Ludwig Boltzmann Cluster Arthritis and Rehabilitation
Ludwig Boltzmann Department of Rehabilitation of internal diseases
Head: Univ.-Doz. Dr. W. Kullich
Special rehabilitation center of the PVA, Thorerstraße 26, A-5760 Saalfelden
Phone 06582/74936 or 790-71187, Fax: 06582/790-71290, eMail: lbirehab@aon.at

Scientific evaluation of the MBST Magnetic Resonance Technology regarding the therapeutic potential and proof of clinical efficacy

The aim of the Clinical Evaluation Report (CER) is to demonstrate the therapeutic efficacy and safety of the MBST® Magnetic Resonance technology.

Univ.-Doz. Dr. Werner Kullich
Head of the Department of Rehabilitation
of the Ludwig Boltzmann Cluster Arthritis and Rehabilitation
Thorerstraße 26, 5760 Saalfelden, Austria
eMail: lbirehab@aon.at

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Univ.-Doz. Dr. W. Kullich

Table of contents

Evaluation of magnetic resonance technology

Summary:
Review and evaluation of the Magnetic Resonance Therapy (MBST®) was performed on the basis of documents provided by MedTec Medizintechnik GmbH, Wetzlar, in the form of numerous carried out and published studies in vivo and in vitro, publications in peer-review journals, scientific poster presentations and lectures at international conferences as well as evaluations in the field of human and veterinary medicine.

Preclinical experiments, clinical investigations and studies according to international standards were carried out on both cell cultures and animals. Numerous working groups have been able to show that there is no doubt that the special irradiation in the application of MBST triggers biological effects, such as an active influence on the cell metabolism, which cannot be explained by placebo effects.

A potentially damaging effect was also tested on cell cultures but could not be observed on the basis of the study results.

Therapeutically and clinically relevant efficacy of MBST could be reliably demonstrated in patients with the following indications:

- degenerative changes of the musculoskeletal system such as osteoarthritis and osteoporosis
- growth, metabolic and circulatory disorders in the osseous structures
- degenerative and painful affections of the spine (such as low back pain)
- damages to muscles, tendons and ligaments
- acute and chronic effects of sports and accidental injuries
- triggering of verifiable regeneration processes in organs

To this day, no pain and harmful side effects have become known. Seldomly during the course of the therapy there is a temporary slight increase in pain, which can be regarded as a positive therapeutic reaction, or other reactions in the form of a pleasant feeling of warmth or a tingling.

At the symptomatic level, reports about pain reduction are very consistent. This can be explained against the background of recent scientific findings from basic research/electrophysiology that magnetic resonance influences voltage-dependent Ca ion channels, changes concentrations of intracellular Ca^{2+} and alters / regulates protein kinases activated by pain-maintaining mitogens. A direct relationship between ion channels and intracellular Ca in the transfer and processing of pain could be proven.

Overall, it can be said that based on the current available data, evidence of a therapeutic efficacy of the MBST therapy has been provided in the scientific and medical sense.

Introduction

Living organisms are a highly complex biological system that follows cybernetic laws. The healthy or normal state in this biological system is determined by the balance of the ongoing processes of regeneration and degeneration. Disease is generally referred to changes or disturbances within this system that do not correspond to the norm. Disturbances of this equilibrium can not only be detected at different levels using scientific methods, such as biophysical and biochemical methods, but can also be corrected in many cases. This applies equally to the whole-body and organ levels as well as to the cellular and molecular levels. The basis for this, however, is an exact and comprehensive understanding of the molecular, chemical-cellular and physical processes including their interdependencies. Generally speaking, when correcting the disorder, a distinction is made between causal and symptomatic therapy. The number of available causal therapies is still very limited, as most disease processes could not yet be explained sufficiently. Therefore, in most cases symptomatic therapies must be used. Usually, these are based on medical experience and still represent the overwhelming part of medical practice. Unfortunately, in the foreground are still medical doctrines, which have to be modified by new study results.

- One of these outdated opinions is that cartilage tissue and cartilage cells could not or hardly be regenerated, even though evidence of the contrary has been given over 20 years ago.
- Another unsustainable and incorrect assertion, which is still often discussed, is that magnetic resonance can only be generated with extremely large magnetic fields (over 0.5 Tesla). Scientific tests and expert evaluations have shown that magnetic resonance can be generated even with a magnetic field of the size of the static magnetic field of the earth.

This is important in that the desired „evidence-based medicine“ approach is not even possible for all established treatment strategies. The experience of the individual physician is therefore still a decisive factor in his therapeutic approach. This still derives mainly from interventions in chemical processes and much less from modulations through physical processes. This has historical reasons, as plant extracts, whose medical function comes from their chemical ingredients, have been used successfully for thousands of years. The application of physical principles could naturally only be attempted after recognition of the natural scientific connections at the molecular and cellular level. It was only after the discovery of the electrical processes in the living body that research was able to investigate their significance and propose corrective measures for the treatment of disorders. Exactly this therapeutic alternative of biophysical findings regarding electrical processes is the subject of the here discussed therapeutic treatment procedure with its now extensively confirmed causal and side-effect-free efficacy.

- Another reason is the lobby of the pharmaceutical industry, which is trying to dominate the health care market with always new expensive drugs and promises. Under these conditions, it is very difficult to take hold in the healthcare market with new, innovative therapies that are effective, causal and inexpensive for the social system in the long term.

Physical Therapy

The aim of the therapeutic application of physical methods is, as already described, to restore the impaired balance on a cellular and molecular level. An enormous advantage is the fact that the therapeutic application of physical methods is not invasive. An application can basically be achieved in two different ways.

- Firstly, the body is directly supplied with electrical energy, for example by means of tens devices. It is surprising for laypeople that enormous changes in brain activity can be achieved with the help of electrodes resp. the application of very small amounts of energy to the peripheral nerve. So it‘s not always possible to follow the motto: more helps more (example: electroshocks in the treatment of depression).
- Secondly, the body is indirectly supplied with energy by using the principle of magnetism. Here too, there are application examples where a large amount is transmitted by induction, such as in the case of transcranial magnetic stimulation (TMS) for the treatment of depression (also known as „soft electroshock“).

The fact that even small amounts of energy have an influence on electrochemical processes in the body is now undisputed and has been proven by numerous scientific tests and studies about the efficacy of magnetic resonance applications.

In the past, the problem with regard to the therapeutic application of smaller amounts of energy was partly due to the fact that the existing knowledge of biophysical processes at the molecular level, which are to be influenced, was still insufficient.

It was therefore impossible to avoid that in therapeutic application a great deal of experiments were initially carried out using simple pulsating magnetic fields (PEMF technology) (especially field strengths, signal patterns and different frequencies) without there being a scientifically justifiable basis for the use of these application parameters. Therefore, it is not surprising that in the past, therapy successes and a general acceptance of „magnetic field therapy“, as documented in Prof. Krone‘s report, could not have been achieved, although minimal effects of special frequencies and the transport of energy via ions, which are known to exist in living organisms as charge carriers only in very small numbers, could not be ruled out.

A further disadvantage is that the dissipation factor of this PEMF technology is extremely high and only very small amounts of the available energy can be transferred into the ions of the biological body.

This changed fundamentally with the introduction of the imaging method based on magnetic resonance imaging (MRI).

Application observations in diagnostic magnetic resonance imaging (magnetic resonance tomography (MRI) now led directly to therapeutic application in the form of highly effective magnetic resonance therapy systems (MBST® Magnetic Resonance Therapy or MBST® therapeutic magnetic resonance).

Both, magnetic resonance imaging and magnetic resonance therapy, work with the same technology, the physical phenomenon of nuclear magnetic resonance of hydrogen protons and the different relaxation times of different tissue types.

The transfer of energy and the resulting therapy effect or treatment effect is achieved by the protons of the hydrogen atoms of the human or animal tissue, which are present in large numbers due to the very high content of water of the human and animal body.

This was confirmed in an evaluation of the University of Würzburg, Germany.

Title of the evaluation „Wissenschaftliche Bestätigung der Wirkhebel der Kernspinresonanztherapie“ [Scientific confirmation of the therapy lever of nuclear magnetic resonance therapy]

Prof. Dr. P. Jakob, Institute of Physics at the University of Würzburg, Chair of Experimental Physics 5, Germany May 2005.

Therefore, it cannot be compared or equated with conventional magnetic field therapies. The use of a special frequency, the larmor frequency, which is used for resonant excitation of the protons of the hydrogen atoms for therapeutic purposes, is absolutely new and unique and patented worldwide with numerous patents.

Here, the radio frequency and modulated special low frequencies are radiated via a technically complex control unit and a connected highly complex air coil system with a static basic magnetic field, thus causing the loss-free resonant energy transfer via the stimulated protons.

Technical Background

In the use of magnetic fields for therapeutic purposes, a basic distinction must be made between:

a) static magnetic fields
b) dynamic, pulsating magnetic fields
c) nuclear magnetic resonance spin effects based on the larmor frequency of protons

Since the effects of these three types of application on living biological cell systems are very different, it is important to warn against confusion - as is often the case in the lay press - and to point out the fundamental differences.

Ad a) The importance of static magnetic fields in nature is well described in the literature and is not subject of the assessment of clinical efficacy. To what extent these findings can be used for therapeutic purposes is still open.
Ad b) The importance of pulsating magnetic fields is discussed in literature in two ways. On the one hand, there is a well-founded suspicion that, in the context of radio broadcasting, people are exposed to unsolicited magnetic fields, the effects of which cannot yet be finally estimated. For example, a double-blind, placebo-controlled, randomized clinical trial shows a significant effect on electrical brain activity in humans (Reiser et al., 1995).
On the other hand, pulsating magnetic fields were investigated in a large number of studies with regard to their effects on living matter in order to use them therapeutically. Here, too, the literature reports individual successful experiments that mainly produced effects on a cellular basis, but which cannot be generalized due to heterogeneous test designs using a wide variety of frequencies in the most diverse indications.

A comparison with the new MBST method evaluated in this report is not possible.

Ad c) However, the application of the principle of nuclear magnetic resonance based on the well-known magnetic resonance imaging using static and dynamic magnetic fields for therapeutic purposes is - scientifically speaking - still relatively new.

This may be partly due to the fact that this technology was developed just a few years ago. These are the therapy devices offered under the name MBST-Technology, the availability of which is unfortunately but understandably due to its young age still limited.
With regard to the principle underlying this technology of triggering a special nuclear magnetic resonance of protons and its implementation in the therapy device offered, I refer again to the expert opinion of Prof. Dr. Jacob, University of Würzburg.

His evaluation clearly shows that these therapy devices contain the specified properties with regard to the triggering of the special magnetic resonance (Jacob, 2005) and thus differ from a purely technical point of view in the most significant way from conventional therapy devices which are based on only one of the other two forms of application of magnetic fields (static or pulsating).

The technological invention concerns a device for nuclear magnetic resonance therapy by means of which magnetic resonance can be achieved in the tissue to be treated by sweeping a magnetic field, which extends as homogeneously as possible through a treatment volume, and simultaneously irradiating an alternating magnetic field perpendicular to it, at least while the swept field falls.

The field strength of the swept field is between 0.3 and 3 mT. This is accompanied by a frequency of the alternating field of 10 to 100 kHz. The maximum field strength of the alternating field is preferably between 0.1 and 3 mT. The coils are preferably mainly in Helmholtz configuration and thus generate an essentially homogeneous field that runs across the couch.

In addition, the MBST system uses Adiabatic Fast Passage (AFP), which compensates for the inhomogeneity of the required static basic magnetic field B0.

The technology has all the characteristics of uniqueness. Scientific studies on the therapeutic efficacy of nuclear magnetic resonance therapy, both in vivo and in vitro, are available in large numbers and are presented below.

Therapeutic magnetic resonance (MBST)

The physical effect of nuclear magnetic resonance is also used in the MRI diagnostic procedure. This is based on a highly developed technique, also known as magnetic resonance imaging (MRI). In contrast to the ion function transfer principle of magnetic field therapy, nuclear magnetic resonance technology is used to transfer energy into the organism at the very effective proton level of the hydrogen atoms. The basic conditions for nuclear magnetic resonance are a homogeneous static basic magnetic field, the sweep field and an additional coupled radio frequency field. This signal (reflection or echo) is then used to create the image. In this way, the entire body can be penetrated without contact and without side effects. However, in a conventional MRI device to process the signal in order to display an image very large amounts of energy are required in order to obtain the necessary magnetic field of 0.3 to 4 Tesla.

Since the human body consists of 70% to 80% water, in this way energy can be optimally transferred into the body in resonance, i. e. almost without losses, and can be directed to the target location of the damaged tissue in a further resonance. The physical effect of nuclear magnetic resonance makes it possible to stimulate proton spins in living tissue in order to to use them for energy transport (intermediate energy storage via the protons of the hydrogen atomic nuclei) so that they in turn emit a measurable signal.

The energy transmitted by the resonance system (B0 and RF field) by means of the protons of the hydrogen atoms into the tissue is precisely controlled by the cell resonance effect into the still living, damaged cells of the tissue and here stimulates regeneration. The cell group (skin, cartilage, bone, organ, etc.) is defined by the program of the treatment chip card.

Devices for therapeutic magnetic resonance

For the application of therapeutic nuclear magnetic resonance therapy, special medical technological devices have been developed that are capable of producing low-energy therapeutic nuclear magnetic resonance effects. Depending on the area of application, ring-shaped or open applicators and flat applicators are used for energy transfer.

Developmental stages:

1st generation of therapeutic nuclear magnetic resonance, ClosedSystem series

- Ring systems with permanent magnets
- Magnetic resonance field volume of approx. 1 litre for type CS300,10 litres for CS600

2nd generation of therapeutic nuclear magnetic resonance, OpenSystem series

- Electrical generation of the static basic field B0
- The Adiabatic Fast Passage (AFP)
- The transition from the ClosedSystem generation of devices (ring systems with permanent magnets) to the OpenSystem (open applicators) was only possible with the invention of the Adiabatic Fast Passage. This greatly homogenizes the static basic magnetic field.
- The volume of the nuclear magnetic resonance spin field has been increased by a factor of 10, i. e. 30 litres field volume for type OS 350 and 150 litres for type OS 700.
- The success rate of the treatment is hereby considerably increased (due to minimization resp. prevention of errors in patient positioning).

3rd Generation of therapeutic magnetic resonance

- Completely renewed therapy systems with extended list of treatment zones!
- Basis of 4 new patents
- The Adiabatic Fast Passage (AFP)
- Electronic testing and monitoring functions of quality, size and effectiveness of the magnetic resonance nuclear spin field
- therapy pauses are possible
- Improved compensation of metal parts in the treatment room
- Optimized and enlarged nuclear magnetic resonance treatment field with extended treatment zones and a significantly higher therapeutic success rate
- All treatment options can be carried out easily and comfortably

The size of the magnetic resonance field is in the range of 0.4 mT, which is a fraction of the field of a magnetic resonance tomograph used in MRI.

In order to prevent errors in the operation, the treatment process has been automatized, starting is carried out easily and error-free by means of a special start button.

Prior to the start of treatment, tissue-specific treatment data depending on the indication is automatically read into the control unit via a smart card reader unit. For each indication a fitting, study-based, tissue-specifically programmed treatment chip card is required. The treatment takes one hour and is applicated daily. During this time, different tissue-specific program sequences are processed.

Depending on the indication, a series of treatments lasts between 7 to 10 hours. The devices can be used for a wide variety of clinical indications.

Usage and control

- As described above, the technology was directly adopted from magnetic resonance imaging (MRI imaging) and the use for therapeutic purposes is protected by several patents in numerous countries.
- In contrast to magnetic resonance imaging with energy fields of 0.3 to 4T, which are known to be free of side-effects, MBST® magnetic resonance technology requires only 0.4mT.
- The products of nuclear magnetic resonance technology are easy and safe to use and are used for the treatment of diseases of the musculoskeletal system in human and veterinary medicine.
- The therapy is practically free of side-effects and harmless for the medical professional and the patients treated. Numerous studies in cell laboratories have shown no negative changes in the organism.
- The therapy is only carried out by specially trained medical professionals (doctors and medical assistants, therapists) and is only used after prior medical diagnosis.
- For the medical professional (medical specialist) there is an extensive list of indications and a safety-related list of contraindications.
- Even if this list of contraindications is not observed, or if it is not used properly by the medical professional, no hazards or dangers develop in the therapeutic application of the technology.
- Quality control: Regardless of the studies carried out, the success of the therapy is recorded by the medical professional voluntarily over 5 different assessment periods (before and directly after the therapy and after 3, 6 and 12 months). The filled-in internationally recognized score sheets are checked for completeness, evaluated and archived by MedTec.

Treatment standards and application

The duration of treatment for the MBST® nuclear magnetic resonance method is based on studies:

- For diseases of the musculoskeletal system or joints (osteoarthritis, sports and accidental injuries, injuries to tendons and muscles, etc.), a total of 7-9 (usually 7) treatment hours.
  Duration of treatment: 1 hour per day on 7 consecutive days (interrupted by the weekend)
- In the event of pathological changes of the osseous structures and to increase bone development (circulatory or metabolic disorders), fracture, loosening of implants, ligament injuries etc. a total of 9 treatment hours)
  Duration of treatment: 1 hour per day on 9 consecutive days (interrupted by the weekend)
- For the treatment of osteoporosis in the whole body a total of 10 treatment hours.
  Duration of treatment: 1 hour per day on 10 consecutive days (interrupted by one max. two weekends)

An additional radiologist‘s report may be required for the initial examination as well as for diagnosis by the treating and diagnosing specialist.

Other necessary aids for diagnosis: anamnesis, MRI, CT, ultrasound or X-ray resp. DXA measurement values

Presence of the medical professional

- Evaluation and monitoring measures in every hour of treatment to be carried out.
- Monitoring of correct positioning of the patient.
- Monitoring and observance of therapy-related contraindications (possibly bacterial infections in the treatment area, electronic implants, tumors, etc.).
- Start of the treatment device via the treatment software chip card.
- Controlling proper functioning and running of the nuclear magnetic resonance spin field (field structure) of the treatment system.
- Control of the nuclear magnetic resonance spin indicator.
- Evaluation of the degree of disease by the specialist physician using MRI, CT or X-ray images, the radiologist's medical diagnosis report or the measured values of the DXA procedure.
- Detailed medical consultation and information about the disease and the possibilities of the mode of operation of the nuclear magnetic resonance method as well as indications and contraindications.
- Determination and definition of the tissue-specific treatment software chip card (number of treatment hours and type of treatment software chip card).
- Planning and coordination of the treatment to be carried out.
- Carrying out and monitoring the proper course of treatment.
- Explanation, control and evaluation of assessment scores (pain, function, efficacy) to be carried out for each patient in 4, if possible 5 time periods to monitor the success of the treatment (before and directly after the therapy as well as 3, 6 and, if possible, 12 months after).

MBST and the circadian clock: effect of Magnetic Resonance Therapy on the circadian clock and the hypoxia signaling pathway – experiments with zebrafishes

In a new, scientifically very high quality research project of a team of biologists at the University of Innsbruck, a new functional and efficacy model confirms the effects of nuclear magnetic resonance therapy on zebrafish. In extensive and repeated series of tests, the zebrafish cells were treated with the MBST device for one hour per day for 4 days. The measurements were carried out on the 5th day.

Research results until now:

- The MBST treatment leads to a synchronization of the internal clock with a strong increase in amplitude.
- The MBST devices change the circadian clock in zebrafish cells, thereby influencing the hypoxia signaling pathway in a highly significant way. The effect is apparent at the mRNA level and at the promoter regulation level (reporter assay).
- The treatment time of one hour per day triggers a new synchronisation of the circadian.
- Both affected signalling pathways play an important role in many diseases. This means that in the future it might be possible that MBST technology will have a much wider range of applications than the current indications for degenerative diseases such as osteoarthritis and osteoporosis.

Effects of Therapeutic-NMR (MBST-Nuclear Magnetic Resonance) on the Circadian Clock and the Hypoxic Signaling Pathway in Zebrafish Cells
R. Oliva, Master thesis for the academic title Master of Science (MSc), Faculty of Biology, Institute of Ecophysiology, Leopold Franzens Universität Innsbruck, Innsbruck, Austria.

MBST and the circadian clock: Effects of Nuclear Magnetic Resonance Therapy on the circadian clock and the hypoxic signalling pathway
[MBST und die Circadiane Uhr: Auswirkungen der Kernspinresonanztherapie auf die Circadiane Uhr und den Hypoxie-Signalweg]
Regina Oliva, Felix Benscheidt, Adolf Michael Sandbichler and Margit Egg, Institute of Zoology, University of Innsbruck, Austria Lecture symposium in Wetzlar, Congress Center of the Rittal Arena, 03 – 04 March 2017

Effects of Therapeutic-NMR (MBST-Nuclear Magnetic Resonance) on the Circadian Clock and the Hypoxic Signaling Pathway in Zebrafish Cells

A very interesting three-year research project with zebrafish entitled “Effects of Therapeutic NMR (MBST-Nuclear Magnetic Resonance) on the Circadian Clock and the Hypoxic Signaling Pathway in Zebrafish Cells” at the Leopold Franzens University of Innsbruck, Faculty of Biology, Institute of Ecophysiology, provided a completely new way of looking at the effects.
The zebrafish (Danio rerio) belongs taxonomically to the family of Cyprinidae and is endemic to South and Southeast Asia as well as northeastern India, Bangladesh and Myanmar (Nelson 1994, Barman 1991).
Danio rerio was used as a model organism in genetics, developmental biology, neurophysiology and biomedicine due to special characteristics such as the short generation time of 3-4 months, cheap breeding costs and several hundred eggs after 2-3 days. The large and transparent eggs (0.7 mm diameter during fertilization), the possibility of external feeding, that is relevant for monitoring, and rapid development stages are also very interesting in research. The development of important organs within 36 hours is exemplary for further advantages of the model organism (Kimmel et al., 1995, Spence et al., 2008).

The most interesting feature is the genotypic comparability of the syntenic relationship between zebrafish and humans (Dawson et al., 2000), which is described often in specialist literature.

The very innovative, scientifically advanced research programme of a team of scientists from the University of Innsbruck, led by Dr. Margit Egg, confirms a new proven functional model for zebrafish.
In the series of experiments, which were carried out repeatedly, the zebrafish cells were exposed to therapeutic nuclear magnetic resonance (MBST) for one hour per day for 4 days. The measurements were carried out on the 5th day.

Result

- The MBST treatment leads to a synchronization of the internal clock with a strong increase in amplitude.
- The application of nuclear magnetic resonance changes the circadian clock in zebrafish cells, thereby influencing the hypoxia signaling pathway highly significantly, which in turn has a massive influence on cell ATP.

The effect is apparent at the mRNA level and at the promoter regulation level (reporter assay). Both of the pathways influenced play an important role in many diseases, which indicates that MBST technology might be used in a wider range of applications beyond the indication fields of degenerative diseases such as osteoarthritis and osteoporosis.

The gene transcription experiments confirm the effect of NMR treatment (MBST®-CS300) compared to control sham experiments.

- The first test series showed that the timing of the NMR treatment and/or measurement is decisive for the result.
- The second series of experiments was carried out in order to compare the experimental setup for the integration of the optimal cell culture time on the one hand and the number of NMR treatment days on the other.

This experiment was necessarily performed three times because usually patients are treated on 7-10 consecutive days, a period of time that is not possible when working with zebrafish cells.
Even the reduced experimental set-up of seven days led to a loss of rhythmicity in the circadian oscillation of the cells due to the absence of synchronizing timer light.

