

**Methods:** As part of a prospective study evaluating the use and effectiveness of OMT, patients assessed how they felt immediately after OMT compared with before OMT using a 5-point ordinal rating scale (much better, better, about the same, worse, much worse). For patients who indicated they felt their condition had changed, a follow-up, open-ended question asked them to describe how it had changed. Patients who felt worse or much worse were considered to have experienced an adverse event. Two reviewers independently coded the types of adverse events based on the descriptions provided by the patients. Generalized logistic regression models were used to calculate incidence rates and 95% confidence intervals (CI) for the types of adverse events. These models were also used to calculate the odds ratios (OR) and 95% CIs for associations of adverse events with demographic characteristics and with individual OMT techniques after accounting for demographic characteristics.

**Results:** Immediately after OMT, 884 patients provided data at 1847 office visits (663 [76%] women; 794 [92%] identified as white; mean [SD] age, 51.8 [15.8] years). Patients reported they felt worse or much worse immediately after OMT at 45 office visits; incidence rate for adverse events was 2.5% (95% CI, 1.3%–4.7%). Pain/discomfort was the most commonly identified type of adverse event (16 [0.9%]; 95% CI, 0.5%–1.6%). Insufficient information was provided to determine the type of adverse event at 20 office visits. Women reported adverse events more frequently than men (OR = 13.9, 95% CI = 1.7–115.6;  $P=.01$ ).

**Conclusion:** The incidence of adverse events immediately after OMT, most commonly pain/discomfort, was lower than previous reports from other manual medicine disciplines. Larger studies are needed to determine the incidence of serious adverse events and to assess adverse events that occur in the days following OMT.

### Evaluating muscle activation patterns in women with low back pain syndromes

Brian F. Degenhardt

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**Context:** No studies have compared somatic dysfunction findings to biomechanical characteristics of women with and without low back pain.

**Objective:** To determine if objective measurements of muscle activity differed among women with chronic low back pain (LBP), chronic sacroiliac joint pain (SIJP), or no LBP/SIJP controls and how those findings correlate with somatic dysfunction findings.

**Methods:** Women were classified into LBP, SIJP, and control groups based on medical history and blinded palpatory examination. The examination was objectively quantified using motion and pressure capturing systems. Bilateral muscle activity was measured for the erector spinae, rectus abdominus, gluteus medius, rectus femoris, and biceps femoris with surface electromyography. Each participant performed tandem walk, squat, sit-to-stand, and step-up-and-over tasks on a force plate system. Asymmetry was calculated as the absolute value of the difference between the left and right sides, and magnitude as the average of the left and right sides. The groups were compared on asymmetry and magnitude using Kruskal-Wallis tests followed by Dunn's multiple comparison when appropriate. Palpatory findings were compared between groups using Fisher's exact tests.

**Results:** For the tandem walk, the erector spinae had less magnitude for the SIJP group than the LBP and control groups ( $P=.005$ ). For the squat, the erector spinae had less asymmetry for the LBP group than the SIJP group at 90° knee flexion ( $P=.01$ ), and the biceps femoris had less asymmetry for the LBP group than the SIJP and control groups at 60° ( $P=.04$ ) and 90° ( $P=.05$ ) knee flexion. For the sit-to-stand, the erector spinae had less asymmetry for the LBP and SIJP groups than the control group ( $P=.01$ ). For the step-up-and-over, the erector spinae had less asymmetry for the SIJP group at the initiation of the task on the lead leg side than the LBP and control groups ( $P=.02$ ). At completion of the task, the LBP and SIJP groups had less asymmetry and magnitude on the lead leg side than the control group ( $P=.05$  and  $.02$ , respectively). Iliac crest height, localized tenderness and lumbar translatory springing differentiated between the three groups.

**Conclusion:** Based on these results, muscle activation asymmetry, magnitude and palpatory examination seem to differentiate between these groups. While study trends support previous reports, reproducibility of findings with larger sample size is needed.

### New frontiers in medical robotics

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**Introduction:** Medical robotics includes implantable substitutions of organs (e. g., artificial heart, artificial pancreas), surgical instruments ([https://www.robotics.org/content-detail.cfm/Industrial-Robotics-Industry-Insights/Robots-and-Healthcare-Saving-Lives-Together/content\\_id/5819](https://www.robotics.org/content-detail.cfm/Industrial-Robotics-Industry-Insights/Robots-and-Healthcare-Saving-Lives-Together/content_id/5819)),

radiation treatments (e. g., <http://www.cyberknife.com/>) tools for rehabilitation ([https://www.intechopen.com/books/rehabilitation\\_robotics](https://www.intechopen.com/books/rehabilitation_robotics)), mobility aids (e. g., <http://odalab.spub.chitose.ac.jp/english/research.html>) and many other human assistants for improved evidence-based medicine. This presentation will cover only rehabilitation robotics (<http://www.cy-bathlon.ethz.ch/cyathlon-2020/disciplines.html>).

**Aim:** Robotic assistance allows restoration of motor functions and intensive exercising in persons after amputation, spinal cord injury, cerebrovascular accident, and other central or peripheral nervous system injuries/diseases. The assistance changes the overall quality of life and plays a significant role in the rehabilitation and reintegration into the productive life.

**Materials and methods:** Many robotic aids for rehabilitation hold considerable promise, but they are still at the level of ideas, not innovations that can be found on the market. The complexity of use of robotic systems for daily usage and the cost-benefit ratio which is not high enough, are the main limiting factors. A limitation in the widespread use of robotics is also often the clinician's lack of familiarity with this technology. An example that will be discussed is functional neuromuscular stimulation (FNS) for the restoration of functions in persons with paralysis. A specific novelty that is being recognized as a necessity is hybrid systems. The most challenging aspect that needs to be improved is the integration of the robot and the body, that is the integration of natural control implemented by the user and the artificial control of the robot.

