



# Jogging for the Cell



## Competence and innovation in medical technology



Just like the vast majority of highly innovative and new technologies, the MBST® Magnetic Resonance Therapy Device was developed by a highly creative, medium-sized company.

Both the MBST® Magnetic Resonance Therapy Devices, and the procedures for treating musculoskeletal system disorders using magnetic resonance therapy, were developed over a number of years by the two German companies MedTec Medizintechnik GmbH (founded in 1998) and AD Elektronik GmbH (founded in 1981) in collaboration with a number of engineers, physicists, biologists and doctors from well-known research institutions and universities.

MBST® KernSpin was launched in Germany and Austria following a two-year trial period, during which it was tested in doctor's surgeries, and the performance of two pilot studies.

Since the day it was founded, MedTec Medizintechnik GmbH has developed into a research and sales-oriented company with a number of

international contacts.

AD Elektronik GmbH has made an international name for itself as an innovative developer of specialist medical technology products in the fields of cardiology, electrophysiology, intelligent battery-management and accessories. Its products and the development services provided by the Wetzlar-based company's engineers and physicists are in high demand by medical sector corporations from around the world.

Both companies are now owned by Muntermann Holding GmbH.

## The idea – Tackling causes instead of the symptoms



Initially, the idea of investigating the therapeutic effects of MRI arose in response to reports from radiologists and orthopaedist concerning the frequent improvement of and even complete cessation of pain in patients with joint problems after having MRI scans.

The physical effects of magnetic resonance - as used in magnetic resonance imaging and by MBST® - on the degenerative processes affecting human cartilage and bone structures are those of a causal, biophysical therapy. However, even today, most of the treatments available for musculoskeletal system disorders and diseases only address symptoms as opposed to causes, generally involve the use of chemical substances and tend to heavily rely on the doctors' experience for their success.

In view of the number of people suffering from musculoskeletal problems, the need for scientific proof of the positive and causal effects of magnetic resonance therapy on pain, cartilage regeneration, bone density and strength, is taking on a pivotal role and its establishment should be actively pursued.

The huge demand for effective therapies in this field makes magnetic resonance therapy a perfect alternative to and complementary therapy for the conventional treatments currently available for arthritis, injuries in general, sports injuries and osteoporosis. It's significance is further reinforced by the near total lack of therapeutic approaches targeting the underlying causes of these kinds of diseases, its safety and lack of side effects, as well as the fact that it does not involve any pain.

## The MBST® Magnetic Resonance Therapy Devices



MBST® Magnetic Resonance Therapy Devices come in four different versions to ensure that different anatomical regions and symptoms can be treated in the most efficient manner possible.

MBST® Magnetic Resonance Therapy Devices consist either of a two-component applicator coil or a flat applicator and a control unit.





The control unit acts as the processor module for activating and transmitting treatment programme information to the applicator in which the relevant therapeutic magnetic fields are generated as specified by pre-programmed chip cards.



# The right treatment for every condition



The right therapy device for every treatment.

-  MBST® Arm/Leg: For the treatment of the joints of the upper and lower extremities
-  MBST® Back: Treatment couch for the treatment of the spine, shoulder and pelvic girdle
-  MBST® Osteoporosis: Full-length treatment couch for the treatment of osteoporosis
-  MBST® ProMobil: Portable therapy device for the treatment of all joints and the spine



# Indications for Magnetic Resonance Therapy



MedTec Medizintechnik GmbH constantly researches new potential indications for magnetic resonance therapy and always notifies its customers immediately if or when it becomes aware of any such, or if the therapy chip card programmes have been optimised in

response to new research findings. This ensures that all MBST®'s are always kept up to date and removes the need for replacing them – thus saving costs and always making sure that customers are able to benefit from the latest treatment optimisations.