- Therefore, the third experiment was carried out with only four instead of seven days of treatment time.

The results of this last experiment again confirmed the question of treatment time, as had already been the case with the first pilot experiment. The potential phase shift of two hours occurring in the oscillations of the Per1 and cry1 genes caused by NMR treatment show the involvement of the circadian clock in the cellular effects caused by NMR.

The timing of the therapeutic NMR (MBST®-CS300) treatment could be very important to achieve a continuous synchronisation of the circadian clock in the tissue.

The treatment time of one hour per day triggers a new synchronisation of the circadian.

An involvement of the circadian clock in cartilage matrix homeostasis and the progression of osteoarthritis was recently reported (Gossan et al 2013; Gossan et al., 2014).

The positive effects of NMR treatment on clock oscillation in our study explained that the method of application plays an important role for the cellular signaling pathways.

In addition, the last experimental set-up also shows an effect of NMR treatment on the hypoxic signaling pathway.

- It could be shown that the HIF1 gene transcription degree changed significantly over the entire cycle.
- HIF3 also showed significant upregulation in gene transcription between 24h and 8h.

Although the role of HIF3 is still insufficiently researched, its role in the articular cartilage of the knee joint by hypoxia dominates. It is likely to act as a negative regulator of HIF-1 (Li et al 2006, Ke & Costa 2006, Makino et al 2001).

Naturally, the results of experiments on human chondrocytes and osteocytes need to confirm the observed effect of NMR treatment on zebrafish cells.

Effects of Therapeutic-NMR (MBST-Nuclear Magnetic Resonance) on the Circadian Clock and the Hypoxic Signaling Pathway in Zebrafish Cells

R. Oliva, Master thesis for the academic title Master of Science (MSc), Faculty of Biology, Institute of Ecophysiology, Leopold Franzens University of Innsbruck, Innsbruck, Austria

Hypothetical active principle

The molecular basis of electrical activity in individual cells is bound to the presence of ion channels in the cell membrane (that separates the interior from the exterior of a cell). These ion channels are formed by large protein structures (protein molecules) which, due to their configuration, allow very selective ions to pass through the membrane or exclude them from the passage.

In contrast to the generally known current coming from the socket, the charge carriers in living tissue are ions and not electrons. Ions are negative or positive charged atoms like K+, Na+, Ca++, Cl-, but also H+ (protons). In the latter case, they are also called proton channels. Recent research in this field has made it possible to assign biological functions to the different channels, which are among others distinguished by their conductivity. For example, it was possible to establish a link between the proton channels and the receptor for vanilla acid. This receptor is important in pain transmission (Hellwig et al., 2004).

A change in the passage of protons through these channels due to changes in the energy level of protons (caused by resonance) would clearly affect the experiencing of pain. The importance of proton channels, rapid transport of protons, energy-transmitting membrane proteins and enzymes is clarified by recent reasearch (e. g. Pomes and Roux, 2002; Miloshevsky and Jordan, 2004). An explanation of pain reduction caused by successful therapy with MBST technology is therefore based on quantum mechanics.

In recent years, numerous scientific investigations of the natural scientists Kullich, Steinecker-Frohnwieser and Weigl of the Ludwig Boltzmann Department for Rehabilitation Saalfelden and the Medical University of Vienna have been carried out in the field of cell research. The most important ones will be described in more detail in the following part (in vitro studies) of this clinical evaluation report.

Clinical-pharmacological expertise commissioned by the Investitionsbank Hessen on the efficacy of nuclear magnetic resonance therapy in various orthopaedic indications

As early as 2004, a clinical-pharmacological report was prepared on behalf of Investitionsbank Hessen on the efficacy of magnetic resonance therapy for various orthopaedic indications. The report refers to extensive material of various clinical observations submitted by MedTec Medizintechnik GmbH, Gotenweg 51, D-35578 Wetzlar, as well as discussions with clinical investigators and with the ‚notified body' that has issued the CE mark.Author of the report: Prof. Dr. med. Peter Lücker, FACP physician for clinical pharmacology/toxicology, physician for clinical pharmacology.

Excerpt of this report dated 2004
On the Effectiveness of Magnetic Resonance Therapy:

In order to assess the expert opinion, the company MedTec Medizintechnik GmbH, Gotenweg 51, D-35578 Wetzlar, Germany, presented application observational surveys of various clinical institutions and medical practices. In total, the material consists of 13,686 cases treated with nuclear magnetic resonance therapy from 3 studies that were evaluated statistically correct but partly without prospective design.

Until today [2004!], nuclear magnetic resonance therapy is not a recognised medical treatment method, as despite the high number of surveys, its effectiveness has not been scientifically proven with the examinations submitted. Nearly all of the studies submitted do not meet the latest medical and scientific requirements of a clinical trial. However, since 13,686 cases were submitted as proof of efficacy, Prof. Lücker concludes that nuclear magnetic resonance therapy is highly effective in the treatment of the in the evaluation reported and described indications of degenerative cartilage damage of various joints and osteoporosis. Lücker continues: „If the efficacy can be proven by appropriate cell biological examinations and a large clinical study, the associated worldwide patents are financially very worthwhile with almost certainty. In addition to the studies already under way at renowned German universities and Austrian institutes, these and the proposed clinical study will also with a probability bordering on certainty lead to a positive result [this assumption has indeed come true!]. I recommend that the further studies described in this report be carried out in order to provide a more detailed scientific representation of nuclear magnetic resonance therapy and to establish it as a generally recognised standard medical technology therapy in hospitals, rehabilitation centres, doctors' surgeries and health insurance companies".

The problem with this report lies in the fact that, on the one hand, there are well over 13,000 case studies which largely show that magnetic resonance therapy, depending on the indication, leads to a significant improvement of between 70 and 90 percent of the clinical finding, combined with a significant improvement of the patient's state of health. On the other hand, there are only 3 studies that have been evaluated using a valid statistical method.

However, the studies suggest that nuclear magnetic resonance therapy is highly effective in the treatment of the indications tested. Regarding the unfortunate description of the study and the name of the therapy in the study of the German Sports University Cologne - title: Evaluation of the effectiveness of three-dimensional pulsating electromagnetic fields of MultiBioSignalTherapy (MBST~) on the regeneration of cartilage structures" – it has to be stated that the technology used is not the widely applicated PEMF (Pulsating Electromagnetic Fields) technology but the nuclear magnetic resonance spin technology that is protected by worldwide patents, as it is described in the paragraph "Material and Method" of this study. Due to this conglomeration of inadequate methodology but three very acceptable studies and positive clinical findings on the other, the final statement of the evaluation can only lead to a very positive assessment of nuclear magnetic resonance therapy, because according to generally accepted clinical standards the treatment of the two indications has been very successful and can thus be considered highly effective.

Clinical-pharmacological expertise commissioned by Investitionsbank Hessen on the efficacy of nuclear magnetic resonance therapy in various orthopaedic indications
[Klinisch-Pharmakologisches Gutachten im Auftrag der Investitionsbank Hessen zur Frage der Wirksamkeit der Kernspin-ResonanzTherapie bei verschiedenen orthopädischen Indikationen]
Prof. Dr. med. P. Lücker, FACP, Pharmacology/Toxicology Doctor, Clinical Pharmacology Doctor, October 2004, Germany

In vitro studies

As with any other new form of therapy, it is important to detect indications of possible damage to the organism in good time. Increasingly, in vitro models such as that of primary cell culture are being used for this purpose (also in order to spare animal experiments). Programmed cell death (e. g. apoptosis), changes or retarded growth can be clearly identified and recorded partly not only qualitatively but also quantitatively. Investigations into the possible risks of MBST therapy were therefore quite appropriate.

Innocuousness (cell cultures)

Temiz-Artmann et al., 2005, were able to report that in a prospective study of primary chondrocytes and osteoblasts the exposure of the primary cell cultures to the field on nine occasions with a duration of 30 or 60 minutes each, did not show any cell-damaging effect. The viability of the cultures was determined using the generally accepted trypan blue exclusion method. Apoptosis (cell death) was detected using a commercially available kit. Positive controls in the presence of H202 (caused cell death) were also carried out. The duration of field exposure was based on the usual duration of clinical therapy and can therefore be considered relevant.
In addition to this positive result, a tendency towards stronger cell growth was observed. However, this could not be verified statistically by the applied method of counting selected, randomized visual fields, since the cells were almost confluent (grown together without visible transitions) at the end of the experiment. The counting of the cells at day 15 could not be expected to yield a clearer result. The differences in the proliferation rate of 271 and 290% are rather modest in view of the overall proliferation rate of almost 1400% and could not be verified statistically significant in contrast to placebo due to the scattering of the measured values. It has to be noted that it is unfortunate that the authors did not determine the total protein content of the cultures. This would have provided clearer information on the growth rate of the cells and would have been easier to handle for statistics. Nevertheless, the work is of particular importance because it has not shown any evidence of tissue-damaging effects, but on the contrary has given first indications of a proliferation of chondrocytes and osteoblasts.

NMR In Vitro Effects on Proliferation, Apoptosis, and Viability of Human Chondrocytes and Osteoblasts

A. Temiz-Artmann, P. Linder, P. Kayser, I. Digel, G.M. Artmann and P. Lücker, Laboratory for Medical and Molecular Biology, Aachen, University of Applied Sciences, Jülich; Prof. Dr. Lücker, Consulting GmbH, Grünstadt, Germany; published in: Methods and Findings Exp. Clin. Pharmacol. 2005, 27(5), 391-394.

Since the effects of magnetic fields on biological cells have already been reported in a large number of publications, it has become necessary to differentiate the completely new mode of functioning and active principle of nuclear magnetic resonance therapy using different models of examination.

Changes in protein synthesis in fibroblast cultures

In a further study, Prof. Dr. Artmann, University of Aachen (Artmann, 2007) conducted a three-part study on fibroblast cultures using this new technology. In this series of tests, the technology was tested not only against placebo, but also very sensibly against the application of a static magnetic field. In this way, not only the possible effect of MBST therapy should be recorded, but also a demarcation from the application of static magnetic fields should be achieved. The result impressively confirms this hope. Definite differences between the application of placebo and the application of a static magnetic field on one side and the application of the MBST® therapy device on the other side were found during 12 hours of application (6 times for 2 hours per day). In the latter case, there were major changes in protein synthesis. An upregulation of some protein classes as well as downregulation of other protein classes was found, both of which could not be observed in the application of placebo or static magnetic fields. Based on comparative analyses using the proteome map of a human fibroblast cell line, the majority of these proteins could – with reservation - be assigned to the structural and regulating protein classes.

Decrease in extracellular collagen crosslinking after NMR magnetic field application in skinfibroblasts

M. Artmann, A. Temiz Artmann, I. Digel, E. Kurulgan, Pt. Linder, P. Kayser, D. Porst, G. J. Braem, K. Zerlin, University College of Applied Sciences Aachen, Campus Juelich, Competence Platform Bioengineering; published in: Journal of the International Federation for Medical and Biological Engineering, No. 1, January 2007,45: 91-97.

Two main effects of NMR on fibroblast cells

- a. Influence on cellular protein expression:
  NMR treatment leads to a change in the protein profile of skin fibroblasts that is visible on 1D and 2D PAGE gels. The proteins affected are probably related to the cytoskeleton and the inflammatory signaling pathways.
- b. Changes in collagen crosslinking
  NMR treatment led to a significant increase in soluble EZM collagene, while at the same time decreasing sparingly soluble and insoluble EZM collagene. This leads to an improved hydration of the ECM.

The author concluded that these changes in the sense of a positive influence due to a better hydration occurred as a result of the MBST application. Interestingly, one class also included proteins of the inflammatory signaling pathways (indication of an influence on inflammatory processes). This finding establishes a direct reference to the positive effects of MBST on inflammatory processes during joint treatment that were observed in the treatment of patients. These extensive and very complex investigations not only prove a biological effect of the MBST application, but also clearly show the assumed difference to the application of static or pulsating magnetic fields.

Decrease in extracellular collagen crosslinking after NMR magnetic field application in skinfibroblasts

I. Digel, E. Kurulgan, Pt. Linder, P. Kayser, D. Porst, G. J. Braem, K. Zerlin, G. M. Artmann, A. Temiz Artmann, University of Applied Sciences Aachen, Campus Juelich, Competence Platform Bioengineering; published in: Journal of the International Federation for Medical and Biological Engineering, No. 1, January 2007, 45: 91-97.

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Proteome level effects of the MBST application in the skin cell model

In a further study, Prof. Dr. Artmann, University of Aachen (Artmann, 2006) conducted another three-part study on fibroblast cultures with the title „Proteome-level effects of MBST application in the skin cell model in cultures“, using the new technology of gene-chips (proteome level model).

This series of tests was again very sensibly performed not only against sham or placebo, but also against the application of a static magnetic field. In this way, not only the possible effect of MBST therapy should be recorded, but also a demarcation from the application of static magnetic fields should be achieved.

Extensive analytical methods were used in execution of the tests

- Sample groups and the planning of experiments
- Experimental controls: SDS-PAGE data, 2D-PAGE data
- NMR impaired protein groups
- NMR effect on collagen cross-linking

Example groups: 1 - culture medium before NMR, 2 - culture medium 1 day NMR, 3 - culture medium 3 days NMR, 4 - culture medium 6 days NMR, 5 - culture medium 9 days NMR, 6 - cell biomass, 7 - NaCl extract pH 5, 8 - acetic acid extract at room temperature, 9 - acetic acid extract 70ºC, probe analysis: protein content (Bradford method), protein content (Lowry method), SDS SITE, 2D SDS SIDE, ELISA, Western Blotting
Results: Two major effects of NMR on fibroblast cells were found:
Influence on the expression of cellular protein

- NMR treatment led to protein profile changes visible in 1D and 2D PAGE gels. The proteins involved are probably cytoskeletal and inflammatory pathways. Changes in collagen cross-linking.
- The NMR application caused a significant increase in soluble ECM collagens with a corresponding decrease in semi- and insoluble ECM collagens. This leads to improved hydration of ECM in the skin.

Proteome level effects of MBST application in the skin cell model in culture [Proteom-Level-Effekte der MBST Anwendung im Hautzellmodell in Kultur]
A. Temiz-Artmann, P. Linder, P. Kayser, I. Digel, G. M. Artmann Artmann GM (2006) Study report (assigned study MedTec Medizintechnik GmbH, Wetzlar)

Nuclear magnetic resonance – Influence on the NFAT pathway in osteo- and chondrosarcom cells

A further study by the Austrian team of researchers Steinecker-Frohnwieser, Weigl, Kullich and Kress of the Ludwig Boltzmann Department in Saalfelden and the University of Vienna on a possible influence of nuclear magnetic resonance on the gene expression of CAL-72 cells showed that the expression of components that are involved in the NFAT pathway in CAL-72 cells increased. NFATc1, c3 and NFAT5 seem to be most conspicuously regulated, the two transcription factors NFATc2, 4 and NFATC2IP seem to be hardly regulated and are also expressed very weakly. As a result of the two experiments, it was possible to observe clearly and divergently altered expression levels with respect to calcineurin (PPP3), glycogen synthase kinase (GSK3), calmodulin (CALM) and calcium/calmodulin-dependent protein kinase (CAMK). In addition to a clear increase in the expression of NFKB2 and NFKBIE, the expression pattern of the stimulated cells has also changed with regard to other different regulatory proteins. With the exception of GSK3, RT-PCR enabled the detection of a prominent expression of the individual genes for both CAL-72 and CAL-78 cells; the specificity of the selected primers was confirmed by controls. The first real-time PCR experiments were able to show the effects observed in the gene array with CAL-72 partially or using the Chondrosarcom-CAL-78 test series more clearly.

Results and conclusion: The nuclear magnetic resonance caused a change in the expression of the components of the NFAT pathway in both cell lines investigated. The observed differences between the effects of gene arrays and PCRs could be attributed to different specificities (samples of gene array versus „genespecific“ primers) of the methodology used.Further PCR experiments are expected to provide more detailed information on the expression rate. Statistical data analysis makes it possible to validate those genes that also show changes in the expression level in the gene array analysis under the influence of nuclear magnetic resonance. The observation, that nuclear magnetic resonance effects a modulation of the NFAT pathway within osteosarcom and chondrosarcom cells, coincides with studies that discuss the induction of cell growth in connection with the active principle of nuclear magnetic resonance. Inhibition of the NFAT pathway in both osteoblasts and osteoclasts leads to a reduction in the proliferation and differentiation of these cells.Due to the fact that the activation of NFAT leads to a dephosphorylation event triggered by an increase in the intracellular Ca2+ concentration, additional investigations at the protein and cellular levels are indispensable. Planned measurements of the intracellular Ca2+ concentration and activity of the NFAT using a reporter gene assay should provide information about the more precise mechanism.

Influence of nuclear magnetic resonance therapy on the regulation of the NFAT pathway in osteo- and chondrosarcoma cells [Einfluss der Kernspinresonanz-Therapie auf die Regulation des NFAT-Pathways in Osteo- und Chondrosark]
B. Steinecker-Frohnwieser, L. Weigl, W. Kullich, H. G. Kress J Miner Stoffwechs 15 (4), 201 (2008)

Influence on the metabolism of cell lines

Another study entitled „Influence of NMR Therapy on Metabolism of Osteosarcoma and Chondrosarcoma Cell lines“ was conducted in order to register the regulation of different genes under the influence of nuclear magnetic resonance therapy.

Important osteological/rheumatological facts are:

- Stress activated protein kinases (SAPK / JUN amino-terminal kinases / JNK) are members of the MAPK family and are activated by a variety of environmental stress factors, inflammatory cytokines and growth factors.
- c-Jun signalling together with NFAT is decisive for the RANKL-regulated osteoclast differentiation! (IKEDA et al., 2004)
- NFAT plays an important role in the transcription program of osteoblasts.
- NF-KB is activated by RANKL and plays a crucial role in osteoclastogenesis.
- The Fas ligand (FasL) serves as an important death factor in the immune system by inducing apoptosis.
- The ras/raf/MAPK/ERK-pathway negatively regulates IGF stimulated PG synthesis in chondrocytes.
- Apoptosis inhibitor (IAP) are a family of proteins that prevent cell death. The expression of BIRC-3 is increased after the action of NF-KB by TNF receptor.
- Glycogen synthase kinase 3 (GSK-3) activity may dictate how cells react to glucocorticoids (Galliher-Beckley et al., 2008)

Several growth factors (e. g. IGF, TGF, VEGF) regulate the performance of cells in bone and cartilage and play a role in the inflammatory immune response.

Methodology: For the investigations CAL-72 osteosarcoma cells and CAL-78 chondrosarcoma cells were purchased by DMSZ (German collection of microorganisms and cell cultures). The cells used for RNA isolation were treated with an NMR therapy device (MBST®, MedTec, Wetzlar, Germany) for 20 hours within 4 days (6 hours on the first 3 days and 2 hours on the last day).

The extracted RNA was labelled with biotin and hybridized on membranes carrying different gene markers. The expression of specific genes was quantified by bioluminescence.
In addition, quantitative PCR was performed to support the results of gene arrays. RNA of cells incubated at room temperature at the same time is used for controls. The concentration of free Ca2+ in living cells was determined fluorometrically with cells loaded with Fura 2 AM for 60 min.
Using histamine, the cells were transfected with DNA constructs corresponding to the luciferase reporter genes to test the up and/or down regulation of the activation of regulatory proteins involved in signal transduction pathways.

Results and conclusions:

- As shown in the microarray technique, different genes are regulated differently compared to control.
- Obviously, the genes of the NFAT pathway are regulated uniformly.
- The qPCR of the most conspicuous genes showed no significant changes compared to control.
- Luciferase reporter gene assays definitely showed no significant increase, but a slight decrease in NF-KB or MAPK activity compared to untreated cells. This could be important because high NF-KB and MAPK support the properties of inflammatory processes in rheumatic diseases.
- Intracellular Ca2+ signaling was not significantly altered due to the influence of the NMR.
- From the qPCR, it can be concluded that NMR in the therapeutic dosage triggers no apoptotic mechanisms in Cal-72 and Cal-78 cells.
- Arrays relating to apoptosis, cell cycle and osteogenesis are effective tools for evaluating the feedback of potential dangers and showed no oxidative, metabolic, repair or heat shock voltage during NMR exposure.
- The results show that NMR with a magnetic field strength of up to 2.3 mT and a therapeutic treatment time of 20 hours in 4 consecutive days has no harmful effects on osteo- and chondrosarcoma cells.

Influence of NMR Therapy on Metabolism of Osteosarcoma- and Chondrosarcoma Cell lines
B. Steinecker-Frohnwieser, L. G. Weigl, C. Höller, E. Sipos, W. Kullich H. G. Kress, Arab Health Show Daily 4, 7 (2010)

Influence of NMR therapy on Ca2+ signalling and gene expression

Introduction: Nuclear magnetic resonance therapy (NMRT) with weak magnetic fields (up to 2.3 mT, 100 kHz) has shown that repair processes in cartilage are stimulated and pain signaling is influenced. On the contrary, strong magnetic fields (3 T) used for imaging purposes are believed to have harmful effects on chondrocytes and cartilage repair. In order to assess the effect of NMRT with an optimized field strength on cellular processes, we used microarrays and quantitative PCR (qPCR) for the expression profiling of NMRT-treated chondrosarcoma and osteosarcoma cells.

RNA was isolated from cells treated with an NMR therapy device (MBST®, MedTec, Wetzlar, Germany) for 20 h in 4 days. The RNA was labelled with biotin and hybridized on membranes carrying different gene markers. Bioluminescence was used to quantify the expression of specific genes. A qPCR was used to confirm the results of gene arrays.

The concentration of free Ca2+ in living cells was determined fluorometrically with cells loaded with Fura 2 AM for 60 min. Ca2+ release was triggered in osteosarcoma and chondrosarcoma cells by the application of different concentrations of histamine. To investigate the voltage-activated Ca2+ current, we used PC12 cells, a cell line of neuronal origin. The depolarization of the cells was achieved by a solution with a high concentration of potassium.

Conclusions:

- The degree of expression of the transcription factors of the NFAT family was detected by microarrays or qPCR in cells after NMR treatment and in control cells.
- A quantitative effect of the NMR treatment of osteosarcoma and chondrosarcoma cells could not be demonstrated.
- The modulation of the transcription via NFATs is not necessarily dependent on its expression rate. The functional modulation of NFATs is due to their phosphorylation state.
- A functional modulation of NFATs by NMR was not detectable.

Influence of NMR therapy on metabolism of osteosarcoma- and chondrosarcoma cell lines
Bibiane Steinecker-Frohnwieser, Lukas G. Weigl, Carmen Höller, Elisabeth Sipos, Hans Georg Kress, Werner Kullich Bone 44(2), 295 (2009)

Studies with animals

In the field of drug development, the examination of a human indication using an animal is very often carried out worldwide in order to be able to take measurements that are prohibited in living humans. It was therefore standing to reason to examine the effects of MBST therapy in the animal experimental model in order to gain additional insights into the effect of MBST.