**Results:** Intelligent powered prostheses of hand, arm, leg or some parts of the leg controlled at the subconscious level are now becoming a reality and products are approved for use by the regulatory bodies and covered by insurance companies. Exoskeletons are slowly pushing their entrance into the clinical theatre. Soft robotics is making giant steps in solving the gadget tolerance problem of users and clinicians. Improved interfaces and improved control facilitate the use of FNS.

**Conclusion:** Although the full clinical and home usage of robots is slow and have some false beginnings, the work saving aspect of robotic technology will ultimately ensure its adoption.

### Dry needling as an adjuvant to physical therapy for anterior knee pain in soldiers: a proposal for a randomized controlled trial

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**Background:** Anterior knee pain (AKP) is common among trainees, with a constant 15% among infantry recruits in Israel. Patients with AKP have been shown to have myofascial trigger points (MTrPs) in their quadriceps, a finding that raises the possibility of a myofascial mechanism in AKP.

The purpose of this single blinded randomized controlled trial is to assess if treating MTrPs in the quadriceps with dry needling is beneficial to patients with AKP.

**Methods:** 100 patients aged 18–25 referred for physical therapy to treat AKP (after Cowan) with tender points or in the vastus medialis, vastus lateralis, distal sartorius or rectus femoris suitable for dry needling were randomized (sealed envelopes) with a 1:1 study to control ratio.

**Exclusion criteria:** previous needling or knee surgery, trauma, inflammation and concurrent activity limiting complaints in the ipsilateral limb or back. Treatment will include 6 weekly sessions. During the first 3 sessions, patients in the study group will receive MTrP dry needling while the controls will receive placebo intervention (superficial needling on the anterior thigh 3 cm away from any MTrP). All patients in all sessions will receive standard treatment including quadriceps & gluteus medius strengthening, proprioception and muscle balance training and interferential current to the patella. From week 4, stretches and patellar mobilization will be added. Primary outcomes are numeric pain rating scale (NPRS) of maximum & mean pain over past 72 hours, knee flexion range of motion, patellar and vastus medialis algometer testing and an 8", 30 second step down test (after Loudon). In addition, demographic data, pain manikin, and Kujala AKP questionnaire will be collected. Follow-up will be for 6 months.

**Importance:** If dry needling of quadriceps MTrPs will be found effective in management of AKP, it will be important addition to the arsenal of treatment options of this common condition.

### Where and how are the communities of practice relating to manual/musculoskeletal medicine represented in academic institutions?

Jens Foell

Chairman Education Science IAMMM, London, Great Britain

The origin of "academia" stems from Plato's community of practice. This exclusive community in the suburbs of Athens practised a sceptical dialectic thinking style. It stands for dialogue rather than doctrines.

Currently musculoskeletal medicine is only marginally represented in academia. This has consequences for the status of the knowledge generated and transmitted in the musculoskeletal communities of practice.

The physiotherapists are the musculoskeletal practitioners with most representation in current academic institutions. Epistemic problem of manual medicine (function instead structure, position in different communities of practice) and how this matters for its representation in academic institutions.

I will highlight the well-established connection to musculoskeletal disabilities and the links to other areas of performance optimization (sport, music, drama).

I intend to comment on the fluid set of indications for therapy, ranging from diagnosis to performance optimization and/or health promotion.

Then I will draw a connection to institutions of higher education, their function and financing and its importance for the recognition of a field of knowledge, the link to regulation of research and of course the scientific inquiry into the validity of diagnostic and therapeutic procedures

### What is the future for manual medicine in the age of technology?

Michael Hutson

Nottingham, Great Britain

Upon a background of evidence based medicine (EBM), and a well-established biomedical model, the advance of technology was inevitable in the twenty-first century, driven and strengthened by the perception that technology offers "objectivity" and diagnostic "certainty", thereby diminishing the much-maligned "subjective" contribution to patient assessment and management. It is perceived and promoted that technology provides tangible evidence that medicine is "scientific".

The status of MM/MSK medicine is severely challenged by the unrestricted use of technology. Dependency and abuse are rife. Technology (particularly MRI and USS) threatens to hinder medical practice by over-intensive focus on "abnormalities". Certainty has been manufactured and doubt continues to confound. *However, uncertainty and complexity are always present in manual medicine, and should be embraced.*

It is the doctor or therapist who communicates well, who 'understands', takes trouble to be kind to his or her patient, provides wise counsel, and who will get the best results by honing *haptic evaluative and therapeutic skills*, based on *scientific research*.

### Limitations and problems in pain medication (critics to paracetamol, NSAIDs, gabapentinoids and especially opioids)

Jouki Pekka Kouri

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There are many common beliefs of the efficacy, safety and costs about pain medication. New knowledge and scientific studies are changing our old beliefs and learned opinions about it. The change is happening in science world first, then in Guidelines, then in clinical practice and more slowly among the patients and usual people. On the other hand, social media is working fast and in many cases our patients can know about some new studies before us doctors.

In my talk I like to highlight some new information about common drug treatment in painful conditions, which are from the field of musculoskeletal problems.