## INDICATIONS:

### Degenerative wear

- Arthritis
- Damaged cartilage
- Damaged spinal discs

### Sports injuries

- Bruised soft tissues
- Strains and twisted joints
- Damaged tendons
- Tennis and Golfer's elbow
- Achilles tendonitis

### Bone diseases

- Osteoporosis
- Metabolic bone diseases

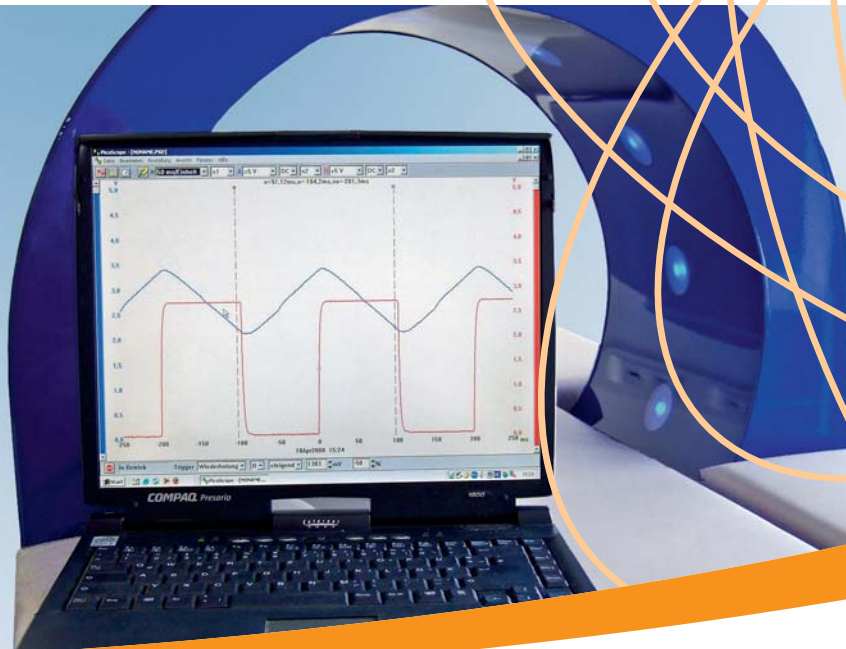
Joints and other areas of the body that can be treated with MBST®:

- Throat and neck
- Shoulders, elbows, hands and fingers
- Knees and ligaments
- Back, vertebral joints and spine
- Hips
- Feet and ankle joints
- Individual body parts of patients, the whole body of patients suffering from osteoporosis

## KONTRAINDICATIONS:

- Pregnant women
- AIDS
- Cancer

## Unique Features of MBST®



In technical terms, magnetic resonance therapy is based on the same principles as magnetic resonance imaging - and both of these systems make use of the physical phenomena of magnetic resonance. However, MBST® devices only use magnetic fields of 0.4 to 2.35 Millitesla at a magnetic resonance frequency of 17 to 100 kilohertz, and varying field strengths depending on the specific treatment system used.

MBST® Magnetic Resonance Therapy Devices – and, in some cases, the therapeutic procedures associated with it - are patented in a large number of countries across the world and meet the scientific requirements for generating magnetic resonance.

This makes MBST®s' Magnetic Resonance Therapy Devices unique and clearly sets them apart from the conventional magnetic field therapy systems available on the market today that simply use a pulsed magnetic field to achieve their therapeutic effects, as opposed to the three electromagnetic fields of varying