Posttraumatic gonarthrosis in rabbits

Jansen and his colleagues at the University of Münster (Jansen et al., 2006) surgically severed the anterior cruciate ligament of both hind legs of 12 male adult rabbits, race New Zealand White (resection), in order to produce moderate arthrosis over a period of 6 weeks (= experimental gonarthrosis in the animal model). After these 6 weeks the animals were randomized into two groups. The therapy group was treated for 7 consecutive days, one hour per day each, using an MBST® device from MedTec. The control group was kept under the same conditions, but the therapy device was not activated. After the killing of the animals, the knee joints were examined macroscopically and microscopically with the help of various scores. The examination of osteophyte formation showed a statistically significant ($p<0.05$) doubling under active therapy. The overall macroscopic score for the therapy active group was significantly lower. Therefore, it was possible to give positive proof of a therapeutic intervention by MBST therapy in animal experiments under controlled laboratory conditions. In contrast, the microscopic evaluation of the study period of 6 weeks showed no significant difference between the therapy and the control group because the examination period was too short.

Inaugural dissertation on obtaining the doctor medicinae of the medical faculty of the Westfälische Wilhelms-Universität Münster: Does MBST nuclear spin resonance therapy have an influence on post-traumatic gonarthrosis in the rabbit model?
[Inaugural-Dissertation zur Erlangung des doctor medicinae der medizinischen Fakultät der Westfälischen Wilhelms-Universität Münster: Hat die MBST®-KernspinResonanz-Therapie einen Einfluss auf die post-traumatische Gonarthrose im Kaninchenmodell?]
T. Brockamp, University Hospital Münster, Clinic and Polyclinic for Trauma, Hand and Reconstructive Surgery; April 2009.

Cub-, gon- or coxarthrosis in dogs

Introduction: As osteoarthritis is also a common disease in animals, Dr. Bockstahler conducted a double-blind, randomized study with dogs at the University of Veterinary Sciences in Vienna.
Canine osteoarthritis (OA) is a common problem in dogs and is treated for the associated pain, stiffness and lameness.

Aim of the study
The aim of the study was to evaluate whether nuclear magnetic resonance therapy (MBST®) improved clinical signs of dogs suffering from osteoarthritis. Control dates were immediately after MBST® treatment and 3 and 6 months after treatment. Over a period of nine days, 15 dogs were actively treated with NMR (TG) and 15 received placebo (PG).
Used for the evaluation: lameness and pain score, symmetry indices, peak vertical force and vertical impulse, drop-out, additional painkillers or physical therapy during the course of the study. From these parameters, an individual score was calculated for each dog to evaluate the overall effectiveness of the treatment (OTE) at the evaluation points.

Results

- Three months after MBST®, the animals in the active group showed a significantly better OTE compared to the animals in the plaebo group. Lameness, score and symmetry as well as indices for peak vertical force and vertical impulse were significantly improved 3 months after treatment.
- As a result, the authors concluded that treatments with NMR had positive effects on the clinical signs of OA in dogs 3 months after therapy.
- The assessment point 6 months after the end of the therapy showed a slight deterioration in the improvement picture of the dogs.
- The reasons for this are probably the control behaviour of the dog owners (too early exertion or overload) and in the higher metabolism of dogs (ten times higher than in the human area).

Treatment of the clinical symptoms caused by osteoarthritis using nuclear magnetic resonance (MBST®) in dogs a randomized trial
Marion Mucha DVM, Ivonne Virac1, Cornelia Lang1, Kathleen Wittek1 DVM, Alexander Tichy2 MA, DSc, and Barbara Bockstahler1 DVM; PD*,1 Department for Small Animals and Horses, Small Animal Surgery, Section for Physical Therapy and Rehabilitation, University of Veterinary Medicine, Vienna, Austria, 2Department for Biomedical Sciences, Platform Bioinformatics and Biostatistics, University of Veterinary Medicine, Vienna, Austria

Nuclear magnetic resonance treatment (MBST®) of clinical symptoms caused by osteoarthritis: a double-blinded placebo-controlled study in dogs
M.C.Mueller, K. Wittek, B. A. Bockstahler, Posterpresentation veterinary congress London 2015

Organ regeneration

Effect of Magnetic Resonance Therapy on liver regeneration

Introduction: Main interest of this investigation was to determine a possible effect of nuclear magnetic resonance on liver regeneration.
The liver is the only organ capable of regeneration. Almost all modern liver resection techniques, including innovative split liver transplantation techniques, are based on this ability.
In addition to the positive effects of the application of MBST therapy at the cellular level, it seemed useful to investigate the effects at the organ level. A promising animal model to test the hypothesis of a positive influence on the regeneration of rat livers was used to provide more information.

Methods: As evidenced by the interim and final reports of Prof. Dr. Spiegel, University of Münster (Hölzen et al., 2006), 108 male Lewis rats were randomized in six experimental groups. The aim of the study was to investigate the effect of nuclear magnetic resonance therapy on liver regeneration after 70% hepatic resection as well as on untreated liver tissue.

For this purpose, the animals were put under anaesthesia for 60 minutes (the usual duration of a treatment session) and irradiated. A total of 6 groups were formed, each with 2 controls, two with an irradiation as used in osteoarthritis therapy and two with an irradiation as used in osteoporosis therapy in the clinical area. Both blood parameters and histological parameters were used as measuring parameters.

The study included three control groups in which only the abdomen was opened and three resection groups. Group size was always n = 18 animals. In each group, either a placebo treatment or an application of nuclear magnetic resonance with one of two different programs (dose I or II) was performed on the first three days postsurgical. Liver biopsies were taken on day 4,7 and 14 after intravenous administration of 100 mg/ml bromodesoxyuridine (BrdU) per kg body weight. Weight and various serum parameters (AST, ALT, alkaline phosphatase) were examined as markers for possible liver damage. The progress of liver regeneration was assessed with mitoses, mitoses in the S-phase, signs of inflammation, cell necrosis, connective tissue, glycogen and angiogenesis. Overall, no damaging effect of the non-invasive procedure on healthy tissue was found.

Method:

- 70% resection of rat livers
- MBST for checking liver regeneration
- 3 groups of 18 rats each:
- 1 control group (placebo group)
- 1 therapy group treated with osteoarthritis therapy cards
- 1 therapy group treated with osteoporosis therapy cards

On day 1, 2 and 3 postsurgical 60 min MBST

- Killing of rats after 4, 7 and 14 days.
- Study parameters: weight, liver volume, general condition Blood laboratory (Na, K, Krea, Bili, Ammonia, PCHE, GOT, GPT, Y-GT, LDH, AP), Histology (Mitoserate BrdU/Ki 67, VEGF (angiogenesis) and liver injury (silver and HE staining as well as immunohistochemical determination of antivimentin)

Only about 25% of patients can have an initial curative operation. A non-invasive procedure such as nuclear magnetic resonance therapy might be able to increase this number.
In split liver transplantation, the concomitant treatment with nuclear magnetic resonance therapy to stimulate liver cell regeneration might reduce the risk of a postsurgical dysfunctioning for both the donor and the recipient and might contribute to a faster recovery of the patients.
This model has shown that the frequency modulations I and II of nuclear magnetic resonance therapy have different effects on healthy as well as on regenerating liver tissue.

In healthy tissue, however, this led to a significant difference between the three groups only for the glycogen content of liver cells, but in the longitudinal course a tendential difference between the two treated groups especially with regard to the detected mitoses in the cells could be detected. This was also evident in the regenerated liver tissue after resection.

- The frequency modulation of the clinical application for osteoporosis of the treatment device showed the greatest influence on liver cell proliferation (OD map). In this treatment pattern, significantly higher mitosis rates were observed partially, especially in the specific rate of S-phases compared to the two groups that were treated differently. Additionally, this group had significantly smaller nuclei in the histological evaluation on day 14, which marks the completion of regeneration.
- Under frequency modulation II, which is usually used for osteoarthritis (OA card), a delay seemed to occur with regard to some of the regeneration processes mentioned here. Mitotic rates in this group tended to be lower than those in the untreated group. The same applies in particular to the S-phases.

In this study, data was collected for a period of 14 days, as it was assumed that liver regeneration is largely completed after this time. Further investigations should be carried out to examine the long-term effect of nuclear magnetic resonance therapy on the schematic representation of the regeneration of the resected rat livers under the various treatment patterns in longitudinal proliferation as well as the cell activity in the control groups of proliferating tissue.

In particular, the different effects that depend on frequency modulation and thus on the depth of penetration require further analysis. The author concluded: „Nuclear magnetic resonance therapy – in this case MBST – obviously influences various molecules in the cells as well as receptors and enzymes by stimulating hydrogen atoms and the resulting changes in intra- and extramolecular bonds such as hydrogen bridge bonds. This opens up many more further questions.“
The application of MBST therapy led to statistically significant differences in two important parameters, namely the regeneration volume of the resected liver and the histologically recorded mitosis rate ($p < 0.05$).

Results: This experiment has shown that the frequency modulations I and II of nuclear magnetic resonance therapy have different effects on both healthy and regenerated liver tissue.
Proliferation cycle non-parenchymal cells/hepatocytes different
One of 20,000 hepatocytes in replication phase (co-rate 0.005%)
Control groups (no resection): day 4, 7, 14 - equal values of mitoses per mm2 (20/mm2). Osteo card frequency:
significant increase in mitosis ($p < 0.01$) after day 7

- VEGF- (angiogenetic factor, reg. factor/wound healing/growth) Hepatocyte expression on day 4 higher than on day 14 (OD and OA map).
- VEGF score for non parenchyma cells on day 4 strongly significantly ($p<0.01$) increased compared to day 7, significantly lower on day 14 = regeneration completed earlier! (OD card only).
- At no time liver cell damage such as inflammation or cell necrosis (HE staining)
- The glycogen score (glycogen of hepatocytes synthesized from blood glucose under the influence of insulin, but also degraded under the influence of adrenaline and glucagen if necessary) is significantly higher at both MBST frequencies on day 4 than in the control group. Significantly lower in the OD chart on day 7.

It can therefore be assumed that the activity of hepatocytes was clearly increased following MBST treatment.

- Liver regeneration was already well advanced in contrast to the other two groups.
- Vimentin expression (marker for identification of degenerate cells) not increased!

Cell necrosis can be found in all three resection groups, but at different times:

- OD- and OA therapy card: isolated necrosis on days 4 and 7
- Control group: only from day 7 onwards.

Liver regeneration was also characterized by controlled cell necrosis. Earlier onset of this phenomenon = faster regeneration!

Nucleus size:

- OD and OA therapy card: On day 14, the cell nuclei were significantly smaller. This speaks in favour of a largely completed regeneration at this time.

Inaugural dissertation on obtaining the doctorate rerum medicinalium from the Medical Faculty of the Westfälische Wilhelms-Universität Münster: Effects of nuclear magnetic resonance therapy on the dynamics of liver regeneration.
[Inaugural-Dissertation zur Erlangung des doctor rerum medicinalium der Medizinischen Fakultät der Westfälischen Wilhelms-Universität Münster: Auswirkungen der Kernspinresonanztherapie auf die Dynamik der Leberregeneration.]
Budny, N., University Hospital Münster, Clinic for General and Visceral Surgery, Department of Surgical Research; October 2015.

The effects of nuclear magnetic resonance therapy on the regeneration of liver cirrhosis and the question of what frequencies might be used to intervene at certain points in the cell metabolism need to be clarified.

This study showed that treatment with different frequency modulations in the form of nuclear magnetic resonance therapy did not have a damaging effect on healthy tissue during the study period. The available results also show that different frequencies have different effects on both healthy and regenerating liver tissue.

An improvement in cell proliferation, also in a parenchymatous organ such as the liver, might enable a larger extent of liver resection in liver tumor surgery if it is necessary and thus to maximize the possibility of surgical radicality. As already mentioned, only about 25% of the patients can have an initial curative operation.
Magnetic resonance therapy can be repeated as often as required. Split liver transplantation: concomitant treatment with nuclear magnetic resonance therapy to stimulate liver cell regeneration. Reduce risk of post-operative dysfunction of both the donor and the recipient = faster recovery of the patient.

The effects of nuclear magnetic resonance therapy on the regeneration of liver cirrhosis, as well as the question of the frequencies that might be used to intervene in certain areas of the cell metabolism, need clarification and should be the subject of further investigations.The test results clearly show that the application of nuclear magnetic resonance could have a therapeutically useful effect, which may play a role in the treatment of liver diseases in the future.

Clinical results

Influencing the symptoms of osteoarthritis

After a biological effect of using nuclear magnetic resonance therapy at the cellular and organic level has been demonstrated, the question of therapeutic usability arises. In contrast to a general effect on biological systems, the focus here is on the efficacy for certain indications. Following numerous reports in the literature on the efficacy of pulsating magnetic fields in orthopaedic indications, Krösche and Breitgraf (1998) carried out a prospective study of the application of MBST therapy for multiple joint complaints in 30 patients.
Since in some patients more than one joint was affected, a total of 44 treatments were performed. Gonarthrosis was documented in 27 patients. The assessment was based on a 6-stage analogue scale for sensitivity, pain frequency, intensity of pain, restriction of movement, change of bending angle in the knee joint, swelling, overheating, redness and discomfort.

Results: Six weeks after therapy 20 patients (66.6%) showed an improvement, 8 patients (26.7%) showed no improvement and 2 patients (6.7%) showed a deterioration. Five patients had a follow-up treatment carried out according to the same procedure, three of which showed an improvement. In view of the fact that this study was carried out under everyday conditions, the result is remarkable, especially since there were no negative effects, side-effects or other impairments apart from an occasional feeling of warmth or tingling.

Looking at the overall results, including follow-up treatments, 76.7% of the treated patients achieved an improvement in at least one treated joint, 70% of the patients had an improvement in all treated joints.
According to the authors, this proves that MBST therapy is an effective and innovative treatment for osteoarthritis disorders.

Long-term monitoring of MBST® MultiBioSignalTherapy
[Langzeitkontrolle der MultiBioSignalTherapie MBST®]
Breitgraf G, Krösche M, Therapy Center of the MultiBioSignalTherapy Cologne, final report December 1998

Effect on tissue

Dr. Klapsch, Spittal an der Drau, Austria came to a similarly positive conclusion in his observational study, the result of which he presented at the 27th annual conference of the Austrian Orthopaedic Society in Graz (Klapsch, 2003).
In his study, the author treated predominantly knees and ankle joints with five-hour therapy cycles (34/11) and nine-hour therapy cycles (52/7). Subjective satisfaction of the patients, pain levels at rest and stress as well as joint function were assessed.
Very good to good results were achieved in 70% of the patients who received short treatment and 73.5% of the patients who received long (9 hours) treatment.
Although these results can only be regarded as a trend for the time being, as stated by the author himself, these results represent a certain amount of experience which can serve as a basis for planning and designing future double-blind, randomized and placebo-controlled studies.

MBST magnetic resonance therapy - effect in tissue *[MBST-Kernspinresonanztherapie – Wirkung im Gewebe]*
W. Klapsch, Spittal, Austria; lecture at the annual conference of the Austrian Society for Orthopaedics, Graz, Abstractb., 2003.

MBST nuclear magnetic resonance therapy - therapy for degenerative and traumatic joint changes
[MBST-Kernspinresonanztherapie – Therapie bei degenerativen und traumatischen Gelenksveränderungen]
W. Klapsch, Spittal, Austria; lecture at the annual conference of the Austrian Society for Orthopaedics, Graz, Abstractb., 2003.

Regeneration of cartilage structures in cases of gonarthrosis

The literature contains a work by Prof. Dr. Froböse, University of Cologne (Froböse et al., 2000), which reports about the application of the above-mentioned nuclear magnetic resonance therapy on 14 patients with gonarthrosis. The success of the treatment was demonstrated by means of an in the meantime technically highly optimized tomographic imaging method, which is also based on nuclear magnetic resonance.
The field size of the MRI scanner was 1 Tesla.Before the start of treatment, the patients of the MBST® exhibited cartilage defects, some of which had been proven to be serious (Wirth 2 to 3). The MRI images of the knee joint were taken before and three months after MBS therapy. The subsequent cartilage quantification and visual presentation of the positive adjustments of the cartilage structures of the knee joint showed a highly significant increase (increase in volume was more than 30%) in the thickness, volume and area of the cartilage structures. The mean density of the cartilage structures of patella and tibia was compared before and after treatment with magnetic resonance therapy. Statistically, highly significant differences between the pre-value and the post-treatment value were recorded for both structures. Of course, when presenting such results, the question of a controlled test design always arises. It should be noted that the visual representation of a MRI image is real, i. e. a momentary, real, controlled state and thus placebo-free.
Taking into account the fact that the results of the measurements provided a clear approximation to the values measured in healthy people, a relatively high value must be attributed to the study, especially as the authors believe that equivalent successes were a complete novelty and had not yet been observed.

Pulsating electromagnetic waves *[Pulsierende elektromagnetische Wellen]*
Breitgraf G., Froböse I., Cologne; specialist lecture at the German Orthopaedic Congress Wiesbaden, Abstract volume, October 2000

Evaluation of the effectiveness of three-dimensional pulsating electromagnetic fields of MultiBioSignalTherapy (MBST ®) on the regeneration of cartilage structures *[Evaluation der Effektivität dreidimensionaler pulsierender elektromagnetischer Felder der MultiBioSignalTherapie (MBST®) auf die Regeneration von Knorpelstrukturen]*
I.Froböse, U. Eckey, M. Reiser, C. Glaser, F. Englmeier, J. Assheuer, G. Breitgraf; Deutsche Sporthochschule Köln, Institut für Rehabilitation, University of Munich, Klinikum Großhadern, Department of Diagnostic Radiology, University of Munich, Anatomische Anstalt, Institut für Radiologie Köln, ReAgil Therapy Centre; published in: Orthopädische Praxis 8/2000, p. 510-515.

Prospective study of the effect of the MBST Magnetic Resonance Therapy on gonarthrosis

Further evidence of the efficacy of MBST therapy in the treatment of gonarthrosis was reported by Auerbach and employees of the Waldkrankenhaus Bad Düben – an orthopaedic clinic – and presented at the German Orthopädenkongress in Berlin (Auerbach and his colleagues, 2005). Title of the study: „Prospective study on the efficacy of MBST®-Magnetic Resonance Therapy in conservative treatment of gonarthrosis“. In this study, 60 patients with arthroscopically verified cartilage damage were treated with a therapy device of MedTec Medizintechnik GmbH, Wetzlar, for one-hour treatments on five consecutive days. The success of the treatment was objectified by means of various internationally recognised analogue scales and questionnaires.

Results:
a) Evaluation of efficacy in 59 patients immediately after treatment and after 2 and 6 months. For all criteria (7 in total) a statistically significant improvement compared to the previous value could be documented. Pain, joint stiffness as well as joint functions could be recognized as having improved. The improvements were 6-15% directly after the treatment, over 19-27% after 2 months, up to 32-40% after 6 months, depending on the parameters.
b) The success of the treatment was also clearly visible in a further assessment 12 months after completion of the therapy. After this period of time, placebo effects are no longer to be expected. This timing is remarkable because it must be concluded that nuclear magnetic resonance therapy has initiated long-term structural regeneration processes that may result from changes in protein synthesis (see section on preclinical effects).

Prospective study on the efficacy of MBST® nuclear magnetic resonance therapy in conservative treatment of gonarthrosis *[Prospektive Untersuchung zur Wirksamkeit der MBST®-Kernspinresonanztherapie bei der konservativen Therapie der Gonarthrose]* Auerbach B., Yacoub A., Melzer C.; Waldkrankenhaus Bad Düben, Specialist Hospital for Orthopaedics; Lecture at the German Orthopaedic Congress, Berlin, Abstract volume, Nov. 2003.

Prospective examination of the efficacy of MBST® magnetic resonance therapy in the treatment of gonarthrosis [Prospektive Untersuchung der Wirksamkeit der MBST®-Kernspinresonanztherapie bei der Behandlung der Gonarthrose]
B. Auerbach, C. Melzer, Waldkrankenhaus Bad Düben, 2003.

Prospective examination over 1 year on the efficacy of MBST® nuclear magnetic resonance therapy in conservative treatment of gonarthrosis [Prospektive Untersuchung über 1 Jahr zur Wirksamkeit der MBST®-Kernspinresonanztherapie bei der konservativen Therapie der Gonarthrose]
Auerbach B., Yacoub A., Melzer C.; Waldkrankenhaus Bad Düben, Fachkrankenhaus für Orthopädie; Orthopädische Praxis, Taucha; specialist lecture, poster presentation at the 1st Joint Orthopaedics - Trauma Surgery Congress, 19-22 October 2005, Berlin, in: Congress Catalogue, Abstract, Poster R2-446.

Treatment options for diseases of the musculoskeletal system

Today‘s medical, generally known, conservative treatment options for degenerative diseases are very limited. So far, there are no known ways of treating musculoskeletal disorders effectively and long-lasting. Almost all known forms of treatment in the medical field are pure impact treatments, but no causal treatment of the symptoms as the magnetic resonance therapy.

Not to mention the extensive lists of side-effects for numerous widely administered drugs.
Since usually treatments for osteoarthritis only aim at the symptoms but not at the causes – these are 1) Painkillers (mostly NSAIDs) and 2) intra-articular administration of corticoids or hyaluronic acid – all of them ultimately lead to expensive artificial joint replacement.

In addition, even these are usually worn out after 10 to 15 years and have to be replaced, which becomes increasingly difficult with each revision.

For total endoprostheses, it is now common knowledge that 50% of patients are not satisfied with the result of a joint replacement surgery.

However, an important question remains unanswered: Where is the wear and tear of the joint replacement deposited? What are the long-term negative consequences for the patient?

In contrast to all known forms of treatment, with the exception of the often unsatisfactory SYSADOA (systemically effective agents such as glucosamine), magnetic resonance therapy (MBST) causally targets degenerative joint changes at the cellular level.

Through the regeneration of cartilage or bone tissue, long-term pain is significantly alleviated or even eliminated, function and mobility are restored.

Advantages of MBST treatment:

- Non-invasive procedure.
- Causal form of therapy.
- No known side effects so far.
- No risk of infection.
- Uncomplicated form of treatment for diseases of the musculoskeletal system for which no essential form of therapy exists (e. g. finger joint arthrosis, spondylarthrosis, polyarthrosis, metabolic or circulatory disorders in the area of bone, osteoporosis, etc.).
- Short treatment time (5, 7, 9 or 10 treatment hours depending on the stage or type of the disease).
- Treatment is independent of the stadium of the disease.
- Operation delaying or for accelerated regeneration after necessary surgery.
- In surgical interventions, such as cartilage smoothing, the causal active principle at the cell level can be used to build up cartilage.
- In the case of intervertebral disc problems and herniated discs, surgery and the resulting scar tissue can be prevented.
- Sustainable and long-lasting therapeutic effect of 4.5 years and more
- The treatment is independent of the disease stage.
- Causal and sustainable treatment for pain patients or sports or accidental injuries

Effect of MBST Magnetic Resonance Therapy on low back pain

Introduction:
The high costs of treatment and the frequent sick leaves of patients with chronic low back pain as a result of the relative therapeutic refractory have an important social medical significance. In multidisciplinary rehabilitative approaches, we are nowadays looking for concepts that include new ways of improving pain-related disabilities. Back pain is often chronified by various psychosocial factors and because of the psychological stress due to the feeling of not being able to cope with daily activities (e. g. in the job), it is the urgent goal to interrupt the structured net of the factors involved in back pain as quickly as possible by means of appropriate therapy measures, in order to enable a reduction of the impairment. Thus, the treatment of back pain should be multimodal and this can be realized best in the context of in-patient rehabilitation.