1. Common beliefs in our Guidelines
2. Lack of efficacy with paracetamol (in LBP, in acute neck pain, in osteoarthritis)
3. Side-effects and paracetamol
4. Osteoarthritis treatments and placebo effect
5. Is there place for hyaluronate injections?
6. What about NSAIDs?
7. Is there evidence for using topical NSAIDs?
8. Opioids and efficacy in treatment of non-malignant pain
9. Neuropathic pain drugs- when to use?
10. Guidelines and non-medicine treatment possibilities of pain

In current situation we can say that the medical treatment of pain is in some kind of crisis. There are no really important new drugs against pain right now, we find whole time more problems with our old drugs (low efficacy, new side-effects).

In this moment I feel that there is really a need for manual musculoskeletal medicine and teaching of it to new medical doctors instead of only trying to help pain patients with drug treatment.

### **Evaluation of kinematics of the cervical spine and temporomandibular joints in healthy subjects. Do some „clinical norms“ need to be updated?**

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**Introduction:** Purpose of the research it was evaluation of the kinematics of cervical spine and temporomandibular joint in healthy subjects and assess whether the results are consistent with the clinical norms for healthy population.

**Material and methods:** Group of 60 healthy subjects without cervical and temporomandibular pain and dysfunctions, aged 30–60 years. AROM of cervical spine were examined using ZEBRIS 3-D ultrasound measuring device. AROM of TMJ were assessed using linear measurements. The measures obtained were compared to physiological clinical norms of cervical AROM and clinical norms of AROM of TMJ.

**Results:** The results of the study showed that examined group, in active range of motion (AROM) of cervical spine in flexion, extension and rotations significantly exceeded the clinical norms for healthy population. AROM of TMJ in examined group were significantly different in comparison to norms but laterotrusion in both sides had higher range and opening of the mouth had significantly lower range according to norms.

**Conclusions:** The mobility of the cervical spine and TMJ in group of healthy subjects significantly exceed the norms for healthy population so that suggest that they should be revised on bigger sample of examined group and updated.

#### **Keywords**

Cervical spine  
TMJ  
AROM  
Measurements  
Clinical norms

### **Clinical examination of the SI joint. What does the literature tell us?**

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The sacroiliac (SI) joint is considered to be a source of pain in 15–30% of the chronic low back pain (LBP) patients. The clinical diagnosis is based on three points: the distribution of pain; the positivity of sacroiliac maneuvers; the absence of any other possible source of pain. This review focuses on the second point (clinical examination). The diagnostic value of the SI maneu-

vers has been routinely assessed in the literature with an anesthetic block delivered under fluoroscopy. The positivity of this block has been regarded as the gold standard for the diagnosis of sacroiliac pain by many authors. Three issues has been raised: the value of the block, the value of the assessment of SI dysfunction and the number of pain provocation maneuvers required for a positive diagnosis of painful SI joint

#### **Value of the block**

The value of the anesthetic block was questioned for three reasons. First, because there is a possible leakage of the injected liquid out of the joint, toward the trunk of the sciatic nerve, which may be anesthetized (false positive). In our experience, the occurrence of this leakage seems to be rare. Second, because the anesthetic does not reach the SI ligaments, which are, according to some authors, a possible source of pain (false negative). This may be true, but it is of secondary importance provided we accept that patients with pure and isolated ligament pain cannot be diagnosed with a SI joint block, contrary to these with intra-articular pain. Third, because of its placebo effect, evidenced in studies with a double block, where the second block is positive in only 60% of the patients with a positive first block.

#### **Assessment of SI dysfunction**

The SI maneuvers can be divided in two categories: those assessing SI dysfunction, which are osteopathic maneuvers, and those aiming at the reproduction of pain which are orthopedic maneuvers.

The osteopathic maneuvers (Gillet test, standing and sitting flexion tests, joint play ...) are supposed to appreciate the amount of mobility of the SI joint, which is challenging as the usual range of movement of this joint is poor. They have a very low predictive value of a positive block. Their kappa value is poor. They measure something different than the capacity of the joint to generate pain. Obviously more research is needed in this field.

#### **Number of pain provocation maneuvers required**

The orthopedic maneuvers (Thigh trust, Patrick/FABER test, resisted abduction test, hyperextension of the hip, compression/distraction of the iliac wings test ...) perform a little bit better and are more reliable than tests measuring motion for identifying a painful SI joint, with an average kappa value at 0.6. The issue is how many positive maneuvers do we need for a positive diagnosis. The literature suggests that the presence of 3 or more positive provocative tests have reasonable sensitivity and specificity.

### **Non-specific low back pain—an attempt to develop subgroups**

Kay Niemier

Hamburg, Germany

90% of low back pain patients get classified as unspecific. Treatment results in Germany of patients classified of having chronic unspecific low back pain are poor. Only ¼ of patients profit from the treatment provided, while ¾ either get worse or have no benefit.

So far there is no comprehensive diagnostic system to divide patients according to the clinical presentation, clinical and para-clinical findings. Since a sound diagnosis is necessary to provide treatment, the poor treatment results are not surprising. In order to overcome the problem multimodal, interdisciplinary treatment programs were developed. In these programs one subgroup of patients with dysfunctional beliefs and coping strategies are treated successfully. The ANOA group evaluated a treatment program for patients with muscular skeletal dysfunction as the main cause for the chronic unspecific low back pain.

Unspecific low back pain (LBP) is usually caused by a combination of different individual and clinical factors. There are morphological as well as psychosocial factors and muscular skeletal dysfunction. In addition neurophysiological chronification of pain plays a role in the development of LBP. In order to plan the treatment for each individual patient it is necessary to evaluate the different influencing factors.

In this presentation an attempt to classify the patients into subgroups will be discussed.