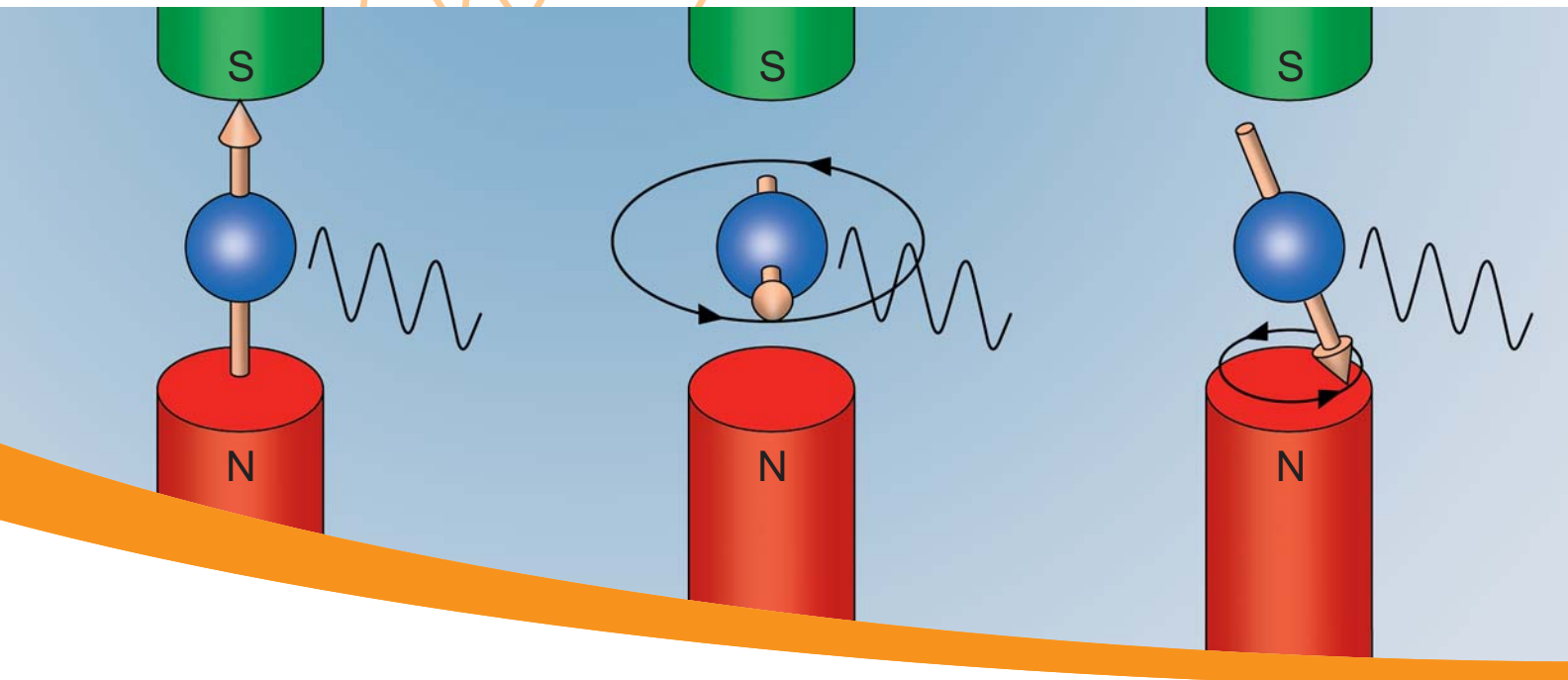
characteristics that are required simultaneously to create the magnetic resonance

used by MBST®. These three electromagnetic fields are:

The main static magnetic field, a variable sweep field  $\text{dBo}/\text{dt}$  that runs parallel to the main magnetic field and an alternating magnetic field  $B_1(t)$  that meets the Lamor frequency conditions and runs vertical to the other fields.

This field constellation can be visualised at any time using a magnetic resonance detection system or oscilloscope, and clearly and verifiably shows the magnetic resonance generated by the MBST® Magnetic Resonance Therapy Devices.

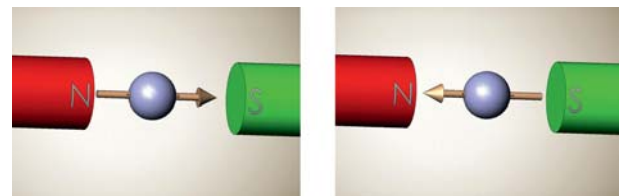
# The functional principle of Magnetic Resonance Therapy



MBST<sup>®</sup> works by using the therapeutic form of magnetic resonance to selectively act on the nuclei (protons) of H-atoms. The atom nuclei's resonance or Larmor frequency can be calculated using the Larmor's formula  $f = \gamma \cdot B$ .  $B$  is the strength of the magnetic field in Tesla and  $\gamma$  is a constant which, for hydrogen, is 42.6 MHz per Tesla.