Recently, a special form of magnetic resonance technology, a therapy method with special and highly complex magnetic fields based on the nuclear magnetic resonance, known as MBST® magnetic resonance therapy (MBST®), can be used. The active principle is based on that of well-known magnetic resonance tomographic diagnostic systems.

Method:
The study included 62 patients (36 men, 26 women) aged 18 to 71 (mean age: 48.1 years) with low back pain who had been admitted to the special hospital for illnesses of the musculoskeletal system of the Saalfelden pension insurance institution for a three-week in-patient rehabilitation. The diagnoses of the patients with chronic low back pain were secured by a physician and supported by means of computer tomographic, radiological or magnetic resonance imaging (MRI) techniques. They included: chronic lumbar syndrome (chronic low back pain, disc protrusion, spondylarthrosis, condition after spinal column fractures) n = 52, discus prolapse n = 7, postlaminectomy syndrome after discus extraction n = 6, cervical syndrome n = 10 (partly combinations of several diagnosis).

The design of the study was placebo-controlled, double-blind, randomized monocentric, multipointsurvey over a period of 3 months. All patients were treated with a standard in-patient multidisciplinary rehabilitation concept for spinal disorders including a physiotherapy concept consisting of dry and wet spinal gymnastics, mechanotherapy, massages, parafango and medical baths. Electrotherapeutic applications and stanger baths on the affected spinal segments were avoided.

All patients were treated in a highly complex air coil system with static permanent magnetic field (MBS therapy) with one-hour therapy sessions for 5 consecutive days (total treatment time with MBST® magnetic resonance therapy = 5 hours) (4).
The treatment device (nuclear spin resonance therapy system version KSRT-Key K1B, type MBST 600 KSRT; serial number 12100015) of MedTec Medizintechnik GmbH, D-35578 Wetzlar, Germany, works according to a new MBS therapy principle, which brings the protons of the hydrogen atoms into resonance with magnetic resonance. The protons of the hydrogen atoms (hydrogen nuclei) use the special permanent magnetic field to align their polarity (spin axis) in the magnetic field in the course of the field lines. The energy level of the hydrogen nuclei is influenced by defined frequency changes of the electromagnetic field through coupled radio frequencies with modulated treatment sequences. This magnetic resonance of the hydrogen protons generates energy, which is emitted highly effectively and in resonance when the field direction changes to the surrounding tissue.
In contrast to the conventional technique of pulsating electromagnetic fields (PEMF), the MBST® uses a command control unit with 12 separately controllable and independent coil systems, which are arranged partly ortogonally, i. e. offset by 90° to generate 3 threedimensional treatment fields that together with the permanent magnetic field generate a nuclear magnetic resonance field in the center of the coil system (4). The coded computer chip cards were also used for double-blind randomization. In this way, the generation of the complex nuclear magnetic resonance treatment field by the control unit was activated in half of the patients (= patient group with MBS therapy), while in the other group of patients no magnetic resonance field was generated (= patient group without additional MBS therapy = magnetic resonance placebo treatment).
After a comprehensive clinical examination at the start of the study (= day 0), 1 week after therapy and after 3 months the pain symptoms were assessed by means of a 10-part visual analogue scale (VAS) for a) the peak pain, b) the average pain during movement and c) the pain at rest. In order to assess the extent of the disability caused by chronic low back pain, the Roland & Morris questionnaire for low back pain was used at the above-mentioned measurement times.

Results

In the context of in-patient rehabilitation, the Roland & Morris' overall score for low back pain improved significantly after the three-week rehabilitation period in all patients with low back pain with the standardized multidisciplinary rehabilitation program, both in the group with additional MBS therapy ($p < 0.00001$) as well as in rehabilitation patients without MBST® ($p < 0.005$). It is noticeable that those patients with MBST® nuclear magnetic resonance therapy, starting from a higher average Roland & Morris score, improved more markedly than the comparative group despite double-blind randomization, with values of 10.93 ± 4.42 compared to 6.37 ± 4.48. On average, both study groups were practically identical after the three-week rehabilitation with regard to the Roland & Morris score. After 3 months, however, the Roland & Morris overall score for the patient group without MBS therapy rose again in scores close to those of baseline and was then no longer significantly lower than baseline with a score of 10.07. In the patient group, which had additionally received the 5-hour MBST® magnetic resonance therapy during inpatient rehabilitation, a significantly reduced (7.30; $p < 0.00001$) Roland & Morris overall score could still be documented after 3 months. Particularly noticeable improvements in the MBST® group were observed in question 18 regarding sleep disorders, where a significant ($p < 0.02$) improvement was observed after only 3 weeks which persisted even after 3 months. Also in question 6 – „Because of my back I lay down more and more to rest" – the percentage of patients who replied with „Yes" was reduced by half. Further advantages for MBST® treated patients were found in the time needed for dressing, which is discussed in Roland & Morris Question 9. The pain measurements with the 10-part visual analogue scale showed that pain during the three-week in-patient rehabilitation could be significantly improved in with both placebo and additional MBST® patient groups after only one week, and this reduction in low back pain was partially still noticeable 3 months later. For example, the low back pain patients assessed the peak pain after 3 months with VAS at 5.3 respectively 5.1 which is significantly lower than before the 5-day treatment series (VAS 7.9 respectively 8.1). The VAS-values of stress pain were significantly reduced under MBST® even after 3 months, but not under placebo. In general, all patients in the active MBST® group rated the MBST® as pleasant, free of side effects and pain.

Discussion

The lifetime prevalence of low back pain, i. e. the frequency of spinal pain related to the whole life, is reported to be 50 - 80%. This high incidence gives rise to a great social-medical significance of low back pain due to its adverse effects, as it causes considerable health economic costs. The evaluation of the success of therapy is nowadays regarded as standard: spine-specific function, pain, health status, ability to work and satisfaction of the patient. The Roland & Morris questionnaire is a validated German-language instrument for recording the functional status of low back pain patients. With the combined application of 10-part Visual Pain Scale (VAS) and Roland & Morris questionnaire it is possible to measure the success of Low Back Pain Therapy regarding pain, disability and physical improvement.

The results show that the successes achieved with standardised physiotherapy during 3-week rehabilitation with significant improvements in function, measured using the Roland Morris questionnaire for low back pain, are likely to lead to longer-term success in those patients with additional MBST®, as was evident after 3 months. At that time, the Roland & Morris global score was still significantly improved. In contrast to this, the rehabilitation effect of the standardised physical therapy measures is likely to be exhausted after 3 months without MBS therapy, since the RMDQ score values of the placebo group were again within the range of the baseline values at that time. In many of the Roland & Morris scores, patients treated with active MBS therapy had a significant advantage over the group with standard therapy program and additional MBST® placebo treatment. For example, the patients treated with MBST® were significantly less handicapped in for example crouching down and dressing after 3 months than in the placebo group. It is interesting to note the significant improvement of sleep disturbances caused by low back pain, which could be observed only a few days after the therapy and even after 3 months, the patients treated with MBST® were able to benefit from an improved sleep quality. It should be noted that these patients also reported less pain-related periods of rest (Roland & Morris, question 6). The pain measurement (VAS) shows that a longer-term positive improvement of the pain tolerance could be achieved in both groups, this fact documents significantly the treatment success of the three-week in-patient rehabilitation program. However, a clear advantage was observed in the MBST® group with a reduction of stress pain, which could be recorded over the entire observation phase; this naturally suggests a structurally modifying effect, which would be possible after 3 months. However, the clear improvement in pain after just one week of therapy indicates an additional fast triggering of other effects that are directly analgesic.

In general, MBST® magnetic resonance therapy is seen as an additional, easy-to-use therapy procedure with very short therapy times, which can significantly increase the therapeutic success in the rehabilitation of patients with low back pain without side effects.

Osteoarthritis as main indication for MBST

Background: Arthrotic changes of the musculoskeletal system are a very big problem in health systems due to their enormous frequency and them being one of the highest cost factors. The increase in the age structure, the conditions of the private and working environment are constantly changing to the negative, so that degenerative changes in joint and bone structures, osteoarthritis, spinal disorders and osteoporosis are immensely increasing diseases.

The prevailing medical doctrine up to the year 2000 that cartilage tissue, if damaged, could not be regenerated, has meanwhile been proven to be inaccurate based on the findings of cell research.
The counterevidence was also supported by the results of studies using nuclear magnetic resonance therapy equipment.
A large number of scientific investigations conducted in accordance with internationally recognized rules showed that nuclear magnetic resonance fields can trigger verifiable regenerative processes in living tissue.

Low back pain
Chronic back pain is very common and causes considerable psychosocial and health economic costs.
The cervical and lumbosacral regions are usually affected. Low back pain is often associated with functional deficits/disabilities (Urwin et al., 1998).
The prevalence of chronic, non-specific low back pain is constantly on the rise in all industrialized countries. In addition to the impairment of patients at work and in everyday activities due to treatment costs and loss of work, it is also associated with high socio-economic expenditures for the general public (Waddell, 1996; Murtezani et al., 2011; Deyo et al., 1991). The vertebral joints with the articular surfaces on the Processus articulares can cause considerable pain when affected by degenerative arthrotic changes. With the wear and failure of mechanical stabilization and load distribution during degeneration and reduction of the height of the intervertebral discs, pathological shifts, shear movements and tilting are possible, which affect the entire motion segment.
In the region of the posterior pillar of the spinal column, overstressing and degeneration or osteoarthritis of the vertebral arch joints occur.
These arthrotic processes of the spine are called spondylarthrosis or facet joint syndrome. Here, too, the characteristics of osteoarthrosis are a narrowing of the joint line, sclerosis and edge serration in the X-ray.
These changes in the vertebral joints lead to pain, muscle tension and vertebral blockages with myofascial pains at the tendon/band attachments.

Functional improvement in fingerpolyarthrosis

Introduction: Due to the limited therapeutic possibilities for hand and finger joint arthrosis, there is a need to evaluate new therapeutic principles. Nuclear magnetic resonance can stimulate repair processes in the cartilage and influence pain signal transduction cascades.
Thereby therapeutic effects in the treatment of osteoarthritis are possible.
Latest research literature on wrist arthrosis urgently demands the evaluation and examination in clinically controlled studies of new therapeutic strategies. This demand is met with the nuclear magnetic resonance therapy.

Osteoarthritis of wrists and finger joints are the main cause of disability to carry out daily activities. The main symptoms of finger osteoarthritis are: in early stages a feeling of tension and stiffness, stress-dependant pain, increased pain in cold and damp weather, swelling and redness of the joints, movement restrictions, muscle tension due to compensatory relieve postures, loss of function.
To date, not all pathogenetic processes are known, so therapy consists of combating symptoms or a surgical intervention. This is why concepts that also include new ways to improve pain-related handicaps in the treatment of wrist and finger joint osteoarthritis are of great interest. One of these new concepts is therapeutic nuclear magnetic resonance (KSRT). Cells can react to the nuclear magnetic resonance of hydrogen protons with a functional or structural change.
Everyday activities such as finger functioning, dressing as well as hand functioning for personal care and household activities, „hold a cup“ or „open a lock“ are well captured with the applied QUABA score.

The effect of nuclear magnetic resonance treatment on 70 patients with osteoarthritis of wrist or finger joints was examined in a double-blind, randomized, placebo-controlled study over a period of 6 months (length of treatment series; 9 x 1 hour).

Methods:
The study design included patients with clinically and radiologically diagnosed finger joint osteoarthritis according to the criteria of the American College of Rheumatology (ACR). Middle of patients was 69 ± 8 years. The assignation was performed randomly and double-blind to one of two groups: Group I (n = 35) with active nuclear magnetic resonance therapy and Group II (n = 35) placebo group without activated magnetic resonance field.
Blind computer chip cards for the control unit of the magnetic resonance therapy system guaranteed double-blind randomization. The therapy system used was a device from MedTec Medizintechnik GmbH, Wetzlar, Germany (nuclear magnetic resonance therapy, Key 1B, type MBST 300). Therapy duration was 1 hour daily on 9 consecutive days (total therapy duration = 9 hours).
In order to measure the effect of the therapeutic measure nuclear magnetic resonance and to be able to make statements about the progression of the finger joint osteoarthritis, the following outcome measurement instruments were used:
Visual analogue scale (VAS) for peak, stress and pain at rest; the clinically functional handscore according to QUABA for assessing hand function and disability for the criteria:

- 1. Dressing (pull on stockings; button up blouse/shirt),
- 2. Personal care (wash and comb hair; dry with a towel),
- 3. Household activities (cut with scissors; open cans with a mechanical can opener),
- 4. Manual everyday activities (grasp single coins from a wallet; hold a soft plastic cup filled with water; open or close the front door resp. lock; write with a pen).

Measuring dates were day 0, day 10 and day 180.

Results:
Pain intensity could be significantly reduced by magnetic resonance therapy, but not in the placebo group. Peak, stress and pain at rest improved with the application of KSRT, but not under placebo. During the active nuclear magnetic resonance therapy and in the follow-up after 6 months, pain frequency could be significantly reduced continuously. In the control group with placebo treatment, however, there was a steady and after 6 months even significant increase in pain frequency ($p < 0.005$). Hand functioning improved significantly after treatment with the active magnetic resonance, as can be seen in the highly significant increase of the QUABA overall score. This significant improvement could be maintained even after 6 months ($p < 0.00001$).In the inactive magnetic resonance therapy placebo group, on the other hand, QUABA values concerning hand functioning did not improve after placebo treatment; in contrast to the group with active magnetic resonance treatment, the values of this group deteriorated significantly after 6 months. Both treatment groups did not differ statistically on day 0, but after 6 months the group with active magnetic resonance therapy had a significantly higher QUABA score than the placebo group. In addition, for the subcriteria of the QUABA score, such as dressing, personal care, household activities, manual dexterity, similar good results in the group with active nuclear magnetic resonance and a deterioration of the functioning under placebo could be observed. In both treatment groups, not a single adverse effect was recorded during treatment with the magnetic resonance therapy system.

Summary:
Due to the limited available therapeutic possibilities for hand and finger joint osteoarthritis, there is a need for the evaluation of new therapeutic principles.

Magnetic resonance therapy is a new effective treatment option for hand and finger joint osteoarthritis. Everyday functions such as finger functioning during „dress" activity as well as hand functioning during personal care and household activities, „hold a drinking cup" or „open a lock" are well captured with the QUABA score. Our studies show that these finger functions, as well as the stress pain in patients treated with KSRT, were improved after 6 months, but not after placebo treatment, which group showed a significantly reduced hand functioning with a simultaneous increase in pain within 6 months.

A proliferation of volume and density of cartilage in knee joint cartilage following the therapeutic application of nuclear magnetic resonance treatment was already computer tomographically demonstrated a few years ago. Stamm et al. recommends clinical outcome variables such as daily acitivites and pain as well as mobility and stiffness. Studies by Kjeken et al. shows that about half of the patients with finger joint osteoarthritis have problems opening bottles and wringing out clothes, because the strength of their grip is reduced by more than 40% and the limited mobility of the hands is painful. Our examinations show that with the application of therapeutic nuclear magnetic resonance in the treatment of finger joint osteoarthritis finger functioning in manual everyday activities is improved sustainably for several months and pain is reduced. This shows that nuclear magnetic resonance therapy is a new treatment option for osteoarthritis of the finger and wrist joints.

Functional improvement in the case of finger joint arthrosis after therapeutic use of nuclear magnetic resonance
[Funktionsverbesserung bei Fingergelenksarthrosen durch therapeutischen Einsatz der Kernspinresonanz]
Kullich. W, Ausserwinkler . M., Orthopädische Praxis, 44 (6), 287-290 (2008)

Improvement of function in finger joint arthrosis by magnetic resonance
[Funktionsverbesserung bei Fingergelenksarthrose durch Kernspinresonanz]
W. Kullich, M. Ausserwinkler; published in: Jatros Orthopaedics, official organ of the ÖGO, No. 4/2008, p. 29

Improvement of function in finger joint arthrosis through the therapeutic use of nuclear magnetic resonance
[Funktionsverbesserung bei Fingergelenksarthrosen durch therapeutischen Einsatz der Kernspinresonanz]
W. Kullich, Ludwig Boltzmann Institute for Rheumatology, Balneology and
Rehabilitation; Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases; scientific poster presentation at the 56th Annual Conference of the Association of South German Orthopaedic Surgeons, 1-4 May 2008, awarded with a poster prize of the Association of South German Orthopaedic Surgeons, Baden-Baden 1-4 May 2008.

Long-term effect of Magnetic Resonance Therapy for osteoarthritis shown by multicentric data of more than 4,500 patients

Introduction: In the present study, over a period of 10 years treatment data was evaluated for a technical medical device in an unusually large group of 4,518 treated patients. Data was recorded and evaluated multicentrically for various types of arthrosis 10 days, 3 months, 6 months and 12 months after nuclear magnetic resonance therapy treatment, using internationally recognized pain and scoreboard arches. In patients with chronic non-specific low back pain, there is no clear indication for surgical intervention. Therefore, depending on the pain condition, therapy is usually carried out with medication or physiotherapy. The non-surgical MBST therapy tries to delay or even reverse the course of the disease. Non-drug treatments for osteoarthritis are often based on relieving the joint to reduce symptoms (Rannou and Poiraudeau, 2010).

Methodology: The evaluation criteria for the therapeutic effect of this large-scale study was to assess rest-, stress- and peak pain using the Visual Analog Scale VAS. Validated functional indices, which are well suited for long-term documentation of osteoarthritis and are able to measure disability, functional deficits and limitations of everyday activities in addition to pain condition were used for further evaluation of the clinical success.

- For the indications gon- and coxarthrosis the functional score of Lequesne was used (Lequesne, 1991; Lequesne, Mery et al., 1987).
- Indices developed for gon- and coxarthrosis by Lequesne (1987,1990,1991) for the detection of symptoms and physical functional handicaps are often recommended as the endpoint in the testing of symptom-oriented therapies (Stucki et al., 1996). The Lequesne Index is a self-assessment tool that is well established internationally. The time requirement is short and the sensitivity to change is excellent.
- The score of Mazur et al. (1979) was used to assess osteoarthritis of the ankle joint.
- Functioning of the back was assessed using the Oswestry back disability questionnaire from Fairbank et al. (1980).

The evalutation included the reports of 4,518 patients (gonarthrosis n = 2770; coxarthrosis n = 673; ankle joint arthrosis n = 420; low back pain n = 655). Average age of the patients was 62.4 ± 12.9 years (gonarthrosis), 64.6 ± 10.7 years (coxarthrosis), 58.6 years ± 15.3 years (osteoarthritis of the ankle joint), 62.8 ± 14.1 years (low back pain).

Gonarthrosis

Additional studies by the authors of the Ludwig Boltzmann Department in Saalfelden and Gröbming (Austria) on a small group of 32 patients showed a good pain-reducing effect of nuclear magnetic resonance therapy, even with only 5 therapy units, but here with the effect showing a slightly decreasing tendency after 6 months; experience shows that 7 to 9 units are more advantageous for sustainability.
If the handicap of the activities of daily life is reduced in accordance with the intensity of the pain as indicated in the Visual Analogue Scale, as could be demonstrated for the therapy with KSRT in several thousand patients, it is possible to make an overall assessment of the long-term course of the disease.

Knee joint osteoarthritis represented the largest number of evaluable protocols. 41.9% of gonarthrosis patients were male, 58.1% female. It is noticeable that the highest percentages of overweight (45.8%) and obese (22.2%) persons were observed in cases of gonarthrosis, only 32% of the patients surveyed was of normal weight with a BMI below 25.

During the course of the 1-year follow-up, peak, stress and pain at rest were on average continuously reduced. Already after the MBST treatment series, patients reported reduced pain scores on the VAS scale, the improvement was further intensified after 3, 6 and 12 months and did not return to baseline levels. For all 3 types of pain, the pain reduction was significantly reduced at all 4 observation times with a significance level of $p < 0{,}00001$. The frequency of pain in the knee joint also decreased significantly for all 3 types of pain with a remarkable low incidence of pain after 6 and 12 months after MBST® therapy. The stress pain decreased from a score of about 6 (= often) on a 10-part scale to about 4 (= little), the frequency of peak pain was reduced to „very little“ (= 3) and the pain at rest to „rare“ to „very rare“.

Parallel to the pain reduction, the functional handicaps measured with the Lequesne index were significantly improved.

The Lequesne Osteoarthritis index consists of 3 sections with a total of 10 questions. In addition to the global score, the survey also evaluated these 10 questions on complaints, walking and functioning and calculated the 3 sections statistically. Like the significant improvement in the global score, all three sub-sections of the Lequesne index improved, with the highly significant reduction in functional handicap and pain and discomfort ($p < 0.000001$). The number of patients with gonarthrosis who had no complaints at night was increased from a baseline of 39% to 72% 12 months after magnetic resonance therapy.

The group without pain while walking was also increased from 23.5% to 48.2%. Remarkably good improvements with high percentages were recorded especially in climbing stairs, walking on uneven ground, kneeling and walking distance 6 to 12 months after nuclear magnetic resonance therapy. 31.9% of patients with knee joint osteoarthritis were able to kneel or squat without any difficulty one year after the therapy. Before this had only been possible for 14.9% of the 2,770 patients.

The correlation analysis carried out showed significant correlations between pain and functional limitations in patients with gonarthrosis with respect to the changes within 1 year after an MBST treatment series. Thus, for example, the reduction of the stress pain described above correlated clearly with the complaints while walking as described in the Lequesne index ($r = 0.42$; $p < 0.000001$).

Another example is the correlation between the decrease in the intensity of peak pain within 12 months and an improved ability to „squat down“ ($r = 0.38$; $p < 0.000001$) or go down the stairs ($r = 0.40$; $p < 0.000001$).
It should be noted that significant improvements in the degree of movement occured after only 3 months; these increases in flexion and extension were even higher after 6 and 12 months.

The analysis of the collected data with regard to the Body Mass Index (BMI) is also interesting. In the presence of an obesity with a BMI > 30, a significantly higher Lequesne global index could be demonstrated at all times of measurement. This also applies to the subsections pain/complaints, walking distance and functional handicaps. The initially significantly higher pain in obese patients, regarding both intensity and frequency of pain, did not differ from the values of normal weight gonarthrosis patients with a BMI < 25 one year after the application of nuclear magnetic resonance therapy.

Coxarthrosis

The application of a series of nuclear magnetic resonance treatments showed an overall clear improvement in pain and functioning in the group of patients with hip joint arthrosis. It is interesting to note that these improvements were still detectable 1 year after the therapy. Stress pain improved from a median VAS score of 4.6 ± 2.4, which stands for very significant pain, to a value of 3.3 ± 2.1, with peak pain intensity also decreased significantly from 5.2 ± 2.7 to 3.1 ± 2.9 after 1 year.

Calculation of the percental change in each individual patient, based on the baseline value of peak pain, shows on average a clear increase in the frequency of a reduced peak pain in coxarthrosis patients from 18.9% at 3 months to 27.7% at 6 months to 34.5% at 12 months.
The improvement in pain were also shown in pain at rest ($p < 0.000001$), where the value after 1 year, VAS 1.4 ± 1.7, differed significantly from the baseline value of 2.8 ± 2.5.

Based on the improvement in each individual patient, the level of rest pain improvement after 1 year was 42.8% related to the intensity, in terms of frequency 36.3%. With the decrease in the intensity of the pain, a significant reduction in the 10-part ranking of the frequency of pain with regard to peak pain, stress pain and pain at rest was observed in the course of one year after magnetic resonance therapy. Peak and stress pain correlated significantly with the global score of the Lequesne index ($r = 0.33$ resp. $r = 0.34$; $p < 0.01$), but also with functional handicaps ($r = 0.34$, $p < 0.01$).