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### Outcomes of a stationary multimodal complex treatment of the musculoskeletal system. Results of the ANOA study

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**Background Context:** The evidence-based treatment of chronic back pain comes into focus of current research. Treatment modalities of pain patients are discussed diversely. Single standing therapeutic measures are considered less efficient and with less impact than multimodal approaches. A positive scientific evidence exists for cognitive behavioral multimodal complex programs. It is still unclear whether certain subgroups of patients with chronic back pain benefit from other forms of therapy, such as functional multimodal therapy concepts.

**Purpose:** Is a stationary interdisciplinary multimodal nonsurgical complex treatment of the musculoskeletal system (ANOVA concept) effective for a subgroup of patients with complex (multifactorial) vertebral pain syndromes?

**Materials and methods:** In the prospective multicentre cohort study a functional diagnostic and treatment concept with a subgroup of patients was employed.

249 patients (42.6% men, 57.4% women) with vertebral pain syndrome were included.

The outcome measure for this study is the change in pain intensity, were collected with the assessment for pain graduation (von Korff). From this assessment in the present study two items were used: average pain (AP), v. Korff- mean pain intensity (MPI).

As part of the multimodal interdisciplinary diagnostics, patients with chronic back pain on the basis of complex disorders of the musculoskeletal system were selected for the functional multimodal treatment concept. After the treatment, the changes in pain perception were recorded. The data were collected at the following measuring time points (MTP): T1 (before the intervention/baseline), T2 (end of intervention), T3 (6 months after the end of the intervention) and T4 (12 months after the end of the intervention). The statistical analysis was performed independently by the clinics. After testing for normal distribution the t-test for dependent samples or the Wilcoxon test was used. The statistical subgroup analysis based on selected personal parameters (degree of pain chronicity [MPSS], gender, age) was performed with the process "linear mixed models".

**Results:** For both parameters, a significant reduction in the perceived pain intensity was detected over all MTP. With the parameter AP, a reduction by 1.83 points (6.02, T4: T1 4.19) was found, while the AP intensity was reduced by 18.43 points (T1: 65.42, T4: 46.99). Furthermore, with the statistical subgroup analysis we were able to define the efficacy of the treatment concept within the subgroups (chronicity degree (MPSS), gender, age).

**Conclusion:** By the multimodal interdisciplinary diagnostic and treatment concept a subgroup of patients with chronic back pain was selected and treated successfully. A differentiated approach to the diagnostics and treatment of chronic pain syndromes of the musculoskeletal system is a possible approach to find a way out of the dilemma of chronic back pain.

### Sample size in reproducibility studies using kappa statistics: preliminary results of a exploring study

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**Introduction:** Kappa statistics are frequently used in reproducibility studies that evaluate the inter-observer agreement of diagnostic procedures used in musculoskeletal medicine. The IAMMM has developed a standardised protocol for this kind of reproducibility studies in which also the problem of the dependency of the kappa of the prevalence of the index condition was solved. One of the important aspects of studies using kappa statistics is the calculation of the sample size or power calculation. Normally for power calcu-

lations a well-defined hypothesis is mandatory. For reproducibility studies using kappa statistics, such a hypothesis cannot be developed.

**Method:** Based on virtual computer studies that problem was analysed.

**Results:** Preliminary data are presented how to handle sample size in reproducibility studies of a single diagnostic procedure evaluated by two observers using the IAMM protocol.

**Conclusion:** Proposal for a new protocol are presented in which the overall agreement has a more central place besides the kappa value.

### Spinal cord displacement with the straight leg raise test in patients with lumbar intervertebral disc herniation: 1.5-year follow-up

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**Introduction:** Sciatica is described as pain radiating from the buttock down the posterior aspect of the lower extremity with the vast majority (85–90%) of cases being caused by lumbar intervertebral disc herniation (LIDH). In our previous study we found that, with sub-acute single level posterolateral LIDH patients a significant limitation of neural movement (66.6%) was evident during symptomatic-side SLR. In this study, we followed up the same patient group as in our previous study over 1.5 years to ascertain if changes in cord excursion accompany changes in clinical symptoms.

**Methods:** 14 patients, who originally had sciatic symptoms due to sub-acute LIDH, were re-studied with a 1.5 T magnetic resonance (MR) scanner. First we did a new diagnostic MRI to assess the current status of the previously herniated disk. Following this the subjects were scanned using different scanning sequences for planning and measurement purposes. The experimental protocol was identical with our previous studies. Displacement of the conus medullaris during the unilateral and bilateral SLR was quantified reliably with a randomized procedure and compared between maneuvers.

**Results:** At 1.5 years follow-up, the conus medullaris caudal displacement increased extensively by 325.12% (2.53 mm,  $P \leq 0.001$ ) with the symptomatic SLR, 37.7% (0.84 mm,  $P = 0.0058$ ) with asymptomatic SLR, and 48.9% (1.67 mm,  $P \leq 0.001$ ) with the bilateral SLR. At this 1.5 year follow-up, comparison between symptomatic and asymptomatic SLR showed no statistically significant difference ( $P = 0.573$ ). The increase in neural sliding correlated significantly with the decrease and resolution of radicular symptoms in the ipsilateral limb (inverse correlation).

**Conclusion:** In this study we have shown that the limitation of neural movement during SLR correlates with LIDH patients' radicular symptoms that are proven both clinically and radiologically. Furthermore, there was correlation between recovery and improvement in spinal cord movement. To the best of our knowledge this is the first time a clear correlation has been established between a measurable quantity in the MRI and clinical radiculopathy in an in-vivo setting.