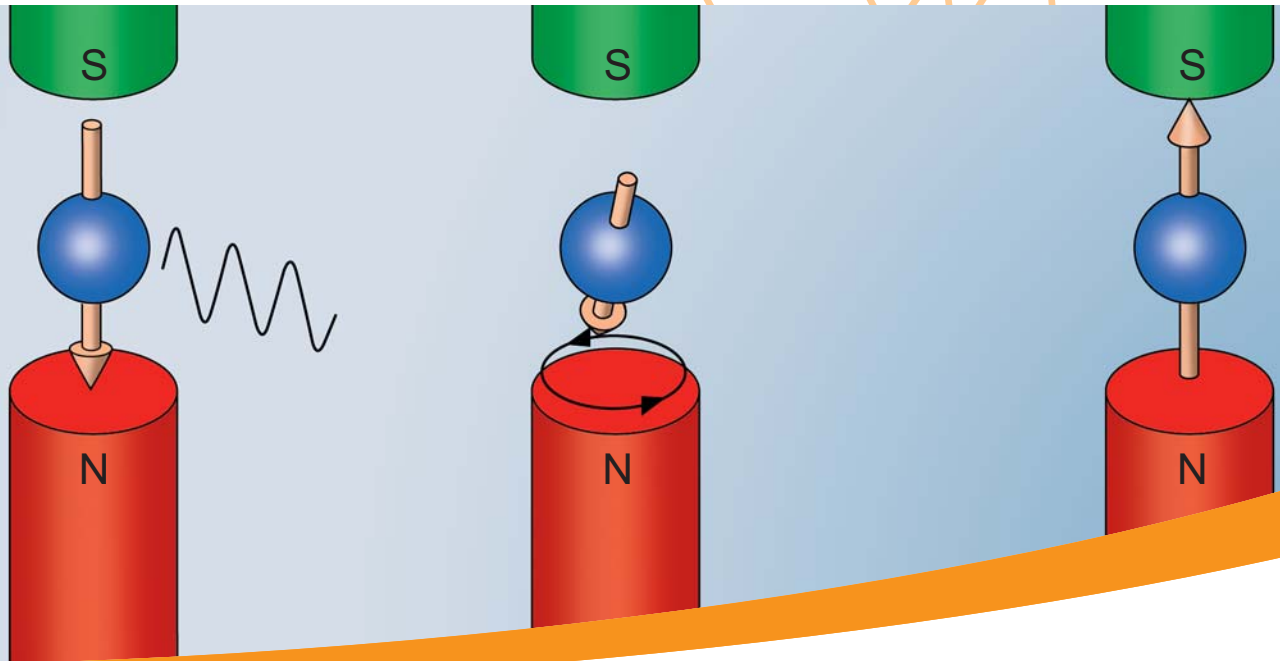
If the nucleus of an atom is exposed to a radio wave with a frequency of  $f$ , the radio wave will be absorbed and the nucleus will turn in a specific way, i.e. away from the applied magnetic field, and move into a higher energy state. When the radio wave is turned off, the atom's nucleus returns to its former alignment and the lower energy state.

By periodically exposing them to radio frequency, hydrogen nuclei repeatedly aligned with and then turned away again from the magnetic field they are exposed to. When doing so, the radio wave will act on all of those hydrogen nuclei that are aligned with the magnetic field at the moment of exposure.



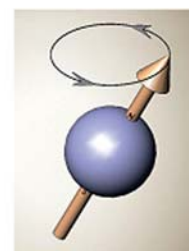
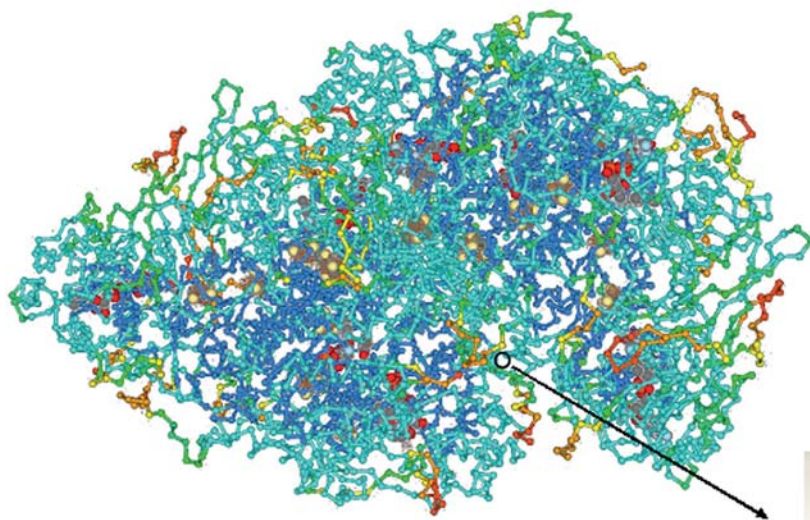
This process of turning a H-proton in such a way that it opposes the applied magnetic field requires energy – which is why it is called moving into a “higher energy state”.