These changes also explain the improvement in sleep quality recorded in the Lequesne index. Overall, the Lequesne index for the assertion of symptoms and physical functional limitations of coxarthrosis decreased significantly in the global score from 7.14 on average ($p < 0.000001$) to 4.58 within the 1-year follow-up period, which is also confirmed by the distribution-independent median value, which dropped from 7.0 to 4.0.
In addition to the Lequesne global score, which comprises the values assessed in 10 questions that can be assigned to 3 sections, these sections on pain/complaints, walking and functioning were also statistically evaluated individually for hip joint arthrosis. In particular, the values for complaints improved highly significantly ($p < 0.000001$) of baseline. The functional handicaps were also significantly lower than before treatment at the time of 3 to 12 months after magnetic resonance therapy.

It was noticeable in the percental distribution of the individual questions that after 1 year almost half of the patients, 47.5%, reported that they did not have any problems with walking. At baseline this was only possible for about 20% of the patients. 21.9% stated before treatment that they were only able to put on stockings with considerable effort or great difficulty. 12 months after the therapy this handicap existed for only 12.1%. 13 patients had not even been able at all to put on their stockings themselves before the therapeutic application because they could not bend the leg in the hip so far forward.

1 year later, there were no more patients with this kind of handicap, more than half of the patients with hip joint arthrosis (53.5%) were able to put on their stockings themselves without difficulty. All patients were also able to get in and out of a car after 1 year, nobody had great difficulties and only 4% of them had to make a lot of effort. Parallel to the lower rate of functional handicaps and reduced pain, the percentage of patients who were able to walk up/down stairs without difficulty was doubled after 12 months (59.6%).

In the rank correlation analysis following Spearman, which allows an exact examination of non-normally distributed measured values, clear, significant correlations between the intensity of coxarthrosis pain and the Lequesne index that is oriented on functioning could be shown in the analysis of changes between baseline and 12 months after KSRT ($p < 0{,}01$ – $p < 0{,}001$).

Osteoarthritis of the hip joint is often one-sided and predominantly of secondary etiology. As the disease progresses, the possible walking distance shortens increasingly with characteristic limping. The examinations show that patients with coxarthrosis showed a clear improvement of the restricted walking distance after magnetic resonance therapy, while at the same time the discomfort of walking was reduced.

Chronic low back pain in the spine

The application of a series of nuclear magnetic resonance treatments showed an overall clear improvement The data included 655 patients (247 men - 37.7%; 408 women - 62.3%) with chronic nonspecific back pain. Therapeutic nuclear magnetic resonance had a definite influence on the symptom back pain in degenerative spinal diseases. Chronic pains in the area of the spinal column were clearly reduced both during the daytime peaks as well as under stress and at rest during the 1-year observation phase.

For example, the intensity of stress pain was remarkably clear reduced 1 year after magnetic resonance treatment, it decreased on average from 5.01 to 2.86; at the same time, the distribution independent mean value of peak pain decreased from 6.0 baseline to 2.5 after 12 months. Mean pain intensity at rest was also clearly and highly significantly ($p < 0.000001$) reduced with a value of 1.96 on average (1.0 in the median) at 6 months and 1.91 (median: 1.0) at 12 months compared with the mean pain intensity of 3.2 (median: 3.0) at baseline. The frequency of peak, stress and pain at rest in low back pain also decreased clearly and significantly during the 12-month follow-up period ($p < 0.000001$). Considering the percental improvement in pain intensity of each individual spine patient, it becomes clear that the greatest reductions are observed 6 months after magnetic resonance therapy (peak pain 37.7%; stress pain 32.4%; pain at rest 35.9%), but that they are only marginally lower after 12 months (35.5%; 32.0%; 33.1%). This clearly demonstrates the sustainable effect of magnetic resonance therapy for chronic back pain.

Parallel to the reduced pain, patients with spinal affections were able to perform everyday activities such as lifting, walking, sitting, standing and travelling more easily, especially in the period of a half up to 1 year. The quality of sleep improved continuously and the ability to personal care was less handicapped. These functional improvements are included in the Oswestry Disability Index. The global score of the Oswestry Disability Questionnaire showed a clear downward tendency both on average and in the median. The change from 23.9 (median: 22.5) points in baseline to 12.4 (median: 7.5) points in the Oswestry after 12 months represents a clear improvement, which is usually defined from a difference of 10 points or more, statistical data processing showed a significant decrease in the Oswestry disability score ($p < 0.000001$). This reduction of the restriction of activity or subjectively experienced handicaps has a very positive effect on the psychosocial influencing factors in the process of chronification of back pain.

When comparing obese and normal weight patients with back pain in relation to the sustainability of the effect of the therapeutic nuclear magnetic resonance, it is noticeable that in the case of obesity the effects are weaker, a significant worsening of all types of pain in terms of intensity and frequency after 12 months can be observed. These values are significantly different from the VAS measurement results of normal weight patients, who reported the lowest pain scores after 1 year. This fact is also confirmed by the Oswestry Disability Index with significantly ($p < 0.000001$) better values for back functioning with normal weight (BMI < 25) compared to those with obesity (BMI > 30) 12 months after nuclear magnetic resonance therapy.

Ostearthritis of the ankle joints

For the patients with painful arthrotic changes in the ankle joint included in the survey a clear significant reduction in the intensity of stress pain, but also with regard to peak and rest pain was achieved right after magnetic resonance therapy. The improvement, calculated from the changes of each individual patient with ankle joint arthrosis, averaged 46.7% for peak pain, 47.0% for stress pain and 40.4% for pain at rest 1 year after the therapy series; pain reductions about of 37 - 40% were already registered 3 - 6 months after nuclear magnetic resonance therapy.

Also the frequency of pain showed a declining statistically significant ($p < 0.000001$) tendency from score values around 6 = often/daily over 4 = little to 2 = rarely/1x per month. The score calculated according to Mazur averaged 51.8 (median: 53.0) points. Pain was the leading complaint.
In the 12-month follow-up, the survey showed a continuous increase in points over 63.5 (median: 70.0) points 3 months after nuclear magnetic resonance therapy up to 69.3 (median: 75.0).

Because of the complaints in the area of the upper ankle joint, there were clear restrictions due to limping, especially with regard to walking distance and climbing stairs. All of these parameters were significantly improved after 12 months ($p < 0.01$ for stair climbing up to $p < 0.000001$ with regard to the walking distance). These observations show a clear improvement in the function of the upper ankle joint after a therapeutic nuclear magnetic resonance. With regard to functioning, it should also be noted that after just 6 - 8 weeks the walking distance, which is a good indicator of an improvement regarding the ankle joint, improved considerably with further increases over the entire observation period of one year.

At the same time, other parameters such as climbing stairs, walking uphill, standing on toes improved and the use of walking aids was reduced significantly.The statistical analysis proves these observations with correlations, in particular the intensity of the peak pain with the overall score according to Mazur ($r = 0.46$; $p < 0.003$), walking up and down stairs ($p < 0.02$ - $p < 0.002$) as well as the covered distance ($r = 0.40$; $p < 0.01$). Clearly, there is a significant formal correlation between the increase in the distance covered and walking up and downhill ($r = 0.68$ or $r = 0.60$; $p < 0.00001$ or $p < 0.000001$). A Finnish study (Karjalainen et al., 2003) describes a negative influence of a high BMI on the success of therapies for low back pain. This observation is confirmed by our examinations, since after the application of nuclear magnetic resonance therapy the effects on pain of patient with a high BMI are worse than with normal weight, especially after 12 months. Also the functioning of the back was significantly better in patients with normal weight (BMI < 25) after 1 year than in those with obesity (BMI > 30).
In contrast, the resulting effects of magnetic resonance therapy for normal weight and obese patients did not differ did not differ in the case of osteoarthritis of the ankle joint, gonarthrosis and coxarthrosis.

Summary: The presented improvements in pain and functioning in knee and hip joint arthrosis after KSRT treatment can also be valued positively for fatigue, which occurs in about half of the patients; this connection was recently described by a Dutch study group in an examination of 231 patients with gon- and coxarthrosis (Snijders et al., 2011). As with other joints, osteoarthritis of the upper ankle joint is associated with cartilage degeneration, increased abrasion and a narrowing of the joint line. As with other kinds of osteoarthritis, in the course of the disease the symptoms in the ankle joint become more frequent and the exercise capacity decreases. Further damage is caused by inflammatory reactions in the joint. Due to the osteoarthrosis of the ankle joint with functional handicaps, the quality of life of the affected person decreases further. The chronicity of low back pain also includes individual, psychosocial and acquired risk factors, such as changes in the boundaries of pain (pain memory), depression, obesity. Therefore, the data of normal weight and obese patients were compared during the evaluation. Any long-term pain-reducing treatment, such as in our case the therapeutic nuclear magnetic resonance, is important to interrupt the chronification of pain with negative effects on the pain memory. The data from this 10-year survey confirm the experiences of previous studies, the Oswestry disability questionnaire clearly shows the functional improvements regarding back pain following the magnetic resonance treatment series for everyday activities such as walking, sitting, lifting, travelling, personal care and sleep quality.

Conclusion: The data on the use of nuclear magnetic resonance for therapeutic purposes with an observation period of almost 10 years clearly shows that the application of therapeutic nuclear magnetic resonance in degenerative rheumatic diseases can lead to lasting improvements in pain experiencing and handicaps due to functional deficits in everyday activities.
From a cost-benefit point of view, the statistical analyses carried out show that the application of nuclear magnetic resonance therapy in the treatment of degenerative rheumatic diseases, in particular osteoarthritis due to the long-term effects, represents an economic additive therapy or alternative treatment and thus makes a highly significant contribution to the health economy.

The therapeutic application of nuclear magnetic resonance in the treatment of gonarthrosis, low back pain and finger polyarthrosis *[Die therapeutische Anwendung der KernspinResonanz bei Gonarthrose, Low back pain und Fingerpolyarthrose]*
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the conference „Evaluation and Research in Rehabilitation“, Gröbming, Austria, September 13,2007.

Long-term effects of nuclear magnetic resonance therapy in arthrosis show multicentre data from more than 4,500 patients *[Nachhaltige Wirkung der Kernspinresonanztherapie bei Arthrosen zeigen multizentrische Daten von über 4.500 Patienten]*
W. Kullich, B. Stritzinger, B. Steinecker, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden; Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; poster presentation at the first LBG Meeting for Health Sciences, Vienna, Austria, 02 December 2013.

Long-term effects of nuclear magnetic resonance therapy in arthrosis show multicentre data from more than 4,500 patients *[Nachhaltige Wirkung der Kernspinresonanztherapie bei Arthrosen zeigen multizentrische Daten von über 4.500 Patienten]*
B. Stritzinger, B. Steinecker, W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden; Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; published in: Journal for Mineral Metabolism 2013;20 (4): 159.

Nuclear magnetic resonance therapy - sustained improvement of arthrosis pain (multi-center observational study in 4,518 patients) *[Therapie mit Kernspinresonanz – Nachhaltige Verbesserung von Arthroseschmerzen (Multizentrische Beobachtungsstudie an 4.518 Patienten)]*
W. Kullich, B. Steinecker, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; published in: „Traum und Wirklichkeit. Schmerztherapie im Spannungsfeld zwischen Ethik und Ökonomie“, ÖSG lectures, Leykam Buchverlag, 2013: 43-44.

One-year-survey with multicenter data of more than 4,500 patients with degenerative rheumatic diseases treated with therapeutic nuclear magnetic resonance
W. Kullich, J. Overbeck, H. U. Spiegel. J Back Musculoskeletal Rehabil 26 (1), 93-104 (2013)

Application of Magnetic Resonance as a new therapeutic option

Method / Results:
Additional studies by the authors of the Ludwig Boltzmann Department in Saalfelden and Gröbming (Austria) on a small group of 32 patients showed a good pain-reducing effect of nuclear magnetic resonance therapy, even with only 5 therapy units, but here with the effect showing a slightly decreasing tendency after 6 months; experience shows that 7 to 9 units are more advantageous for sustainability.
If the handicap of the activities of daily life is reduced in accordance with the intensity of the pain as indicated in the Visual Analogue Scale, as could be demonstrated for the therapy with KSRT in several thousand patients, it is possible to make an overall assessment of the long-term course of the disease.

Application of nuclear magnetic resonance as a new therapy option for gonarthrosis
[Anwendung der Kernspinresonanz als neue Therapiemöglichkeit bei Gonarthrose]
N. Fagerer, W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden; Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; published in: Arzt und Praxis, May 2007; vol. no. 927, pp. 180-182,61st volume Austria

Analysis of the long-term effects of MBST Magnetic Resonance Therapy for gonarthrosis

Aim of the study and evaluation basis
The results of the present study are based on surveys on the pain condition and restrictions in everyday life of 39 patients suffering from gonarthrosis who were treated with MBST magnetic resonance therapy up to 4 years before the time of the current survey. Patients‘ data includes information on their state of health directly before and after the therapy, as well as 6 months after the therapy and at the time of the current survey. MBST treatment was carried out in nine sessions of 60 minutes each on consecutive working days. The survey was carried out by means of an anonymous patient questionnaire for self-assessment of the course of the disease, which is described by the frequency and intensity of spontaneous peak pain, mean stress pain and pain at rest as well as by the Lequesne index for knee diseases. While the information on pain frequency and intensity is recorded directly via a numerical analogue scale from zero (no pain) to ten (permanent pain or strongest imaginable pain), the Lequesne index was determined indirectly by means of a multiple-choice survey on restrictions in everyday activities such as climbing the stairs.

Results
An overview of the study shows that in all areas examined – pain intensity, pain frequency and Lequesne index – all levels have been shifted to lower values and thus result in an improvement of the general health status after MBST. A comparison of the distribution of pain and Lequesne levels before and after the therapy shows a significant increase in the percentage of patients with no or little pain. Similar values can be observed regarding the intensity and frequency of pain. The proportion of patients in the range of lower points [0–1] increases from 50–60% to 85% for pain at rest, from 10% to 40–55% for moderate stress pain, and from 15% to 40% for spontaneous peak pain. At the same time, the proportion of patients with severe pain [>5], which was in some levels more than 60% before therapy, is reduced to a maximum of 15%. The Lequesne index also shows a shift to lower values after magnetic resonance therapy. In this context, the proportion of patients with low or no handicap increases from approx. 30% to 45%.

Discussion
The results of the study have shown that MBST can have a very positive and sustainable influence on the restrictions in everyday activities assessed by the Lequesne index as well as on intensity and frequency of pain. The temporal development of pain implies that the healing process takes at least one year, but that the symptoms of the patients often subside after only six months, so that overstressing the regenerating cartilage tissue during this period has a negative effect on the healing process. The generally significant reduction in pain at rest indicates that the regeneration process of degenerated cartilage tissue that is activated by MBST therapy first affects pain at rest, which usually only occurs at an advanced stage as a result of a high degree of cartilage degeneration.

The analysis of the reduction in pain intensity shows that the extent of the decrease is not correlated with the corresponding value before treatment but is also influenced by additional factors such as gender, age and physical activity. In contrast, a clear correlation can be observed between the frequency of pain before therapy and the level of pain reduction; a higher value in pain before treatment leads to a greater reduction in the frequency of pain.

Patients with higher degrees of osteoarthritis and/or more active forms can therefore benefit more. The gender-specific comparison shows that the therapy definitely has a more positive effect in female patients, despite similar initial values in the areas of pain intensity and the Lequesne index. It is possible that an increase in bone density, which is also stimulated by the therapy and which tends to be low and steadily decreasing in women at least after the menopause, is probably more noticeable and leads to a stronger subjective reduction of pain. In the analysis regarding age, the study shows that there is a much more pronounced reduction of the restrictions and a more significant decrease in intensity and frequency of pain in the elderly group of patients. A possible cause might be the higher age and thus state of retirement of this group of patients who are as a result not exposed to the physical stress of working life and higher everyday stress. It is also conceivable that a concomitant effect on the osteoporosis, which is mostly detectable at this age, occurs. The data regarding sports activity shows a slightly higher decrease in mean stress and peak pain in the active group, although the level of pain remains above that of inactive patients after treatment. When it comes to pain at rest, however, a much more positive effect on inactive patients could be found, so that they overall tend to achieve a better therapy success. Therefore, a positive influence of the therapy by sports activities is not recognizable regarding restrictions of everyday life or pain condition. One possible cause could be that even when practising sports that are regarded as easy on the joints, wrong performance or misinterpretation of the individual limit of stress can have a negative effect on the cartilage tissue. The study has shown that MBST nuclear magnetic resonance therapy can achieve significant success in the treatment of osteoarthritis and that the regeneration process is not yet complete even years later. Patients obviously feel better for years after a therapy. Further and mostly more expensive treatments are often rendered unnecessary. It is conspicuous that especially in elderly patients with an advanced stage of osteoarthritis there is a significant improvement of condition. In many cases, total endoprothetic joint replacement can be delayed for years or even avoided. Another conservative method of treatment that produces similar results is hardly known to date.

Analysis of the Long-Term Effect of MBST® Magnetic Resonance Therapy in Gonarthrosis
[Analyse der Langzeitwirkung der MBST® KernspinResonanzTherapie bei Gonarthrose]
W. van Laack, G. Froning, Institute of Bioengineering (IfB), Laboratory Biomechanics, FH Aachen, Campus Jülich, Orthopaedic Joint Practice and Centre for Outpatient Arthroscopic Surgery, Herzogenrath b. Aachen; published in: Orthopädische Praxis 47,11,2011, pp. 536-543.

Indication Sports and accidental injuries

Chronic and acute injuries of ligaments, muscles, tendons, bones and joints

In 2007, Dr. Gorschewsky from the Sports Orthopaedics Clinic in Bern carried out a prospectively randomized double-blind study with a group of 60 patients with intraoperatively arthroscopically confirmed gonarthrosis or chondromalacia to investigate the efficacy of nuclear magnetic resonance therapy. Because of patient compliance (distance between place of residence / place of performance), the study was carried out with only 5 application hours (every second day with one hour over a period of two weeks each) in deviation from the guidelines that propose 7 hours. The follow-up check was carried out 4 weeks after the therapy, deviating from the usual 3-month period.
In contrast to the results of earlier studies, this study showed no significant difference in the evaluation of accelerated rehabilitation after knee arthroscopy in patients with chondromalacia. Both the Lysholm and Koos scores showed no significant difference between the placebo and the MBST group.
The researchers put these results in relation to the findings of a study of 2,868 knee patients and found that changes in the MBST application interval have a very negative effect on the efficacy and the overall result. The daily application and the number of treatment hours must therefore be strictly adhered to in MBST treatments in order to achieve the optimum effect. With too short periods of follow-up examinations or evaluation appointments, which in this study deviate from the guidelines, an evaluation of the achieved and objective treatment success is not possible.

Investigation of the efficacy of nuclear magnetic resonance therapy for arthroscopically confirmed chondromalacia of the knee joint or gonarthrosis *[Untersuchung der Wirksamkeit der Kernspinresonanztherapie bei arthroskopisch gesicherter Chondromalazie des Kniegelenks bzw. Gonarthrose]*
O. Gorschwsky, Specialist hospital Sportortopädie Bern, 2007

Top-class medicine in handball – Better care by combined use of different therapies for acute muscle injuries

Aim of the observations
This study examined the therapeutic successes of the therapy in sports and accidental injuries. For some time now, a further method has been used to treat various injuries in handball players: magnetic resonance therapy (MBST). 85 percent of the patients benefited from the therapy with effects that sometimes lasted several years. Based on the active principle, an alternative option can be used for various sports injuries – in addition to rehabilitative measures to accelerate the healing process (MRI-controlled) and to restore performance more quickly.

The following diagnoses, among others, could be treated with good to very good success:

therapy-resistant fracture of the sesamoid metacarpal bone, bone marrow edema acromion after contusion, non-dislocated fracture MTF V, retropatellary, femoral cartilage damage in IM rupture, internal ligament fracture of the knee joint, partial rupture of the anterior cruciate ligament, bone marrow edema/bone bruise tibia, muscle bundle rupture M. rectus abdominis, ruptured muscle fiber M. iliopsoas, rupture Musculus teres major.

Generally, different target structures (bones, muscles, cartilage/joint, tendons/ligaments) can be treated by means of varied, standardized treatment schemes. The very good efficacy of magnetic resonance therapy MBST will be illustrated in the following two case studies of muscular injuries in handball.

- 1.) Injury: rupture of muscle fiber Musculus iliopsoas, 1 November 2015 during match, conservative treatment
  Treatment: seven treatments MBST muscle (10 November 2015 to 18 November 2015) Therapy/rehabilitation: physiotherapy, general conditioning and build-up of stress (e. g. exercise bath, training therapy), since fourth week after injury in combination with handball specific build-up training 1x/day, control MRI 8 December 2015
  Result: ability to compete after six weeks, free of complaints under full stress, no follow-up or recidivism injury.
- 2.) Injury: Rupture of M. obliquus internal abdominis, partial rupture of M. obliquus externus, 2 February 2015 during training, conservative therapy
  Treatment: Seven treatments MBST muscle (11 February 2015 to 19 February 2015) Therapy/rehabilitation: physiotherapy, general conditioning and functional therapy with continuous build-up of stress (e. g. exercise bath, training therapy), after four weeks of being completely free of symptoms combination with handball specific build-up training, control MRI 3 March 2015
  Result: ability to compete after five and a half weeks, free of complaints under full stress, no follow-up or recidivism injury.

Conclusion of the authors:
Both the individual application and in particular the combination of methods such as cryolight cold therapy, ESWT and nuclear magnetic resonance therapy (MBST) can further develop and optimise the treatment of muscle injuries. In addition to the time factor, the focus is also always on avoiding recidivisms and injuries that are more or less directly related to the treated muscle injury. This is one of the most important arguments from the point of view of sports medicine for a long-term successful return to competition.

Top-class medicine in handball – Better care through the combined use of different therapies for acute muscle injuries
[Spitzenmedizin im Handball - Bessere Versorgung durch kombinieten Einsatz verschiedener Therapien bei akuten Muskelverletzungen]
Author: Dr. med Rene`Zoussaint, Specialist in Orthopaedics, Sports Medicine, Manual Medicine, Physical Therapies and Sports Mediation, Sportärztezeitung 02/2016

MBST - Nuclear Magnetic Resonance Therapy. The new opportunity in the treatment of chronic skeleton diseases and sport injuries
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the scientific meeting, Bucharest, Romania, September 2013.

Nuclear Magnetic Resonance Therapy. The new opportunity in the treatment of chronic skeleton diseases and sport injuries.
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the Russian-Slovenian Science Meeting, Terme Olimia, Pod? etrtek, Slovenia, June 2014.

Therapeutic efficacy in the treatment of osteoporosis as well as metabolic and circulatory disorders of the bone

Therapeutic Efficacy in Osteoporosis

Osteoporosis is a pathological, painful condition of the body that is characterized by a reduction of bone mass compared to the age and gender relevant norm. The diagnosis is made with the help of various procedures, on the one hand with quantitative tomography (QCT) and on the other hand with the low-radiation DXA procedure, whose technology and measured values are internationally recognized.