### Reduced neural movement with the straight leg raise test in patients with lumbar intervertebral disc herniation

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**Introduction:** Earlier studies have shown that during the Straight Leg Raise (SLR) test in asymptomatic volunteers tensile forces are consistently transmitted throughout the neural system and the spinal cord in the thora-

columbar region slides distally in response to the clinically applied test. We aim to explore whether impairment of neural excursion occurs in patients with sciatic symptoms due to lumbar intervertebral disc herniation (LIDH).

**Methods:** In this controlled radiological study, fifteen voluntary patients with sciatic symptoms due to subacute LIDH were investigated with a 1.5 T magnetic resonance (MR) scanner. First a spine specialist diagnosed the LIDH with conventional scanning sequences. Following this the subjects were scanned with the same 1.5 T MR scanner using different scanning sequences for planning and for measurement purposes as part of the experimental protocol. Planning: T2 weighted turbo spin echo sequence (Sagittal slices were aligned with the spinal cord to allow better identification of the medullar cone). Measurement: T2 weighted spc 3D-sequence. Coronal, axial and sagittal slices (slice thickness 1 mm, approximately 70 slices in each plane) were reconstructed from the native 3D sagittal scans using the MPR program available in Sectra PACS program.

The displacement of the medullar cone relative to the upper intervertebral surface of the adjacent vertebra was compared between manoeuvres. Each movement was performed twice for evaluation of reproducibility. Measurements were performed by two different observers, allowing for evaluation of intra- and inter-observer reliability.

**Results:** The number of subjects required to produce statistically significant results ( $p < .05$ ) was five for both symptomatic SLR, asymptomatic SLR and for bilateral SLR. The conus medullaris displaced caudally with the asymptomatic SLR by  $2.28 \pm 1$  mm (Mean $\pm$ SD;  $p \leq .001$ ) 95% CI (-2.81, -1.75). However, the excursion produced by the symptomatic SLR was only  $0.76 \pm 0.34$  mm ( $p \leq .001$ ) 95% CI (-0.95, -0.58), a reduction of 66.6%. Alternatively, the symptomatic produced only 33.3% of cord excursion produced by the asymptomatic SLR. The bilateral SLR produced  $3.40 \pm 1.65$  mm of cord excursion ( $p \leq .001$ ) 95% CI (-3.63, -2.98).

Pearson correlations proved higher than 0.99 for inter-observer reliability as well as results reproducibility for each tested manoeuvre. Observed power was 1 for each tested manoeuvre.

**Conclusion:** The data collected suggest that in patients with LIDH, the neural displacement on the symptomatic side is significantly reduced by the compressing IVD herniation. With these results, the authors expect that the sliding of neural structures in the vertebral canal may represent a protective mechanism which preserves the spinal cord and neural roots from excessive strain. It seems plausible that physical therapies aiming at restoring normal amount of neural excursion might be employed. To our knowledge, these are the first data to objectively support the limitation of neural movements into the vertebral canal with LIDH in in-vivo and structurally intact human subjects. These findings clarify the mechanism of why the SLR test is considered a useful tool to assess neuromechanical impairment in sciatic patients.

### Vertebral endplate defect as initiating factor for Modic change in the general population

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**Introduction:** The etiology of Modic change (MC) is still unclear. MC is rarely seen in vertebrae adjacent to healthy intervertebral discs, but appears to be associated with disc degeneration (DD), disc herniation and Schmorl's nodes. Precise understanding of the role of endplate defect in the

etiology MC and DD is lacking, especially in the general population. Our aim was to characterise associations between endplate defects and MC.

**Methods:** The study sample in this cross-sectional MRI study consisted of 831 twin volunteers from TwinsUK (mean age 54 [SD = 8] years; 95.8% female). Lumbar T2-weighted MR images were used to grade endplate defects in 8310 endplates on a scale of 1–6. Total endplate score (TEPS) was achieved by summing both endplate defect scores from the same intervertebral disc level. MC had been coded as absent (grade 0) or present (grade 1) previously and, importantly, was independent of the assessment for TEPS. A survival analysis paired with Cox proportional hazards model analysis was used, with subjects subgrouped by age decade. Receiver operating curves (ROC) were calculated to define critical endplate values predictive of MC.

**Results:** MC was present in 267 (32.1%) subjects, with a higher prevalence at lower lumbar levels (3.5% at L1/2-L3/4 vs. 15.9% at L4/5-L5/S1,  $p < 0.001$ ). TEPS was strongly and independently associated with MC at each lumbar level ( $p \leq 0.001$ ). The ROC showed a TEPS cut-off score of 6 after which there was a higher prevalence of MC. Probability of having MC was significantly increased in all TEPS positive ( $\geq 6$ ) age subgroups.

**Discussion:** This large, population based study confirmed that endplate defects are strongly and independently associated with MC at every lumbar level and in all age groups. As we have previously shown MC to be associated with DD and an independent risk factor for low back pain, we postulate the endplate defect is the initiating trigger for MC and DD.

### New methods of neural regeneration in the Austrian cluster

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The AUVA Trauma research center with LBI Trauma (<http://trauma.lbg.ac.at/en>) is the central research center of all 7 trauma and 4 AUVA rehabilitation centres in Austria. It is also core of the Austrian Cluster of Tissue Regeneration (<http://www.tissue-regeneration.at/>) with translational research activities in the musculoskeletal field- bone, cartilage, soft tissue and neuroregeneration.