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When “flipping” hydrogen nuclei to the higher energy state, the strength and length of the bonds between the affected hydrogen nuclei (H-bonds) inside macromolecules change. This means that MBST® creates structural changes at the intra-molecular level.

The vibrational sequences induced by exposing hydrogen atoms to radio waves match the body’s own vibrational frequencies to such an extent that they simulate the regeneration and repair of cartilage and bone tissue.



# Functional improvement in finger arthritis following treatment by Magnetic Resonance



This study was conducted by: Ludwig Boltzmann Institute for Rheumatology, Balneology and Rehabilitation, LBI Althofen Clinic and LBI Centre for Internal Medicine and Rehabilitation, Saalfelden, Austria, Dr. med. Michael Auserwinkler, Prof. Dr. Werner Kullich

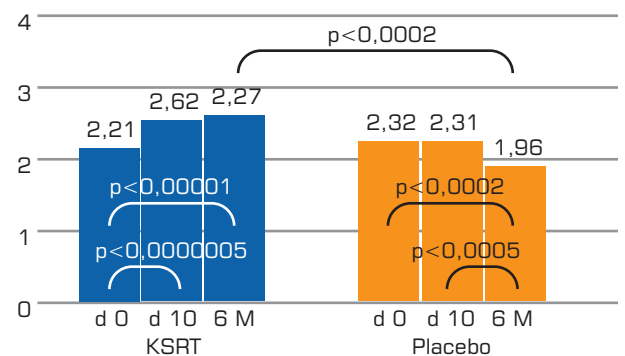
This double-blind, placebo-controlled and randomised study involved 59 patients and was conducted over 9 days during which patients received 1 hour of magnetic resonance therapy a day.

Part of this study's results were published in the form of a special information sheet on the occasion of the 56th annual convention of the South German Orthopaedic Association, May 2008, Baden-Baden

The study and its overall results have been submitted for publication in a scientific journal.

## Results

The test group of this study experience significant improvements in hand function both



immediately following magnetic resonance therapy and after 6 months ( $p < 0.00001$ ), while hand function in the placebo group significantly deteriorated over a 6-month period.

## Conclusion

This study clearly verifies that magnetic resonance therapy improves finger function and that it is associated with a high-level of subjective patient satisfaction, thus making it highly recommended as a new treatment option for the treatment of painful finger arthritis.

# Magnetic Resonance Therapy improves rehabilitation success in chronic lower back pain



This study was conducted by: Ludwig Boltzmann Institute for Internal Medicine and Rehabilitation, Saalfelden, Austria, Univ. Doz. Dr. Werner Kullich, N. Fagerer, K. Machreich, H. Schwann

This study was double-blind, placebo-controlled and randomised, and involved 62 patients with chronic lower back pain.

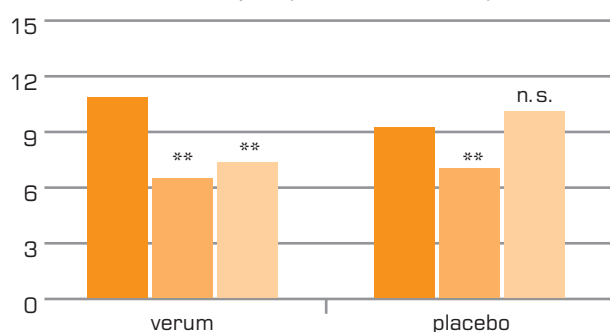
It was published in: Journal of Back and Musculoskeletal Rehabilitation (2006) 19: 79-87 and in: Rheumatologia, 1/2006, 20, 7-12; and presented at the annual conference of the Austrian Association of Rheumatology and Rehabilitation, November 2005, in Vienna; as well as at the EULAR Congress in Vienna, June 2005

Patients' back problems were diagnosed by X-ray, CT and MRI and received treatment over a three-week period through a multidisciplinary rehabilitation program and one-hour treatments with MBST® over five consecutive days.

## Results

At the start of the study, after one week and three months after treatment.

Roland-Morris Questionnaire overall score of "yes" answers to 24 questions. Significant improvements compared to condition at the start of the study: \*  $p < 0.005$  \*\*  $p < 0.001$



## Conclusions

Patients who received treatment with MBST® still experienced a significant and sustained improvement in their lower back pain three months after treatment. This shows that concurrent treatment by MBST® can improve painful chronic back over long periods of time. The most important treatment outcomes reported by patients were improvements related to their performance of everyday activities.