Prospective study on the effectiveness of MBST Magnetic Resonance Therapy for whole-body treatment of osteoporosis

This indication was examined by an observation of application by the specialists Overbeck, Gerhardt and Urban (Overbeck et al., 2004). The examination that was carried out in three medical practices and one treatment centre provides concrete indices for the useful application of nuclear magnetic resonance therapy in the indication osteoporosis. A total of 27 patients with diagnosed osteoporosis and bone density measurement results were treated. The therapy series consisted of 10 one-hour treatments. Following therapy, 4 further bone density measurements were carried out in a period of 6 months: before the therapy, approx. 6 weeks, 3 months and 6 months after the beginning of the therapy. The therapy was generally characterized as painless, free of side effects and gentle. The evaluation of 21 patients, whose data was complete, showed significant improvements in pain condition, frequency of pain and bone density compared to the first measurement. Even though bone density was determined using two different measurement methods, an overall assessment was made possible by breaking down evaluation to individual patients. In this indication area, the absence of a placebo or control group or evaluation against an alternative treatment has no negative effects on the results, since osteoporosis does not improve without therapy. The successes achieved with nuclear magnetic resonance therapy therefore speak for themselves, even if they were initially only gained within the scope of an observation of application. Since – as already mentioned – physicians still primarily use their experiences as guidelines, the enthusiasm of the authors at the end of the report is quite understandable: „The MBST® magnetic resonance therapy is impressive because of its high effectiveness and the existence of no known side effects. According to our results, bone density and thus stability under MBST® magnetic resonance therapy increases faster than with any other therapy known to date.“

Prospective Study on the Effect of MBST® Nuclear SpinResonanceTherapy in Whole Body Treatment as a Possible Non-drug Therapy for Osteoporosis Disease
[Prospektive Untersuchung zur Wirkungsweise der MBST®-KernSpinResonanzTherapie bei Ganzkörperbehandlung als mögliche nicht medikamentöse Therapie bei Osteoporoseerkrankung]
J. Overbeck, Specialist in Surgery and Trauma Surgery, D-doctor, Deggendorf, A. Urban Specialist in Orthopaedics, Worms, Dr. med. G. Gerhardt and Dr. J. Gerhardt, Wendelsheim, ReAktiv-Behandlungszentrum, Wetzlar, Germany, 2003/2004

MBST® nuclear magnetic resonance therapy as possible non-drug therapy for osteoporosis

A small-scale study on osteoporosis was conducted at the Justus Liebig University Giessen to determine whether MBST® magnetic resonance therapy is an effective treatment for this disease.
Result: A considerable improvement in pain intensity and severity could be found. Similarly, a highly significant increase of up to 55% bone density and mineral salt content was observed within 22 to 120 days. The author concluded that the nuclear magnetic resonance method in osteoporosis treatment is an extraordinary and very fast-acting treatment method.

MBST® nuclear magnetic resonance therapy as a possible non-drug therapy for osteoporosis
[MBST®-KernspinResonanzTherapie als mögliche nicht medikamentöse Therapie bei Osteoporose]
Grumbrecht S., Dept. of Diagnostic Radiology, Justus-Liebig-University of Giessen, Article May/2003

Prospective study on the efficacy of MBST magnetic resonance therapy in whole-body treatment as a possible non-drug therapy for osteoporosis

Introduction:
In the case of osteoporosis, bone mass per volume unit is reduced in comparison to the age and gender norm. It is a pathological condition that can be separated from the physiological decline of bone mass with older age in which the composition of the bone substance does not deviate significantly from the norm. Osteoporosis can appear generalized and localized.
The generalized form is the most common metabolic osteopathy that is mostly prevalent in the female sex and predominantly postmenopausal. Osteoporosis can also occur premenopausally, in men and adolescents, even in children. The incidence of manifest osteoporosis is estimated to be around 5 million in Germany.
Aim of the scientific survey: After very positive experiences in osteoarthritis treatment, it was of interest to examine whether nuclear magnetic resonance therapy is similarly effective in osteoporosis.

Method:
A total of 15 female volunteers took part in an initial scientific survey. The average age was 65 years (49 to 78 years). The patients were treated with 10 one-hour MBST sessions for the whole body. Prior to treatment, the patients filled in a questionnaire including an individual assessment of pain on a ten-point scale. In addition, the volunteers agreed to regular blood sampling and urine tests, which were used to determine the course of various bone metabolism parameters, e. g. calcitonin IS or desoxypyridinoline can be controlled in urine.Before, during and after treatment only vitamin D tablets were administered to the patients. An additional therapy with bisphosphonates was excluded. Before and after the first treatment, a QCT to determine bone density was performed by an independent radiological institute.

Results:

- There was no significant change in the concentration of certain metabolic parameters, especially not in calcitonin and parathormone.
- Pain intensity was improved markedly by an average of 5 points. At the end of the treatment, all patients assessed their pain severity at least 8 points better than before the treatment. Pain frequency had also decreased significantly (improvement by 4 resp. 7 points).
- The QCT measured values showed an increase in mean bone density from 88 +/-37 to 90+/- 28 mg/cm3 calcium hydroxylapatite, which is equivalent to a mean percentage increase of 12%. An average increase in mineralization of 28.2% was observed in 9 patients and a maximum decrease of 16% was recorded in 6 patients.
- The distance between the first and second QCT was 44 days on average (minimum 22, max. 119 days). A longer time between the density measurement and the end of therapy had a positive influence on bone density. This might suggest a longer-term effect.
- The determined Z- and T-values showed a dramatic increase of up to 54.75% in some cases, but this is due to the fact that the WHO corrected the reference values downwards during the course of the current survey and the radiological institute used these new reference values for most of the second measurements. Therefore the determined T- and Z-values cannot be used methodically!

Summary:
In summary, the author concludes that the therapeutic effects of nuclear magnetic resonance therapy can hardly not be explained by metabolic stimulation, the regenerative effects are probably much more complex and multifactorial. However, subjective pain sensation in advanced osteoporosis was significantly improved, an effect which is already known from osteoarthritis therapy with MBST.
The results obtained from the scientific survey should be the basis for further clinical and radiologically controlled studies, in particular studies with a longer time frame, maybe with repeated applications, and they should be planned in order to confirm the promising initial results obtained so far.

Prospective study on the efficacy of MBST magnetic resonance therapy in whole-body treatment as a possible non-drug therapy for osteoporosis *[Prospektive Untersuchung zur Wirksamkeit der MBST-KernspinResonanzTherapie bei Ganzkörperbehandlung als mögliche nicht medikamentöse Therapie bei Osteoporoseerkrankung]*
W. Klapsch, KH Spital, Austria, 2003.

Treatment of Osteoporosis with MBST® magnetic resonance therapy

The aim of this study by the Orthopaedic Clinic in Bad Düben, Germany, was finding prove of the influence of magnetic resonance therapy on bone mineralization content.

Material and Method

In the period between January 2004 and March 2006, a total of 54 patients were treated with MBST® magnetic resonance whole-body treatment for osteoporosis. All patients included had a bone density in the range of osteopenia or manifest osteoporosis before the start of the therapy. For this purpose, a QCT (Quantitative Computed Tomography) measurement of the lumbar spine was performed in a radiological practice. Control measurements were carried out under standardised comparison conditions 6 months after treatment. In addition, the standardised examination of the patients was carried out on the basis of the „osteology checklist“ (anamnesis, clinical examination, laboratory, risk profile, primary diseases, e. g. osteomalacia, history of an osteoporotic fracture, medication).

Patients who had already suffered vertebral body fractures related to osteoporosis or who were treated with teriparatide were not included in the study due to the risk of a falsification of bone density measurements. Patients taking bisphosphonates or selective estrogen receptor modulators were evaluated separately. In addition to nuclear magnetic resonance therapy, a basic therapy with calcium and vitamin D3 was administered as well as hydrogenation prior to treatment with about 2 litres of liquid. The treatment was carried out on 10 consecutive weekdays with a 2-day break (interruption by weekend) always at the same time of day on a standard whole-body magnetic resonance therapy couch (ODM) of the company Medtec Medizintechnik, Wetzlar. The treatment time was 10 x 1 hour. Measuring dates: before the start of therapy, after the end of therapy, three months and six months after the end of therapy. Scores: modified Fairbank Score, Roland-Morris-Score, Osteoporosis Quality of Life Questionnaire and the Numerical Analog Scale to determine peak, rest and permanent pain. The bone mineralization content was determined by QCT before and six months after therapy.

Results

Mean bone density of the patients (bone mineralization content in mg/ml, measured with QCT at the lumbar spine) was 97.5 mg/ml (SD: 16.9) before the start of nuclear magnetic resonance therapy. After six months, mean bone mineralization content had increased to 100.2 mg/ml ($p < 0.05$, SD: 15.8). There was no significant difference in bone mineralization content after 6 months in the 14 patients under continuous osteoporosis therapy with bisphosphonates and SERM. The Osteoporosis Quality of Life Questionnaire records pain, restrictions on activities of daily life, household activities, exercise, leisure and social activities, perception of general health and mood.

Therefore, it is a good indicator of the general condition of the patients. No significant differences could be found in measurements during therapy and shortly afterwards. Correlating with the increase in the mineral content of bones, however, we were able to observe a significant reduction in symptoms over the course of six months. We were also able to find similar results for the modified Fairbank Score and Roland-Morris Score. The most significant indicator of pain is an evaluation with the Numerical Analogue Scale for the determination of peak pain, pain at rest and permanent pain. Pain at rest did not change during therapy or shortly afterwards. All three types of pain showed a significant reduction after three resp. six months.

Discussion

The 27 patients included in the study showed a significant increase in bone mineralization content six months after therapy. It was also noteworthy that for the 14 patients who received long-term medication with bisphosphonates and SERMs, no significant change in bone density after six months could be detected. It can be assumed that the reason for this is the stabilizing effect of bisphosphonates and SERMs on the bone structure.

No side-effects of MBST® nuclear magnetic resonance therapy could be detected for the activity scores (OI-QÖQ, Fairbank, Roland-Morris). The only exception to this is a short-term increase in pain during and after therapy. The cause of the increase in pain remains unclear. Presumably it is an expression of the physical response (activation of bone metabolism) to the therapy.

Conclusion of the authors
MBST® nuclear magnetic resonance therapy is an innovative, free of side effects and easy-to-use therapy that, in combination with a basic therapy with calcium and vitamin D3, at least for a while stabilizes resp. increases bone density, reduces the patient's complaints and improves his general condition. It has no influence on the bone density of patients with a long-term drug therapy with bisphosphonates and SERMs. Comparing the costs of long-term medication for osteoporosis with the one time only costs of MBST® nuclear magnetic resonance therapy, another interesting therapeutic approach evolves. As there are as yet no long-term results or comparable studies, the long-term effect resp. the benefit of conservative osteoporosis therapy remains to be seen.

Treatment of osteoporosis with MBST® KernSpin *[Behandlung der Osteoporose mit MBST® KernSpin]*
T. Glove, C. Melzer, Waldkrankenhaus Bad Düben, Fachkrankenhaus für Orthopädie; published in: Orthodoc, 5/2008, pp. 1 - 4.

Therapeutic application of nuclear magnetic resonance in osteoporosis

The aim of a study in Croatia was to investigate the long-term effects of the therapeutic application of nuclear magnetic resonance imaging (KSRT) on bone density parameters in patients with osteoporosis.

Methods
103 patients aged 45–89 years with a secure diagnosis of osteoporosis and a reduced bone density (T-score below –2.5) were included in the study. All patients were treated with nuclear magnetic resonance osteoporosis therapy for 1 hour per day on 10 consecutive days (MBST-Osteo treatment couch, MedTec, Germany). Before and 12 months after KSRT treatment, bone density was determined by DEXA measurement.
In addition, the bone turnover markers osteocalcin and bone cross-laps (ß-CTX; crosslinked telopeptides of collagene 1) were determined using commercial Elisa techniques.

Results
Bone density and serum levels of osteocalcin increased statistically significantly from baseline to 12 months. ß-CTX remained stable.

Conclusions
A therapeutic application of nuclear magnetic resonance increases the parameters of bone density within one year after a treatment series (10 x 1h). Therefore, KSRT can be recommended as an alternative or additional therapy to drug therapy for osteoporosis patients.

Non-pharmacological treatment of osteoporosis with Nuclear Magnetic Resonance Therapy (NMR-Therapy) Dalibor Krpan, Barbara Stritzinger, Ivan Lukenda, Joakim Overbeck,, Werner Kullich, PERIODICUM BIOLOGORUM VOL. 117, No. 1,161-165,2015.

Therapeutic application of nuclear magnetic resonance in osteoporosis
[Therapeutische Anwendung der Kernspinresonanz bei Osteoporose]
Kullich, W., Lukenda, Stritzinger, B., Overbeck, J., Krpan, D., Ber. nat. -med. Ver. Salzburg, Volume 18, pp. 7-17, Salzburg 2016.

A new concept of integrated holistic approach in treatment of chronic musculoskeletal diseases The “BAR” method

Another study was carried out and published in the polyclinic K-CENTAR, Zagreb, Croatia under the lead of Prof. Dr. sc. Dalibor Krpan under extended „BAR“ conditions.

The „Bar“ method, a new concept in the treatment of chronic bone and joint diseases. An essential part of the concept is cell regeneration using nuclear magnetic resonance therapy.

The „BAR“ treatment concept stands for: B – for Biomechanics A – for analgesia and R – for regeneration. It is an integrated, holistic therapy approach with a combination of methods to improve „biomechanics“ which offers very good and regular biomechanical impulses and stimulates the regeneration of cartilage and bone formation very well. It relieves pain very quickly, even during the treatment, improves mobility and thus the quality of life. It also stimulates regeneration of cartilage and bone formation.

Conclusion

The statistical analysis of a number of clinical trials in patients with osteoarthritis treated with MBST Nuclear Magnetic Resonance Therapy shows after only one MBST cycle of 5 or 7 days:

- general improvement of more than 60% up to 80% and
- pain reduction to about 50%
- constant decrease in pain intensity and frequency
- All of these improvements yielded a maximum result after 8 weeks to 6 months after the therapy as well as lastingly for a period of one year. The osteoporosis treatment showed a significant increase in BMD up to 35%, T-score of up to 33.9% and Z-score to 72.46%.

Based on clinical experience, the results of the scientific and clinical studies and a cost-benefit analysis MBST can be recommended for usage under the following conditions:

- 1. MBST program once a year for all persons with an increased risk of osteoarthritis or osteoporosis in combination with regular exercise.
- 2. MBST program of 5 or 7 days for all people with osteoarthritis once a year together with exercise and pain therapy.
- 3. MBST program of 7 days twice a year in combination with physical and sometimes orthopaedic therapy of advanced osteoarthritis.
- 4. 10 days MBST osteoporosis program in case of osteopenia, increased risk of osteoporosis or failed pharmacotherapy.

A new concept of integrated holistic approach in treatment of chronic musculoskeletal diseases The “BAR” method

Prof. Dr. sc. Dalibor Krpan, Polyclinic K-CENTAR, Zagreb, Croatia; published in: : PERIODICUM BIOLOGORUM VOL. 117, No. 1, 119–124, 2015.

MBST may reduce the risk of fractures in the case of osteoporosis

Despite various pharmacological treatments for osteoporosis, the problem of osteoporosis has not yet been solved or reduced. Fractures, side-effects of drugs after long-term pharmacotherapy show a need for new treatment methods. Nuclear magnetic resonance therapy could be an alternative or supplement to pharmacotherapy. The aim of a case report study is to present clinical experience in the application of NMRT in the treatment of osteoporosis based on follow-up screening of the incidence of fractures.

For the examination of fractures, 450 patients (male n = 55, female n = 395) with an average age of 68.4 years were assessed on the basis of anamnesis and medical documentation. All of them had been treated with MBST therapeutic nuclear magnetic resonance standard cycles of 10 days during a period of five years. The data shows a reduction in the rate of fracture after NMRT even for more than one year after an NMRT cycle of 10 days.

All patients were treated with therapeutic magnetic resonance (NMRT) during a period of 5 years at the K-Centre (Policlinic / Centre for Osteoporosis and Other Bone and Joint Disorders, Director: Prim. Prof. Dr. med. D. Dalibor Krpan, Zagreb, Croatia).

All patients suffered from osteoporosis, which had been diagnosed with DEXA measurement (T-score less than –2.5) and were treated with therapeutic NMRT in an MBST nuclear magnetic resonance therapy series with the MBST osteo treatment couch (ODM device), from MedTec GmbH, Wetzlar, Germany (one-hour per day for 10 consecutive day).

Due to the fact that NMRT works with a time delay, the maximum effect is reached after about six months. The time of assessment of the fractures is divided as follows:

- A.) less than three months after the treatment,
- B.) between three months and one year after the treatment,
- C.) between one year and two years
- D.) more than two years after the treatment

Particularly noteworthy is the fact that in eleven well-documented cases no incidences of fractures occurred, even after severe trauma. Despite the fact that there are further studies on the NMR treatment of osteoporosis, these case reports support the expectations that NMRT could be a useful alternative or addition to other therapeutic modalities in patients with osteoporosis. It is particularly important that NMRT has no risk for undesired side-effects and is very suitable for early prevention of fractures in combination with exercise and vitamin D3.

Because they are very important evidence of a therapeutic effect, these cases are described separately as case reports.

Results

- A.) less than three months after NMR treatment: 2 patients with fractures
- B.) between three months and one year after NMR treatment: no patient with fractures
- C.) between one year and two years: 2 patients with fractures
- D.) more the two years after treatment: 14 with fractures

In the period less than three months after NMR treatment (A.) there are two patients with fractures. Both suffered a fracture of the forearm after a severe fall, and both had had previous fractures and a very low BMD. No fractures occurred within the period between three months and one year after NMR treatment (B.). Within the period between one year and two years after NMR treatment (C.) there were two patients with fractures: One patient aged 80 years with a new compression fracture of L5. The fracture was found in X-ray diagnostics. The other patient aged 83 years with an underarm fracture, but no hip fracture despite the fact that she fell down the stairs and had a large hematoma around the left hip, which clearly shows that it was a severe trauma.Within the period of more than two years after NMR treatment (period D.) there were 14 patients with fractures. In one case a severe hip fracture trauma, in 4 cases a vertebral compression fracture and in 9 cases a fracture of the forearms occurred. It is important to add that the lady with the hip fracture could be completely restored after TEP. Very important proofs are cases of patients who suffered a severe trauma but no fracture. All of them had a low BMD before NMRT, and four of them had previous fractures.

An overview of the examined patients

Case 1. Patient, 82, fell frequently after NMR treatment and suffered no fractures. Twice she had a large hematoma at the hip without fracture. The last time was five years after MBST treatment.

Case 2. Patient, 80, fell when the bus she was in suddenly stopped due to a traffic accident. He suffered a large hematoma but no fracture. The accident happened one and a half year after NMR treatment. A significant increase in BMD was found in the control DXA.

Case 3. Patient, 87, dropped into a hole in the ground and suffered a severe hematoma, but no fracture. The fall happened more than a year after the NMR treatment. A significant increase in BMD was found on the control DXA.

Case 4. Patient, 78, fell in the street, no fracture. It was three years after the NMR treatment. Control DXA has not been made.

Case 5. Patient, 75, was injured in a traffic accident two years after NMR treatment and she had no fractures. No significant difference in the BMD was found on control DXA.

Case 6. Patient, 80, had a fall in her house. She had a large hematoma at the hip, but no fracture. It happened more than two years after the NMR treatment.

Case 7. Patient, 75, had a traffic accident, suffered various hematomas and bruises, but had no fracture. It happened three years after the NMR treatment. A significant increase in BMD was found on the control DXA.

Case 8. Patient, 78, fell in her house, she had no fracture. It happened more than three years after the MBST treatment. Before the NMR treatment, she had suffered fractures of the forearm and multiple vertebral fractures. A significant increase in BMD was found on the control DXA.

Case 9. Patient, 85, fell in the street and had a large hematoma at the hip but no fracture. It happened more than a year after the NMR treatment.

Case 10. Patient, 70, was injured in a car accident. She suffered a lot of bruises, but no fractures. It happened more than a year after the NMR treatment.

Case 11. Patient, 71, fell from a tree. He suffered many bruises and contusions, but no fracture. It happened more than two years after the NMR treatment.

These cases are very common in the elderly population and the risk of falling increases with age and physical function: about one third of healthy people aged 65 or older and half of the over 80-year-olds fall at least once a year.

Therefore, the authors believe that this case report study provides important information, although the number of cases is rather small. All reported cases are well documented and show that NMRT can be the new non-pharmaceutical method that can reduce the risk of fractures.

In depth analysis shows, that one of these patients, an 83-year-old woman who fell down the stairs, suffered no hip fracture even though she had fallen directly on the hip. A large hematoma on the hip was clear evidence of severe trauma. Other cases showed a reduction in fracture risk even after several years of NMR treatment. Due to the delayed onset of action of NMRT, the two cases of fractures may have occurred within the first three months of MBST treatment. This cannot be assessed as an indicator of failed therapy.

There have been few studies regarding osteoporosis so far. These studies show that MBST is a bone targeted therapy that stimulates bone formation and increases BMD values.
There are studies on MBST treatment of osteoporosis, and these encourage expectations that MBST can be a useful alternative or addition to medical therapy in patients with osteoporosis.
Particularly important is the fact that MBST has no risk of side-effects, which makes it suitable as a treatment in combination with exercise and vitamin D3 in a strategy to prevent fractures.

Nuclear magnetic resonance therapy in osteoporosis reduces the risk of fractures in accidents/downfalls – case report study

Krpan D.1, Kullich W.2 1, Poliklinika K-CENTAR, Zagreb, Croatia, 2 Ludwig Boltzmann Cluster for Arthritis and Rehabilitation, Department for Rehabilitation, Saalfelden, Austria Clinical Cases in Mineral and Bone Metabolism

Indication back pain – low back pain – degenerative changes of the spine, ruptured or herniated intervertebral discs

Therapeutic efficacy for chronic specific back pain

Chronic back pain is a major problem in the population. In many cases, treatment is only symptomatically. In practice, therefore, physiotherapeutic measures are often supplemented with additional forms of therapy.
Changes of voltage in collagene structures due to mechanical changes of stress cause the transport of electrical signals in and out of tissue structures and thus have a positive effect on the metabolic situation.

Recent studies show the stimulating influence of nuclear magnetic resonance therapy on the proliferation of chondrocytes and osteoblasts (Temiz-Artmann et al., 2005) and indicate the regeneration of cartilage-like structures.

The results of the study were published in 2005 and 2006 in a lecture and in two publications in internationally recognized peer-reviewed journals.

Chronic low back pain is primarily a consequence of segmental dysfunctioning and muscle pain, usually associated with degenerative or post-traumatic changes in the affected part of the spine. The clinical examination of all patients included in the study therefore plays an important role. Waddell‘s signs are used: sensitivity to light pressure, pressure pain, compression pain of the lumbar spine under axial stress, pain through rotation of lumbar spine, pain when lifting the stretched leg, regional muscle weakness, sensitivity disorders when lifting the stretched leg, non-verbal pain condition. Mobility was assessed using the finger-to-floor distance and the Schober index. During palpation, vertebral and paravertebral structures were examined, followed by a segmental functional examination and an examination of the hips and statics. The clinical examination was supported by radiological and computed tomographic examination methods.