The neuroregeneration group led by Thomas Hausner studies both the impact on the central nervous system (CNS) and the peripheral nervous system. For the peripheral nervous system, the aim is to improve the regeneration of peripheral nerves as well as the re-innervation to targeted organs such as skeletal muscles. Emphasis is put on development of bio-absorbable synthetic nerve transplants, impact of extracorporeal shockwave therapy on the regeneration of peripheral nerves, improvement of the gliding capabilities of nerves in tissue, improvement of micro-surgical suturing techniques (end-to-side technique to connect severed nerve stumps to already existing nerves) and improvement of end results of brain function after nerve reconstruction by using a training device to produce multimodal virtual sensibility. All these research findings are aimed at being translated into the clinical application to contribute to improving the care of trauma patients. This is already the case for end-to-side coaptation of nerves, the use of virtual sensibility and the improvement of the gliding capabilities of nerve tissue.

In the area of the CNS, reducing secondary damages of spinal cord injuries is essential. The research focus is therefore put on new therapeutic aspects (eg., shockwave—experimental and clinical studies) and specific imaging techniques.

### MRI-rates during the last decade in five Danish regions. When do we need MRI in back pain patients?

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In 2010 the Region of Southern Denmark introduced two new referral options for GPs: a direct referral to lumbar MRI and opening of a Spine

Centre gathering all local spine departments in the region. Thereafter the rates changed significantly (Morten Sall Jensen).

Only a few studies support use of MRI among patients not eligible for surgery. Recent studies suggest that pathology may be a more important contributor to LBP than suggested when focus is multiple findings at MRI in contrast to single findings (Tue Secher Jensen).

MRI data from a general population suggest that multiple and severe lumbar MRI findings of advanced disc degeneration and vertebral endplate signal changes in the lower lumbar spine have a stronger cross-sectional association with pain than milder stages of degeneration (Rikke Krüger Jensen). Including multiple changes into latent class analysis identify five distinct subgroups of MRI findings in the spine and SIJs were identified, and the demographic and clinical differences between these subgroups may contribute to an etiological understanding of these MRI findings and their role in the clinical presentation of back pain (Bodil Arnbak).

International and national guidelines recommend restricted use of MRI (NICE).

What do patients expect? (Lisbeth Petersen)

### National clinical guidelines for non-surgical treatment of patients with recent onset low back and neck pain with or without radicular pain.

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**Purpose:** To summarise recommendations about 41 non-surgical interventions for recent onset (<12 weeks) non-specific low back pain (LBP) and lumbar radiculopathy (LR), non-specific neck pain (NP) and cervical radiculopathy (CR) based on four guidelines from the Danish Health Authority. **Methods:** Four multidisciplinary working groups formulated recommendations based on the GRADE approach.

**Results:** Management of low back and neck pain with and without radicular pain should include information about prognosis, warning signs, and advise to remain active. If treatment is needed, the guidelines suggest using patient education, different types of supervised exercise, and manual therapy. The guidelines recommend against acupuncture, routine use of imaging, paracetamol, NSAIDs, and opioids only after careful consideration.

**Conclusion:** Recommendations are based on low to moderate quality evidence or on consensus, but are well aligned with recommendations from international guidelines. The Danish guideline working groups recommend that research efforts in relation to all aspects of management of LBP and LR be intensified.

### Predictors of a positive outcome of MSK treatment in patients with low back pain

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Between January 2014 and March 2016 a large, web-based, observational cohort study was conducted collecting both baseline and follow-up data about patients who presented for a first consultation in Musculoskeletal Medicine (MSK) practice. The treating physician registered baseline data about age, gender, the type and duration of the main complaint, and the existence of concomitant complaints. At the end of treatment, it was registered what type of treatment had been administered, what number of treatment sessions had been used, and whether the patient had completed the scheduled treatment.

Patients were invited by email to answer baseline questions about the type and the effect of previous treatments, together with PROMs measuring the severity of the main complaint and functional limitations. Thereafter, patients were invited six times during a follow-up period of 1 year to answer the same PROMs measuring the severity of the main complaint and functional limitations, together with a transitional ques-

tion about the global perceived effect. PROMs were tailored to the main complaint.

At 3 months follow-up a questionnaire was added to register adverse events as perceived by the patient.

A total of 5155 patients were registered, of whom 4027 were recruited to participate in the study. Of these 4027 patients 3527 answered to the baseline questionnaire. During further follow-up the number of participating patients gradually declined to 1131 at 6 months. Patients who wanted to discontinue their participation could indicate this in the invitation email. These patients were presented with a small questionnaire in which they could indicate the reason to discontinue their participation, enabling the identification of possible selective loss to follow-up. Prediction models will be constructed in order to identify groups of patients that might or might not benefit from MSK treatment, and to identify patients that are more likely to experience adverse effects.

The data are presently analyzed, and some preliminary results will be presented at the conference.

### Oral-health related quality of life in patients in early and long-term period following injury of lower face (LF)

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**Introduction:** Craniofacial trauma associated with bone fractures leads to serious morphological, functional and esthetic complications which may negatively affect physical and mental condition of the patient throughout the recovery period.

**Purpose:** Evaluation of oral-health related quality of life in patients during early and long-term period following injury of lower face. Assessment of effects of age and sex in the examined parameters.

**Material and method:** The study group included 42 patients with injury of the lower face. Patients' well-being and the most common functional problems following treatment were assessed using Oral Health Impact Profile-14 (OHIP-14). Statistical analyses were performed using Mann-Whitney U test, and Spearman's rank correlation coefficient, with significance level assumed at  $p < 0.05$ .

**Results:** The findings show statistically improved well-being and a decrease in the most common complaints 8 months after the surgery. The favourable change was reported by 39 subjects, constituting for 92.9% of the study group.