Doz. Dr. Kullich and colleagues of the Ludwig Boltzmann Department in the SKA of PVA Saalfelden, Austria have therefore compared the effects of a complementary application of MBST® therapy of one hour per day in double-blind, placebo-controlled randomized form in combination with physiotherapy.
The findings were presented aforehand in a lecture at the annual conference of the Austrian Society for Rheumatology and Rehabilitation in Vienna (Kullich et al, 2005) and are currently in print. The results of 62 patients (30 with MBST treatment, 32 with only physiotherapy and placebo treatment) show a clear, statistically significant superiority of the combinated therapy compared to physiotherapy alone with placebo treatment in almost all parameters, such as the Visual Analogue Pain Scale or the disability score according to Oswestry, both one week after the beginning of therapy and after 3 months (Kullich et al, 2006).

Patients and Methods
Placebo-controlled, double-blind, randomized, multipoint, mono-centric survey over a period of 3 months
62 patients (36 men and 26 women aged 18–71 years, mean age = 48.1 years) with chronic low back pain
the multidisciplinary rehabilitation concept, which was used in the treatment of all patients, consisted of a standardised in-patient physiotherapy programme

Series of treatments with one hour of therapy per day for 9 consecutive days in an MBST® magnetic resonance therapy system: Version KSRT-Key K1B, type MBST® 600 KSRT, serial number 12100015, MedTec Medizintechnik GmbH, Wetzlar, Germany
Double-blind randomization into two groups was achieved using blinded computer chip cards.

- 1. Group I: nuclear magnetic resonance activated (active MBST® group; n = 30),
- 2. Group II: nuclear magnetic resonance inactive (placebo group; n = 32)

Examinations were made at the beginning of the study (day 0), as well as 1 week and 3 months after treatment with the following parameters:

- 10-part Visual Analogue Scale (VAS),
- Oswestry-Low-Back-Pain-Disability Questionaire according to Fairbank at al. 1980,
- Roland & Morris Disability Questionnaire

Results
A standardized multidisciplinary therapy significantly improved the Roland-Morris (RM) overall score for chronic low back pain during a 3-week rehabilitation. RM overall score rose again after the therapy in both groups, placebo and MBST®. Nevertheless, the value of the MBST® group remained significantly below baseline. The Roland & Morris Disability Questionnaire showed that everyday activities could be improved by an additional MBST® therapy.
Group I achieved a better result than Group II in several sections of the Oswestry Disability Questionnaire (such as walking, sitting) than Group II. This is also shown by the overall score of Group I, which with $p<0.001$ at the measurement dates of 1 week and 3 months had a significantly better result than the placebo group. Of great importance for back pain patients should be the fact that there were major advantages in the section “personal care”. 73.7% of the patients of group I reported improved conditions in this section after 3 months and 0% reported a worsening.
The pain measurements (VAS) show a clear reduction of pain in both groups (MBST® and placebo group) after only one week. Three months after therapy, the peak pain in both groups was still improving significantly; however, a significant reduction of stress pain after three months was only observed in the MBST® group.

Conclusion
Due to their frequency, low back pain is of great importance for social medicine, resulting in considerable health economic costs. Standards for the evaluation of a therapeutical success are: back specific functioning, pain, fitness to work and satisfaction of the patient.
The additional MBST® can cause a sustainable improvement of the painful chronic low back pain. MBST® is an interesting, easy-to-use treatment method that can be used as additional therapy in the rehabilitative treatment of low back pain. Positive effects over a period of 12 weeks became evident.
MBST is therefore an additional therapy procedure for the rehabilitation of patients with low back pain, which significantly further improves the significant success of in-patient rehabilitation of disorders of the spine.
In addition, no side-effects of MBST therapy were observed in this study.

Magnetic Resonance Therapy improves rehabilitation success in the case of chronic low back pain
W. Kullich, N. Fagerer, K. Machreich, H. Schwann Lecture at the Annual Conference of the Austrian Society for Rheumatology and Rehabilitation, 25-26 November 2005, Vienna, in: Skriptum - Wiener medizinische Wochenschrift, pp. 11-12

Electromagnetic nuclear resonance field on patients with Low Back Pain
W.Kullich, H. Schwann, J. Walcher, K. Machreich, Journal of Back and Musculoskeletal Rehabilitation, 19 (2006), 79-87.

Impact of magnetic resonance therapy on sickness absence of patients with nerve root irritation following a lumbar disc problem

The Orthopaedic Hospital Speising, CEOPS, Department of Orthopaedic Pain Therapy together with the Department of Radiodiagnostics of the Medical University of Vienna and the St. Pölten Regional Hospital carried out a further study about complementary medical intervention using nuclear magnetic resonance therapy in patients with nerve root irritation due to a lumbar disc herniation.
Test parameters were: variance analyses, time effects, results related to drug groups ZP1 / ZP2, physical functions SF-36, Roland-Morris-Score, VAS scale, neurostatus, pain medication and rehabilitation as well as days of sick leave.

Results: Overall significant positive results have been observed in MBST treatment of herniated discs, especially in the lower lumbar spine. Those patients who were treated with active irradiation using the magnetic resonance therapy device had significantly fewer days of sick leave.
Sick leave before therapy was 14.7 days, after therapy 5.8 days. In contrast, the number of patients in the control group was 7.6 days before therapy and 13.8 days after therapy. The authors: „the cost-effectiveness analysis showed that the direct costs of nuclear magnetic resonance therapy were compensated for to varying degrees depending on the occupational group. For workers, 16.9 days of sick leave compensated for the direct and indirect costs of magnetic resonance therapy for workers, 11.4 days for salaried employees and 9.1 days for civil servants.

Conclusion: By measuring the number of days of sick leave, the study was able to confirm that pain relief and thus a health economic benefit can be achieved by a relatively cheap, alternative technique.

Impact of magnetic resonance therapy on sickness absence of patients with nerve root irritation following a lumbar disc problem
Salomonowitz G1, Salfinger H, Hahne J, Friedrich M. 1, Radiology Technology, FH-Campus Vienna, Austria

Nuclear magnetic resonance therapy in lumbar disc herniation with lumbar radicular syndrome: effects of the intervention on pain intensity, health-related quality of life, disease-related disability, consumption of pain medication, duration of sick leave and MRI analysis
Salfinger H1, Salomonowitz G, Friedrich KM, Hahne J, Holzapfel J, Friedrich M. 1, Centre of Excellence for Orthopaedic Pain Management Speising, Vienna, Austria

Further support of the efficacy of magnetic resonance therapy for back problems is shown by some very impressive case studies of treatments of acute herniated discs (documented in the form of MRI images prior to therapeutic application and 8 weeks after MBST treatment), performed with MBST magnetic resonance therapy systems, that were presented by Osteopath R. Opel at the conference for orthopaedists, surgeons and sports physicians in Wetzlar in March 2017.

Patient, 42 years, farmer

- The patient's first record dates back to 2013.
- He complained of severe pain in the lumbar spine with paresthesia in both legs and had to take strong painkillers several times a day in order to cope with everyday life. A disc herniation was diagnosed, which was shortly treated with 9 hours of MBST (treatment card lumbar spine hip).
- Due to severe osteoporotic changes of the spine, a second nuclear magnetic resonance therapy with 10 treatment hours on the ODM treatment couch was carried out in 2014. Patient has had no complaints since March 2014.

Patient, 46 years, bus driver

- Pain in the area of the cervical spine with severe respiratory problems.
- Physiotherapy and manual therapy as well as the constant use of painkillers did not bring any relief.
- Diagnosis chest kyphosis, according to x-ray.
- In the further course of the differential diagnosis an NPP in cervical spine vertebrae 3 was found.
- Treated with 9h MBST.
- Free of symptoms after the seventh treatment session. The patient is still very satisfied with the progress, he has no problems in his work and his hobby skiing.

Patient, 29 years old, Bachelor in Health Management.

- The young patient first consulted the practice with massive seizure-like pain in 2014.
- Diagnosis showed a severe impairment of the right leg with numbness of the right foot.
- Treatment was carried out with MBST (9-hour card discs).
- From one treatment hour to the next, the walking pattern improved together with considerable reduction of pain.
- Two days after the last treatment session she went on her annual holiday and took a flight to the Dominican Republic. She could enjoy this flight without any problems.
- Later also her mother (49 years) was treated with 9 hours MBST because of an NPP in the area of the cervical spine. She was also completely free of symptoms after three weeks.
- In 2016, her 21-year old sister came to the practice with an NPP in the range of C4 C5. She was also treated with a disc card with 9 hours of treatment.Also in this case, there were no more complaints after 3 weeks.

Patient, 57 years, self-employed

- Patient lives in Valencia, Spain.
- He had heard about the therapy from his sister, who had also been treated successfully. At the end of 2014, he was treated with a 9-hour intervertebral disc card on the nuclear magnetic resonance therapy couch.
- There were three NPPs in the range L3 to L5. Already during the last treatment session the patient was free of symptoms. In February 2017 an NPP in C2 C3 was treated with the same procedure.
- After seven treatment sessions, he was free of pain.

Final assessment by the chiropractor and osteopath Opel:

- Due to my treatment successes and my experience with magnetic resonance therapy, I was able to establish that the intervertebral disc treatment cards are highly effective in the efficiency of the treatment of NPPs and significantly exceed the treatment success of the spinal hip and the spinal shoulder treatment cards.
- Personally, no other treatment method is known to me that triggers such a rapid and highly significant therapeutic success so quickly and sustainably by the activated regeneration process.
- The treatment success in cases of herniated discs, the efficacy, the very fast effect of magnetic resonance therapy and the long-term result cannot be surpassed.

Treatment of acute herniated disks with magnetic resonance therapy at the MRI Therapy Center Riesa
Roland Opel in Riesa, Lecture 4th MBST User Conference Wetzlar, Congress Center Arena, 3–4 March 2017

These case descriptions are clearly not evidence in the sense of evidence-based science, but the observations from daily practice are an impressive complement to the results obtained in placebo-controlled randomized studies.

Evaluation of the results of completed studies

The review of the available scientific material on the efficacy of MBST therapy showed a consistently very positive and stable picture.

In the pre-clinical and clinical areas, for example, sufficiently clear data were presented, i. e. presented at scientific congresses or published in accepted journals, so that an evaluation of efficacy was unproblematic.

There can therefore be no doubt about the efficacy of the discussed therapy method with the application of nuclear magnetic resonance on human bone and cartilage cells, thus with a positive on various forms of osteoarthritis and bone metabolism (e. g. in cases of fractures or osteoporosis) in the indication of osteoarthritis. Furthermore, taking into account the fact that even today therapy is still oriented primarily on the experience of clinically active physicians and in combination with publications mainly in peer-reviewed scientific journals („evidence-based medicine“), the available extensive material consisting of case studies, prospective studies, experience reports and controlled studies, double-blind, randomized and placebo-controlled conducted or evaluated against a standard therapy represents an extremely solid basis that can not be doubted.

This clearly distinguishes the present form of therapy from other therapy attempts with, for example, static or simple pulsating magnetic fields, whose therapeutic effect is discussed controversially in literature due to the very heterogeneous experimental approach.

Since the technology described here is a completely new therapeutic approach, a comparison with previous experiences as they were made in the field of magnetic field therapy, is neither possible nor permissible. Overall, however, it can be said that the proof of therapeutic efficacy of MBST therapy has been clearly demonstrated.

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Werner Kullich1*, Barbara Stritzinger1, Monika Mustak-Blagus2, Albrecht, Falkenbach3, Jutta Rus-Machan4, Thomas Berger5 and Bibiane, Steinecker-Frohnwieser1 1Ludwig Boltzmann Department for Rehabilitation, Cluster for Arthritis and Rehabilitation, Saalfelden/ Gröbming, Austria 2Rehabilitation Centre of the PVA, Gröbming, Austria 3Rehabilitation Centre of the PVA, Bad Ischl, Austria 4Rehabilitation Centre of the PVA, Bad Aussee, Austria 5Rehabilitation Centre of the PVA, Saalfelden, Austria Dates: Received: 15 December, 2016; Accepted: 22, December, 2016; Published: 23 December, 2016
J Nov Physiother Phys Rehabil 3(1), 61-66 (2016)

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Krpan D.1, Kullich W.2 1, Poliklinika K-CENTAR, Zagreb, Croatia, 2 Ludwig Boltzmann Cluster for Arthritis and Rehabilitation, Department for Rehabilitation, Saalfelden, Austria adopted in: Clinical Cases in Mineral and Bone Metabolism, 2017

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Prof. Dr. Werner Kullich, Seminar „Special Pain Therapy" for obtaining the pain diploma of the Austrian Medical Association, Part 2: June 2016, Organizer: Salzburger Schmerzinstitut, Salzburg Society for General Medicine, Vorarlberger Ärztekammer, Lecture June 2016

8) Nuclear magnetic resonance therapy for arthrosis
W. KULLICH (Saalfelden), 35th RHEUMATAGUNG SAALFELDEN, Ludwig Boltzmann Cluster für Arthritis und Rehabilitation Sonderkrankenanstalt der PVA, Saalfelden, Austria, Lecture Research at the Ludwig Boltzmann Cluster for arthritis and rehabilitation 24/25 June 2016

2015:

1) Treatment of the clinical symptoms caused by osteoarthritis using nuclear magnetic resonance (MBST®) in dogs a randomized trial
Marion Mueller1 DVM, Ivonne Virac1, Cornelia Lang1, Kathleen Wittek1 DVM, Alexander Tichy2 MA, DSc, and Barbara Bockstahler1 DVM; PD*1 Department for Small Animals and Horses, Small Animal Surgery, Section for Physical Therapy and Rehabilitation, University of Veterinary Medicine, Vienna, Austria 2Department for Biomedical Sciences, Platform Bioinformatics and Biostatistics, University of Veterinary Medicine, Vienna, Austria

2) Inaugural dissertation on obtaining the doctorate rerum medicinalium of the Medical Faculty of the Westfälische Wilhelms-Universität Münster: Effects of nuclear magnetic resonance therapy on the dynamics of liver regeneration.
Budny, N., University Hospital Münster, Clinic for General and Visceral Surgery, Department of Surgical Research; October 2015.

3)Modulation of NF-kB activity by the therapeutic Nuclear Magnetic Resonance (NMR) to explain pain reduction in patients with osteoarthritis
B. Steinecker-Frohnwieser1, W. Kullich1, A. Mann2, B. Stritzinger1, H. G. Kress2, L. Weigl2, 1Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, LBI for Rehabilitation of Internal Diseases Saalfelden, Austria, 2Department for Special Anesthesia and Pain Management, Medical University of Vienna, Austria; Poster presentation at the International Pain Congress of the European Pain Federation EFIC, Vienna, Austria, 2-5 September 2015.

4)Non-pharmacological treatment of osteoporosis with Nuclear Magnetic Resonance Therapy (NMR-Therapy)
Dalibor Krpan1, Barbara Stritzinger2, Ivan Lukenda1, Joakim Overbeck3,1, Werner Kullich2,1Policlinics K-CENTAR, Zagreb, Croatia, 2Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Department for Rehabilitation, Saalfelden, Austria, 3Surgical practice, Deggendorf, Germany published in: PERIODICUM BIOLOGORUM VOL. 117, No. 1,161-165,2015.

5)A new concept of integrated holistic approach in treatment of chronic musculoskeletal diseases The "BAR" method
Prof. Dr. sc. Dalibor Krpan, Polyclinic K-CENTAR, Zagreb, Croatia; veröffentlicht in: PERIODICUM BIOLOGORUM VOL. 117, No. 1, 119–124, 2015.

6)Effects of Therapeutic-NMR (MBST-Nuclear Magnetic Resonance) on the Circadian Clock and the Hypoxic Signaling Pathway in Zebrafish Cells
R. Oliva, Master thesis for the academic title Master of Science (MSc), Faculty of Biology, Institute of Ecophysiology, Leopold Franzens Universität Innsbruck, Innsbruck, Austria.

2014:

1) Nuclear magnetic resonance treatment (MBST®) of clinical symptoms caused by osteoarthritis: a double- blinded placebo-controlled study in dogs
M. C. Mueller, K. Wittek, B. A. Bockstahler, Department of Small Animals and Horses, Small Animal Surgery, Outpatient Clinic for Physical Medicine and Rehabilitation, University of Veterinary Medicine Vienna, Austria; poster presentation at the International Symposium in Animal Musculoskeletal Practice, Coventry, England, 29-30 November 2014.

2) The influence of nuclear magnetic resonance therapy (NMRT) and interleukin IL1-β stimulation on Cal 78 chondrosarcoma cells and C28/I2 chondrocytes
B. Steinecker-Frohnwieser, Ludwig Boltzmann Institute for the Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; scientific lecture at the Scientific Symposium: Microbiome Research / Personalized Medicine, Graz, Austria, 17-18 July 2014.

3) Nuclear Magnetic Resonance Therapy. The new opportunity in the treatment of chronic skeleton diseases and sport injuries.
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the Russian-Slovenian Science Meeting, Terme Olimia, Pod? etrtek, Slovenia, June 2014.

4) New mode of action: nuclear magnetic resonance therapy
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the course „Special Pain Therapy“, pain diploma of the Austrian Medical Association, Leogang, Austria, June 19,2014.

5)Application of Nuclear Magnetic Resonance Therapy as treatment of degenerative diseases of locomotor system
I. Mařík, A. Maříková, R. Myslivec, Ambulantní centrum pro vady pohybového aparátu s.r.o, Prague, Czech Republic; lecture at 19th Kubat‘s Podiatric Day, Prague, Czech Republic, 8 March 2014.

6)German company develops the first casual therapy for osteoporosis and circulatory disorders of bone
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2014, S. 15.

7) Therapeutic nuclear magnetic resonance revolutionisses medicine in high-performance sport
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2014, S. 15.

8)Causal and Painfree: Cell Regeneration Made in Germany as a Treatment Innovation for Veterinary Medicine and Dermatology
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2014, S. 55.

9)Causal Treatment of degenerative Joint Diseases is Possible only with MBST®-Nuclear Magnetic Resonance Therapy
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2014, S. 15.

10) Top 100 2014: Innovation fund: Ranga Yogeshwar presents Germany‘s innovation elite
Bantle, F.; Blath, M.; Borges, H.; Goebel, B.; Hess, D.; Heubeck, R.; Olschner, S.; Pesch, U.; Rauch, S.; Weiand-Schütt, R.; Redline Verlag, Munich 2014, pp. 100-103.

11)Nuclear magnetic resonance therapy in lumbar disc hernition with lumbar radicular syndrome: effeects oft he intervention on pain intensity, health-related quality of life, disease-related disabitity, consumption of pain medication, duration of sick leave and MRI analysis
H.Salfinger, G. Salomonowitz, K.M. Friedrich. J. Hahne, J. Holzapfel, M. Friedrich. Datum: Eingegangen: 29. April 2014; Überarbeitet: 25. September 2014, Angenommen: 26. September 2014; Veröffentlicht online: 18Oktober 2014, Springer-Verlag Berlin Heidelber 2014

2013:

1) Clinical Efficiency of Nuclear Magnetic Resonance Therapy in Osteoarthritis
W. Kullich, B. Stritzinger, B. Steinecker, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; poster presentation at the First LBG Meeting for Health Sciences 2013, Vienna, Austria, 02 December 2013.

2) Long-term effects of nuclear magnetic resonance therapy in arthrosis show multicentre data of over 4,500 patients
W. Kullich, B. Stritzinger, B. Steinecker, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden; Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; Poster presentation at the first LBG Meeting for Health Sciences, Vienna, Austria, 02 December 2013

3) Long-term effects of nuclear magnetic resonance therapy in arthrosis show multicentre data of over 4,500 patients
B. Stritzinger, B. Steinecker, W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden; Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; published in: Journal for Mineral Metabolism 2013;20 (4): 159.

4) Intracellular Calcium Is Influenced by Nuclear Magnetic Resonance Therapy (NMRT) in Cal-78 Chondrosarcoma Cells
B. Steinecker-Frohnwieser1, L. G. Weigel2, H. G. Kress2, W. Kullich1,3,1Ludwig Boltzmann Institute for the Rehabilitation of Internal Diseases, Saalfelden; 2Department for Special Anesthesia and Pain Management, Medical University of Vienna; 3Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; scientific lecture at the ÖGR Annual Conference 2013; published in: Journal for Mineral Metabolism, 20th volume 2013, number 4, pp. 161-162.

2014:

5)Innovative medical technology – Made in Germany
Muntermann A, Oelsner A, MedTec Medizintechnik GmbH, Wetzlar; scientific lecture at the Dr. Sulaiman Al Habib Hospital, Riyadh, Saudi Arabia, November 26,2013.

6)MBST-Nuclear Magnetic Resonance Therapy – innovative medical technology made in Germany
Muntermann A, Oelsner A, MedTec Medizintechnik GmbH, Wetzlar; scientific lecture at the National Guard Hospital, Riyadh, Saudi Arabia, 27 November 2013.

7)Innovative medical technology – Made in Germany
Muntermann A, Oelsner A, MedTec Medizintechnik GmbH, Wetzlar; scientific lecture at the Saad Specialist Hospital, Dammam, Saudi Arabia, 28 November 2013.

8)MBST – Nuclear Magnetic Resonance Therapy. The new opportunity in the treatment of chronic skeleton diseases and sport injuries
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the scientific meeting, Bucharest, Romania, September 2013.

9)NUCLEAR MAGNETIC RESONANCE THERAPY. A SHORT ANALYSIS OF THE SCIENTIFIC STUDIES FOCUSED ON THE SPINE
Assoc. Professor Ivo Mařík, Md, PhD Ambulant Centre for defects of Locomotor apparatus, I. l. c., Prag, Tschechien, M. Schmitz, A. Oelsner, MedTec Medizintechnik GmbH, Wetzlar; Wissenschaftlicher Vortrag auf dem THE 15TH PRAGUE- LUBLIN-SYDNEY SYMPOSIUM, im Children‘s Rehabilitation Center of Orthopaedics and Traumatology „Ogonyok, St. Petersburg, Russland, 15.-22. September 2013

10) Long-term reduction of pain in various arthrosis after treatment with nuclear magnetic resonance.
W. Kullich, B. Steinecker, J. Overbeck, Ludwig Boltzmann Cluster für Rheumatologie, Balneologie und Rehabilitation, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden, Austria, Surgery Practice, Deggendorf, Germany; published in: Pain News 4 / 2013, pp. 20-23.

11)MBST®– Nuclear Magnetic Resonance Therapy on Gonarthrosis, Long-Term Effects
W. van Laack, FH Aachen; Abstract in the event catalogue of the „Safety and Security“, InnovationAllianz der NRW - Hochschulen, Brussels, Belgium, 18 June 2013.

12)MBST®– Analysis of the scientific studies and its relevance to the daily application
J. G. Overbeck, Private Consultant, Deggendorf; scientific lecture at The Park Hotel, New Delhi, India, 7 June 2013.

13)MBST® – Nuclear Magnetic Resonance Therapy, Analysis of the Scientific Studies and ist Relevance to the Daily Application
J. G. Overbeck, Private Consultant, Deggendorf; scientific lecture at the East Delhi Gynae Forum, Delhi, India, 7 June 2013.

14)Magnetic resonance therapy
J. G. Overbeck, Private Consultant, Deggendorf; Scientific lecture at the 32nd Annual Conference of North Zone Chapter of The Indian Orthopaedic Association, Srinagar, India, June 1,2013.

15) Nuclear magnetic resonance therapy - sustained improvement of arthrosis pain (multi-center observational study in 4,518 patients)(abstract)
W. Kullich, B. Steinecker, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; published in: „Dream and reality. Pain therapy in the field of tension between ethics and economy „, ÖSG lectures, Leykam Buchverlag, 2013:43-44.

16) Nuclear Magnetic Resonance Therapy - Sustained Improvement of Arthrosis Pains
W. Kullich, B. Steinecker, Ludwig Boltzmann Institute for the Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; scientific poster presentation at the 21st scientific conference of the Austrian Pain Society, winner of the 1st prize for poster presentation, Klagenfurt, Austria, 09 - 11 May 2013.

17) Multi-center data from more than 4,500 patients with degenerative rheumatic diseases confirm long-term effects of nuclear magnetic resonance therapy
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden, Austria, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation; scientific poster presentation at the 61st Annual Conference of the Association of South German Orthopaedists and Trauma Surgeons, Baden-Baden, May 1-4,2013.

18) Multi-center data from more than 4,500 patients with degenerative rheumatic diseases confirm long-term effects of nuclear magnetic resonance therapy
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster für Rheumatologie, Balneologie und Rehabilitation, Saalfelden, Austria; published in the special edition of the journal for orthopaedics and accident surgery (VSOU), Deutscher Ärzteverlag, 2013:305-306.

19)Intracellular Calcium is influenced by the Nuclear Magnetic Resonance Therapy in Cal-78 chondrosarcoma cells
B. Steinecker-Frohnwieser1, L. Weigl2, W. Kullich1,1Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; 2Department of Special Anesthesia and Pain Management, Medical University of Vienna, Austria; published in: Bone - Abstracts (ECTS 2013, Lisbon), 2013;1:248.

20) Intracellular Calcium is influenced by the Nuclear Magnetic Resonance Therapy in Cal-78 chondrosarcoma cells
B. Steinecker-Frohnwieser1, L. Weigl2, W. Kullich1,1Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; 2Department of Special Anesthesia and Pain Management, Medical University of Vienna, Austria; lecture at ECTS 2013, Lisbon, May 18-21,2013.

21) Functional ability of skeleton and how we can improve it by MBST
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the Croatian National Congress for Osteoporose, Opatia, Croatia, April 2013.

22) (N)MRT – Nuclear Magnetic Resonance Therapy, Analysis of the Scientific Studies and ist Relevance to Sport Injuries and its Ramifications
J. G. Overbeck, Deggendorf; scientific lecture at the Connective Tissues in Sports Medicine, University of Ulm, April 12-14,2013.

23) Only MBST® can treat degenerative bone and joint diseases causally
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2013, S. 9

24)Skin`s youth code cracked fort he first time! Sustained skin regeneration only possible with SpinRepair®.
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2013, S. 9

25)Causal treatment method avoids long downtime and surgery
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2013, S. 9

26)Regenerative Cell Stimulation with MBST®Veterinary Reülaces Surgery for Cartilage and Bone Demage in Veterinary Medicine
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2013, S. 9

27)One-year-survey with multicenter data of more than 4,500 patients with degenerative rheumatic diseases treated with therapeutic nuclear magnetic resonance
W. Kullich, J. Overbeck, H.U. Spiegel, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden, Austria, Private Consultant Surgeon, Deggendorf, Germany, Department Surgery Research, Clinic and Polyclinic for Primary Surgery and Visceral Surgery, University Hospital Münster, Münster, Germany; published in: Journal of Back and Musculoskeletal Rehabilitation 26 (2013) 93-104; DOI 10.3233/BMR 2012-00362, IOS Press.

28) Function and aesthetics - All in One
Vis. Prof. Dr. Dr. Dr. Andreas Valentin, Dental Clinic at the Water Tower Mannheim, Dr. rer. nat. Karen M. Valentin Articles published Cosmetic dentistry 3-2013

2012:

1) MBST – Nuclear Magnetic Resonance Therapy. The new opportunity in the treatment of chronic skeleton diseases and sport injuries
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the symposium „Best practices in the health evaluation of elite athletes - post Olympic analyses“, Belgrade, Serbia, October 2012.

2)New Revolutionary Procedure for Veterinary Medicine Therapeutic Application of Magnetic Resonance Heals Cartilage and Bone Without Operation
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2012, S. 15

3)An Effective Alternative fort he Treatment of Osteoporosis and Bone Disease Magnetic Resonance Therapy Provides Hope to Millions of Osteoporosis Patients
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2012, S. 5

4)Pioneering Cell Regeneration for Dermatology and Cosmetics
Revolutionary Therapeutic Application of Magnetic Resonance for Wound Healing and a Youthful Skin
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2012, S. 14

5)Osteoarthritis Research News – Major Study Corroborates Medical Evidence of Therapeutic Magnetic Resonance in Osteoarthritis
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2012, S. 21

6)MBST-Publications for Wikipedia – Article Magnetic Resonance Therapy
Wikipedia 2012

7)MBST-Publications for Wikipedia – Low field magnetic resonance
Wikipedia 2012

8)MBST-Publications for Wikipedia – Therapeutic nuclear magnetic resonance
Wikipedia 2012

9) Analysis of the long-term effect of MBST® Magnetic Resonance Therapy in case of gonarthrosis
W. van Laack, G. Froning, Institute of Bioengineering (IfB), Laboratory Biomechanics, FH Aachen, Campus Jülich, Orthopaedic Joint Practice and Centre for Outpatient Arthroscopic Surgery, Herzogenrath b. Aachen, 2012

10)MBST-Nuclear Megnetic Resonance Therapy on Gonarthrosis – Long-Term-Effects
Safety & Security Innovations Alliance of the NRW-Hochschulen E. V. W. van Laack, G. Froning, Institute of Bioengineering (IfB), Laboratory Biomechanics, FH Aachen, Campus Jülich, Orthopaedic Joint Practice and Centre for Outpatient Arthroscopic Surgery, Herzogenrath b. Aachen, 2012

11) Effects of nuclear magnetic resonance therapy on sickness in patients with nerve root irritation due to a lumbar disc herniation - study report
G. Salomonowitz, H. Salfinger, J. Hahne, M. Friedrich, Radiology Technology, FH-Campus Wien, Austria, Orthopaedic Pain Therapy, Orthopaedic Hospital Speising, Vienna, Austria, CEOPS, Orthopaedic Hospital Speising, Vienna, Austria, 2012

12) Guide to Natural Healing Methods for Medical Practice
André-Michael Beer, Martin Adler (ed.), Munich 2012, p. 296

13)Nuclear Magnetic Resonance Therapy for Knee Joint Osteoarthrosis: is there any clinical or Radiological Beneficial Effect? Double Blind Randomised Control Study
J.P.Peehal 1, F.W. Smith 2, S.L.Baker 3, Department of Orthopädics, Positional MRI Centre, Aberdeen, United Kingdom J.Bone Joint Surg Br 2011 vol 93-B no. SUPP III 308

14)Coversative therapy and rehabilitation
J. Overbeck, lecture Spring Orthopedic Symposium Prague, March 22-23,2012

15) MBST®-therapeutic nuclear magnetic resonance therapy for degenerative diseases of the musculoskeletal system
J. Overbeck, Lecture Orthopaedic Congress porada Hotel NH Olomouc Congress, 16-18 May 2012

2011:

1) Analysis of the long-term effect of MBST® nuclear magnetic resonance therapy in case of gonarthrosis
W. van Laack, G. Froning, Institute of Bioengineering (IfB), Laboratory Biomechanics, FH Aachen, Campus Jülich, Orthopaedic Joint Practice and Centre for Outpatient Arthroscopic Surgery, Herzogenrath b. Aachen; published in: Orthopaedic Practice 47,11,2011, pp. 536-543.

2) Effects of nuclear magnetic resonance therapy on sickness in patients with Nerve root irritation due to a lumbar disc herniation
G. Salomonowitz, H. Salfinger, J. Hahne, M. Friedrich, Radiology Technology, FH-Campus Wien, Austria, Orthopaedic Pain Therapy, Orthopaedic Hospital Speising, Vienna, Austria, CEOPS, Orthopaedic Hospital Speising, Vienna, Austria, published in: Z Orthop Accident 2011;149 (5): 575-581 (DOI: 10.1055/s-0031-1280121).

3)MBST – The new treatment of osteoarthritis and osteoporosis
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the ISCEM 2011 and the 5th Croatian Endocrinology Congress with international participation, Pula, Croatia, October 2011.

4)30 Years Boltzmann Institute and 30th Rheumatism Conference in Saalfelden
W. Kullich, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Institute for Rehabilitation of Internal Diseases, Saalfelden, Austria; published in: Jatros Orthopaedics, 5/2011, p. 68.

5) Therapeutic use of nuclear magnetic resonance in various forms of arthrosis
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann, Cluster für Rheumatologie, Balneologie und Rehabilitation, Saalfelden, Austria; lecture at the 30th Rheumatologische Fortbildungstagung, Saalfelden, Austria, 17-18 June 2011.

6) Intracellular Ca^{2+} regulation as a possible target of KSRT
L. Weigl, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann, Cluster für Rheumatologie, Balneologie und Rehabilitation, Saalfelden, Austria; Department of Special Anesthesia and Pain Management, Medical University of Vienna, Austria; lecture at the 30th Rheumatological Training Conference, Saalfelden, Austria, 17-18 June 2011.

7) Influence of nuclear magnetic resonance on arthrosis-relevant factors
B. Steinecker-Frohnwieser, Ludwig Boltzmann Institute for the Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the 30th Rheumatological Training Conference, Saalfelden, Austria, 17-18 June 2011.

8)MBST-NUCLEAR MAGNETIC RESONANCE THERAPY THE NEW POSSIBILITY OF OSTEOARTHRITIS AND OSTEOPOROSIS TREATMENT
Prof. Dr. SC. Dalibor Krpan, Policlinica K-Centar, Zagreb; published in: Balneoclimatologia, Dijagnostica I Le? cenje Osteoporoze, May 2011, Vol. 35, pp. 61-66.

9) Nuclear magnetic resonance influences arthrosis pain
W. Kullich, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Institute for the Rehabilitation of Internal Diseases, Saalfelden, Austria; scientific poster presentation at the 19th Annual Conference from 26 - 15 October 2009 in Vienna, Germany. 28 May 2011 of the Austrian Pain Society.

10)Magnetic resonance therapy crackst he code of youthful skin Skin aging and cellulite are no longer an unavoidable fate. They are rather a challenge which, with the right reatment, can be calmly met.
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2011, S. 6

11)Hope for millions of osteoporosis patients
Magnetic resonance used therapeutically shows highly significant results in the fight against osteoporosis. Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2011, S.12

12)Cartilage regeneration in osteoarthritis patients through nuclear magnetic resonance therapy
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2011, S. 6

13)Bone demage in veterinary medicine treated with nuclear magnetic resonance therapy
Up until now veterinary practitioners have been searching unsuccessfully for an effective and non,evasive treatment method for bone and cartilage demage for large and small animals.
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2011, S. 6

14)Next Generation of medical Technology- Therapeutic Effect of NMR-Therapy against Osteoarthritis Proven
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2011, S. 60

15)MBST – Nuclear Magentic Resonance Therapy. The new possibility of osteoarthritis and osteoporosis treatment
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the International Symposium for Osteoporosis, Niška Banja, Serbia, May 2011.

16)MBST - Treatment of chronic skeleton diseases
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the symposium „The new methods in the treatment of degenerative diseases“, Ljubljana, Slovenia, April 2011.

17)Next generation of medical technology. Therapeutic effect of NMR-Therapy proven
W. Kullich, Institute for the Rehabilitation of Internal Diseases, Saalfelden, Austria; published in: Arab Health Magazine, Jan. 2011, pp. 62-64.

2010:

1) Modulation of VEGF and Cytokines by Therapeutic Nuclear Magnetic Resonance
B. Steinecker-Frohnwieser, L. Weigl, N. Fagerer, W. Kullich, H. G. Kress, Cluster for Rheumatology, Balneology and Rehabilitation, LBI-Office for Rehabilitation of Internal Diseases, Department of Special Anesthesia and Pain Therapy, Medical University of Vienna, Austria; published in: Journal for Mineral Metabolism 2010;17 (4), p. 155.

2)Medical Progress in The Treatment of Arthritis
Arab Health, Dubai; publishedin: The official magazine of the Arab Health Exhibition, January 2010, S. 40

3)The regenerative Cell Stimulation for Cartilage and Bones in Veterinarymedicine Musculoskelatal disorders are a common occurrence in veterinary medicine.
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2010

4)The Therapeutic effects of nuclear magnetic resonance in degenerative joint diseases Introduction Osteoarthritis (OA) of the hand and finger joints ist he main cause of difficulties in the execution of activitis in daily life
Arab Health, Dubai; pubilshed in: The official magazine of the Arab Health Exhibition, January 2010, S. 40

5)Influence of NMR therapy on metabolism of Osteosarcoma – and Chondrosarcoma Cell Nuclear magnetic resonance (NMR) with weak magnetic fields has been shown to stimulate repair prozesses in cardilage and to influencepain signalling.
Arab Health, Dubai; publishedin: The official magazine of the Arab Health Exhibition, January 2010, S. 40

6)Innovation in the therapy of musculoskeletal disorders Magnetic nuclear resonance therapy has been well established over the last year in the conservative therapy for musculoskelatal disorders in Germany
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, January 2010, S. 40

7)Break-Through in Orthopaedics – Causal Solution to Osteoarthritis and Osteoporosis
Arab Health, Dubai; published in featureorthopaedics, 2010, S 28-29

8)MBST – The new concept of the treatment of chronic skeleton diseases
D. Krpan, Policlinica K-Centar, Zagreb, Croatia; lecture at the „Orthopaedic Days“, Maribor, Slovenia, December 2010.

9)Modulation of VEGF and Cytokines by the Therapeutic Nuclear Magnetic Resonance
B. Steinecker-Frohnwieser, L. Weigl, N. Fagerer, G. Weberhofer, W. Kullich & H. G. Kress, LBI for Rehabilitation, Saalfelden, Austria, Department of Special Anaesthesia and Pain Therapy, Medical University of Vienna, Austria; scientific presentation at the annual congress of the Austrian Society for Rheumatology and Rehabilitation, Vienna, 25-27 November 2010.

10)Breakthrough in Orthopaedics: Causal Solution to Osteo-Arthritis and Osteoporosis
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, November 2010, S. 28-29.

11)Worldwide interest in new Technology from Germany: Therapeutic Magnetic Resonance Therapy
Arab Health, Dubai: published in: The official magazine of the Arab Health Exhibition, März 2010, S. 54.

12)Medical Progress in the Treatment of Arthritis
Arab Health, Dubai; published in: The official magazine of the Arab Health Exhibition, Januar 2010, S. 40.

13)Impact of magnetic resonance therapy on sickness absence of patients with nerve root irritation following a lumbar disc problem.
Salomonowitz G1, Salfinger H, Hahne J, Friedrich M. 1, Radiology Technology, FH-Campus Vienna, Austria. gabriele.salomonowitz@fh-campuswien.ac.at

14)Nuclear magnetic resonance therapy in lumbar disc herniation with lumbar radicular syndrome: effects of the intervention on pain intensity, health-related quality of life, disease-related disability, consumption of pain medication, duration of sick leave and MRI analysis.
Salfinger H1, Salomonowitz G, Friedrich KM, Hahne J, Holzapfel J, Friedrich M. 1, Centre of Excellence for Orthopaedic Pain Management Speising, Vienna, Austria, heribert.salfinger@oss.at.

2009:

1) NFAT modulation in bone and cartilage cells by nuclear magnetic resonance therapy
W. Kullich, L. Weigl, B. Steinecker, H. G. Kress, Ludwig Boltzmann Institut für Rehabilitation, Cluster für Rheumatologie, Balneologie und Rehabilitation, Saalfelden, Austria; Medical University of Vienna, Clinical Dept. f. Special Anesthesia u. Pain Therapy, Vienna, Austria; Ludwig Boltzmann Institute for Rehabilitation, Institute Branch Gröbming, Gröbming, Austria; Medical University of Vienna, Clinical Department for Special Anesthesia and Pain Therapy, Vienna, Austria; scientific lecture and poster, German Congress for Orthopaedics and Trauma Surgery, Berlin, October 21 - 24,2009.

2)Influence of NMR Therapy on Metabolism of Osteosarcoma- and Chondrosarcoma Cell lines
B. Steinecker-Frohnwieser, L. Weigl, C. Höller, E. Sipos, W. Kullich, H.G. Kress, LBI for Rehabilitation of internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Department of Special Anesthesia and Pain Management, Medical University Vienna, Austria; published in: Bone - Official Journal of the International Bone and Mineral Society, Nr. 44-2, 2009, S. 295.

3)Influence of NMR Therapy on Metabolism of Osteosarcoma- and Chondrosarcoma Cell lines.
B. Steinecker-Frohnwieser, L. Weigl, C. Höller, E. Sipos, W. Kullich, H.G. Kress, LBI for Rehabilitation of internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Department of Special Anesthesia and Pain Management, Medical University Vienna, Austria; scientific presentation at the 36th European Symposium on Calcified Tissues, ECTS Congress, Vienna, Austria, 23rd -27th May, 2009.

4) From diagnostic apparatus to therapeutic application - nuclear magnetic resonance a new treatment for cartilage formation
W. Sister-in-law article published in: Doctors Week, 7.5.2009, p. 22.

5) Inaugural dissertation on obtaining the doctor medicinae of the medical faculty of the Westfälische Wilhelms-Universität Münster: Does MBST® nuclear magnetic resonance therapy have an influence on post-traumatic gonarthrosis in the rabbit model?
T. Brockamp, University Hospital Münster, Clinic and Polyclinic for Trauma, Hand and Reconstructive Surgery; April 2009.

6)Influence of NMR therapy on Ca2+ signalling and gene expression in osteosarcoma- and chondrosarcoma cell lines
L. G. Weigl, B. Steinecker-Frohnwieser, C. Höller, E. Sipos, H. G. Kress, W. Kullich, Department of Special Anaesthesia and Pain Management, Medical University Vienna, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, LBI for Rehabilitation of Internal Diseases, Saalfelden, Austria; Regional Biophysics Conference 2009, Linz, Austria, 10-14 February 2009.

7) Improves pain and function: MRI therapy for arthrosis
Published in: Medical Tribune, Volume 44, No. 1/2, January 9,2009, p. 9.

8) Fit for sports: training, warming up, healing
Author: Prof. Dr. med. Reinhard Weinstabl, Vienna, 2009.

9) Does MBST® magnetic resonance therapy have an effect on post-traumatic gonarthrosis in the rabbit model? 6 weeks tria - an animal experimental study -
Thomas Brockamp INAUGURAL-DISSERTATION for obtaining the doctor medicinae of the medical faculty
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1) Influence of nuclear magnetic resonance therapy on the regulation of the NFAT pathway in osteo- and chondrosarcoma cells
B. Steinecker, L. Weigl, W. Kullich, H. G. Kress; presentation at the conference of the Austrian Society for Rheumatology, November 2008, Vienna; published in: Magazine for Mineral Metabolism, 11/2008, p. 201.

2) Therapeutic use of nuclear magnetic resonance in the treatment of arthrosis
W. Kullich, Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the German Congress for Orthopaedics - Trauma Surgery, Berlin, October 2008, link to the text: http://www.egms.de/en/meetings/dkou2008/08dkou326.shtml.

3) Arthrosis therapy with nuclear magnetic resonance: procedure can stimulate repair processes in cartilage and influence pain signal transduction cascades.
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden, Austria; published in: Orthopädische Nachrichten, Congress Edition, German Congress on Orthopaedics Accident Surgery, Berlin, 22 - 25 October 2008, p. 12.

4) Treatment of osteoporosis with MBST® Nuclear Spin
T. Glove, C. Melzer, Waldkrankenhaus Bad Düben, Fachkrankenhaus für Orthopädie; published in: Orthodoc, 5/2008, pp. 1 - 4.

5) Improvement of function in finger joint arthrosis by magnetic resonance
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10) Results of gene expression studies under the influence of nuclear magnetic resonance
W. Kullich, B. Steinecker, Ludwig Boltzmann Institute for the Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at MedTec Medizintechnik GmbH - presentation of MBST study results, Wetzlar, April 10,2008.

11) MBST therapy and its influence on the molecular physiology of osteocytes, chondrocytes and PC12 cells
B. Steinecker1, W. Kullich1, L. Weigl2,1Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; 2Department for Special Anesthesia and Pain Management, Medical University of Vienna, Austria; lecture at MedTec Medizintechnik GmbH - Presentation of study results, Wetzlar, 10 April 2008.

2007:

1) Magnetic Resonance Therapy and Bone Health
J. Overbeck, Deggendorf, Germany; Wissenschaftlicher Vortrag am Kings College Hospital, Bone Health Group, London, UK, December 2007.

2) Chronic joint problems: nuclear spin impulses used therapeutically
Accident Surgery Centre Dr. Peter Valentin, Klosterneuburg Austria; published in: Ärztewoche, Austria, December 13,2007, p. 14.

3) Application of nuclear magnetic resonance in degenerative rheumatic diseases
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the 5th MBST User Conference, Wetzlar, November 24,2007.

4) The therapeutic application of nuclear spin resonance in the treatment of gonarthrosis, low back pain and finger polyarthrosis.
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the conference „Evaluation and Research in Rehabilitation“, Gröbming, Austria, September 13,2007.

5) Nuclear magnetic resonance in the therapy of gonarthrosis
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the LBI Cluster Meeting, Bad Tatzmannsdorf, Austria, 22 June 2007.

6) Therapeutic application of nuclear magnetic resonance in finger polyarthrosis
W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the LBI Cluster Meeting, Bad Tatzmannsdorf, Austria, 22 June 2007.

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B. Steinecker, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the LBI Cluster Meeting, Bad Tatzmannsdorf, Austria, 22 June 2007.

8) Use of nuclear magnetic resonance as a new therapy option for gonarthrosis
N. Fagerer, W. Kullich, Ludwig Boltzmann Institute for the Rehabilitation of Internal Diseases, Saalfelden, Austria; published in: Doctor & Practice, Vienna, No. 927, pp. 180-182, May 2007.

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J. Josiliewicz; lecture at the Bengurion University of Negev, April 2007.

10)Decrease in extracellular collagen crosslinking after NMR magnetic field application in skinfibroblasts
I. Digel, E. Kurulgan, Pt. Linder, P. Kayser, D. Porst, G. J. Braem, K. Zerlin, G. M. Artmann, A. Temiz Artmann, Fachhochschule Aachen, Campus Juelich, Competence Platform Bioengineering; published in: Journal of the International Federation for Medical and Biological Engineering, No. 1, January 2007,45:91-97.

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o. Gorschewsky, Sports Orthopaedics Bern 2007

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W. Kullich, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Ludwig Boltzmann Cluster for Rheumatology, Balneology and Rehabilitation, Saalfelden, Austria; lecture at the 3rd MBST training event and user conference, Wetzlar, 11 November 2006.

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W. Kullich, H. Schwann, J. Walcher, K. Machreich, Ludwig Boltzmann Institute for Rehabilitation of internal Diseases; Rehabilitation Centre for Rheumatic and Cardiovascular Diseases, SKA of PVA, Saalfelden, Austria; published in: Journal of Back and Musculoskeletal Rehabilitation, 19 (2006), 79-87.

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W. Kullich, H. Schwann, K. Machreich, M. Ausserwinkler, Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Saalfelden, Austria; published in: Rheumatologia 1/2006, pp. 7-12.

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7) MBST® nuclear magnetic resonance therapy with activated coxarthrosis in a 14-year-old cerebral-pretinal patient.
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Annexes

Reports, lectures, publications