**Conclusions:** 1) The most frequent complaints included pain in the area of mouth, problems with consumption of food and dissatisfaction due to the necessary change of diet. 2) The period of 8 months following the surgery was sufficiently long for the patients to achieve significant improvement in the quality of life. 3) The factors of age and sex did not significantly affect improvement in well-being after surgery.

#### Keywords

Quality of life  
Trauma  
Lower face

## Depression is associated with long-term outcome of lumbar spinal stenosis surgery: a 10-year follow-up study

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**Background Context:** Depression has been shown to be associated with greater postoperative disability in Lumbar Spinal Stenosis (LSS) patients. No previous studies have reported the association in a 10-year follow-up.

**Purpose:** To evaluate the association between the preoperative and postoperative depressive symptoms and the surgical outcome among LSS-patients in the 10-year follow-up period. In addition, we studied the effect of depressive burden on the surgical outcome.

**Materials and methods:** This is a prospective observational follow-up study. Patient Sample: 102 LSS patients underwent decompressive surgery and 72 of the original participants were included in the 10-year follow-up study. Outcome measures: Self-Reported Measures: Oswestry Disability Index (ODI) and Visual Analogue Scale (VAS).

**Methods:** Data collection was performed with the questionnaire, which was administered seven times during the study period. Beck Depressive Inventory (BDI) estimated depressive symptoms. Depressive burden was calculated by summing the preoperative and every follow-up BDI scores. Statistical analysis included cross-sectional group comparisons and linear mixed models.

**Results:** A high depressive burden group had a poorer outcome of pain, disability and walking distance at the 10-year follow-up. In linear mixed models, higher preoperative BDI had an association with higher disability. Furthermore, higher postoperative BDI scores and depressive burden were associated with higher disability and pain in the 10-year follow-up.

**Conclusions:** LSS patients with even slightly elevated depressive symptoms have an increased risk to postoperative pain and disability in the 10-year follow-up. In order to improve the surgical outcome among these patients, screening depression at the preoperative phase and during the rehabilitation following surgery are important.

### Keywords

Depression  
Subthreshold depression  
Lumbar spinal stenosis  
Surgery  
Long-term  
Disability  
Pain

## The FAIR test in the piriformis syndrome

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**Introduction:** The piriformis syndrome is quite often used diagnosis in the low back pain pathology. The diagnosis and clinical criteria are under great criticism and the diagnosis seems to be misused due to the lack of diagnostic criteria. The FAIR test is regularly mentioned in the Piriformis syndrome diagnosis. In our retrospective study we evaluated MRI imaging of 25 patients with complete personal history and objective findings of piriformis syndrome and highly positive FAIR test.

**AIM:** To verify the clinical test specificity in Piriformis syndrome diagnosis.

**Materials and methods:** 25 patients with complete personal history and clinical findings of piriformis syndrome, in period from 2007 to 2017 fulfil all inclusive and exclusive criteria with positive FAIR test were examined by MRI—specific projection to the foramen obturatorius magnus region and pelvis as a whole.

**Results:** From the group of 25 patients 15 of them were diagnosed as piriformis syndrome. In 11 of them compression of ischial nerve under the muscle was found and in 4 cases the nerve was compressed in the piriformis muscle. No pathology was found in 4 cases. In 6 cases another pathology was diagnosed (ovarian cyst, schwannoma, myositis ossificans, lymphadenopathy in pelvis etc.).

**Conclusions:** During 10 years, a group of 25 patients suffering from sciatica in S1 region, without any pathology of the segment L5/S1 or another radiculopathy of radix S1, no positive finding of S1 joint pathology, no laboratory findings of infectious diseases or hip joint pathology were examined by specific projection of MRI. In all these patients the FAIR test was found to be positive—stretching of piriformis muscle caused the pain and/or paresthesia in S1 dermatomes. MRI examination was target to the region, where the ischial nerve crosses the piriformis muscle in the obturatorius magnus foramen. The FAIR test reveals in our group of patients in 60% an undoubted compression of the ischial nerve by the piriformis muscle. In 71% positivity of the test correlates with pathology in the pelvis region. This test seems to be useful in everyday practice but gives no assurance of the real source of irritation.

## Subcutaneous injection of adalimumab trial compared with control (sciatic): a randomized controlled trial of adalimumab injection compared with placebo for patients receiving physiotherapy treatment for sciatica

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**Background:** Biological treatments such as adalimumab are antibodies targeting Tumour Necrosis Factor alpha (TNF-alpha), released from ruptured intervertebral discs, which might be useful in sciatica. Recent systematic reviews have concluded that they might be effective, but that a definitive randomised controlled trial was needed. Usual care in the National Health Service (NHS) typically includes a physiotherapy intervention.

**Objectives:** To test whether injections of adalimumab plus physiotherapy were more effective and cost-effective than injections of saline plus physiotherapy, for patients with sciatica.

**Methods:** Pragmatic, parallel group, randomised controlled trial with blinded participants, clinicians, outcome assessment and statistical analysis with concurrent economic evaluation and internal pilot.

Participants were referred from primary care and musculoskeletal services to out-patient physiotherapy clinics. They were adults with persistent symptoms of sciatica of 1–6 months duration, with moderate to high level of disability. Eligibility was assessed by research physiotherapists according to clinical criteria for diagnosing sciatica.

After a second eligibility check trial participants were randomised to receive two doses of adalimumab (80 mg then 40 mg 2 weeks later) or saline injections. Both groups were referred for a course of physiotherapy. Outcomes were measured at baseline, 6 weeks, and 6 months follow-up. The main outcome measure was the Oswestry Disability Index (ODI). Other outcomes: leg pain version of ODI, Roland-Morris Disability Questionnaire, Sciatica Bothersomeness Index, EuroQol EQ-5D-5 L, Hospital Anxiety and Depression Scale, resource use, risk of persistent disabling pain, Pain trajectory based on a single question, Pain Self-Efficacy Questionnaire, Tampa Scale of Kinesophobia, and adverse effects. In order to detect an effect size of 0.4 with 90% power, 5% significance level for a two-tailed t-test, and 80% retention rate, 332 would have needed to be recruited. The primary effectiveness analysis would have been linear mixed models for repeated measures to measure the effects of time and group allocation. An internal pilot study would have involved the first 50 participants recruited across all centres. The primary economic analysis would have been a cost utility analysis.

**Results:** The internal pilot study was discontinued due to low recruitment after eight participants were recruited from two out of six sites. One site withdrew from the study before recruitment started, one site did not complete contract negotiations and two sites signed contracts shortly before trial closure. In the two sites that did recruit participants, recruitment was slow. This was partly due to operational issues, but also a low rate of uptake from potential participants. Although large numbers of invitations were sent to potential participants, identified by retrospective searches of General Practitioner (GP) records, there was a low rate of uptake. Two sites planned to recruit participants during GP consultations but opened too late to recruit any participants.

**Conclusion:** The main failure was due to problems with contracts. Because of this we were not able to complete the internal pilot or to test all of the different methods for primary care recruitment that we had planned. A trial of biological therapy in patients with sciatica still needs to be done, but would require a clearer contracting process, qualitative research to ensure that patients would be willing to participate and simpler recruitment methods.

**Trial registration:** ISRCTN 14569274

### The assessment of relation of movability of the cervical spine after the odontoid vertebra dens fracture since the time of wearing the Philadelphia collar, the strength level of pain, and age.

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**Introduction:** The aim of the research to evaluate kinetic efficiency of a cervical spine taking into consideration the range of active motion as well as to assess the relation of movability range of the cervical spine since the day of wearing the Philadelphia collar, as well as the level of the strength of pain, and age, whether the results are consistent with the norms for healthy individuals.

**Material and method:** 82 individuals surgically or conservatively treated at the Neurosurgery Ward and subjected to a post-hospital observation at the Neurosurgery Outpatient Clinic of Provincial Hospital in Tarnow participated in the study. The control group consisted of 82 individuals without a clinically diagnosed cervical spine disease. The study of the range of motion of the spine in the cervical section was performed by means of MCU (Multi Cervical Unit) appliance. The measure of the mobility range referred to the following exercises: bending, extension, side bending, and rotation. The measures obtained were compared with physiological standards according to Standard Orthopedic Measurements (ISOM) and to the results of the control group. The strength of the pain was evaluated by means of VAS—the visual analogue pain scale.

**Results:** The individuals after the odontoid vertebra fracture are characterized by a limited motion range in case of all types of motion, except for bending and extension. In the study extremely significant differences of the range of motion of the study group in comparison with the control group were discovered. It was shown that the range of motion of the spine is correlated negatively with age. In case of the time of wearing the Philadelphia collar, statistically significant negative correlations related to entire motion apart from side bending. The strongest correlation was obtained for rotation ( $r = -0,36$ ). The pain level significantly influenced the range of movability in the cervical section of the spine as well.

**Conclusions:** The patients after the odontoid vertebra fractures have statistically significant limitations of the range of active motion of the cervical spine. Age, strength of the spine ache as well as the time of wearing the Philadelphia collar are negatively correlated in a significant manner with the movability range of the cervical section of the spine of individuals after the odontoid vertebra fracture.

#### Keywords

Range of motion  
ROM

Odontoid fracture

Cervical spine

### The benefits of kinesiotherapy of impingement syndrome under the control of sonofeedback

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**Introduction:** Physiotherapists are continually looking for new therapeutic methods that will increase their effectiveness. Patients who exercise at home often make mistakes that can significantly reduce the effects of the therapy. An interesting option is the ability to use ultrasound in physiotherapy as a biofeedback tool.

**Aim:** The objective of the study was to assess the effectiveness of kinesiotherapy of the impingement syndrome of the shoulder conducted under sonofeedback control.

**Material and methods:** The study included 40 men and 40 women (aged 35–55) diagnosed with shoulder impingement syndrome. Subjects were randomly assigned to one of two treatment groups. Both groups performed nine sessions of therapeutic exercise within 3 weeks. The control group carried out therapeutic, flexibility and strengthening exercises ordered by the physiotherapist. The experimental group performed supervised flexibility and strengthening exercises carried out under the control of sonofeedback. VAS pain scale and McGill pain questionnaire were used. The therapists measured strength, pain, and the function of the shoulder before treatment and just after completion. Additional study was conducted 4 weeks after the end of therapeutic sessions. Function was measured with a functional assessment questionnaire.

**Results:** Subjects in both groups experienced significant decreases in pain and increases in function, however there was significant differences between both groups. The sonofeedback controlled exercises were significantly more effective than home-based exercises ordered by physiotherapist.

Both groups showed significant increased mobility and reduced pain after the nine meetings. Pre-treatment pain was mainly at 7 ( $n = 58$ ) and 8 ( $n = 22$ ). At the end of therapy, the experimental group most often referred to pain level 2 while in control group level 4.

**Conclusions:** Exercises combined with sonofeedback control are more effective than ordered by physiotherapist home-based exercises in patients with shoulder impingement syndrome.

#### Keywords

Kinesiotherapy  
Sonofeedback  
Shoulder  
Impingement syndrome  
Physiotherapy  
Exercises