# Prospective study of the effectiveness of MBST® Magnetic Resonance Therapy in conservative gonarthrosis treatment conducted over 1 year



This study was conducted by: Waldkrankenhaus Bad Döben, Specialist Clinic for Orthopaedics; Orthopaedics Department, Taucha, Prof. Dr. med. Christian Melzer, Dr. med. Babett Auerbach, Anke Yacoub

In this study, 60 patients with a diagnosis of gonarthrosis received one-hour treatments by MBST® over a period of five days and were examined at different times over the course of a one-year period post treatment. The study was double-blind, randomised and placebo-controlled.

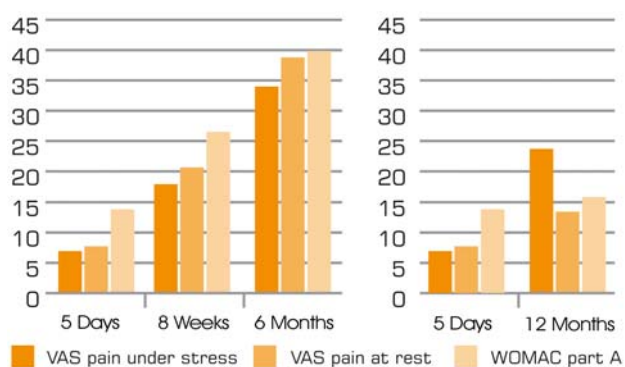
The results of this study were presented at the First Joint Congress for Orthopaedic Medicine and Trauma Surgery, October 2005, Berlin. An information sheet and abstract of the study was furthermore published in the Congress's Abstract Book, R2-446  
Cartilage damage was diagnosed by arthroscopy (33) and X-ray (27).

## Results

Changes in scores in percent

Affect on joint pain

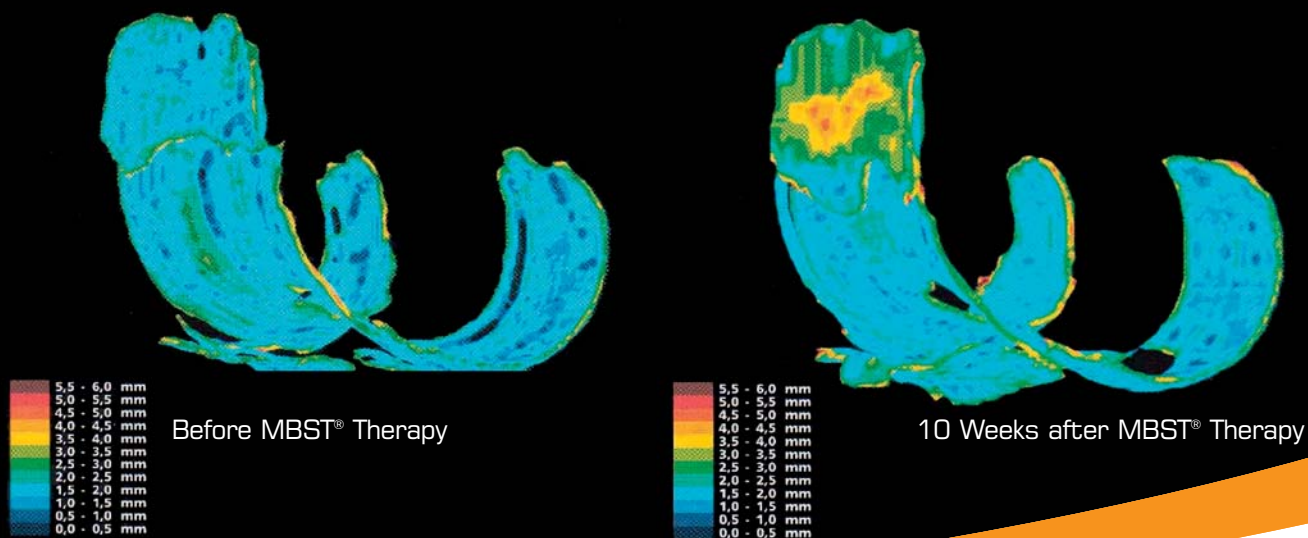
Significant changes during the entire treatment period



## Conclusion

The results of this study indicate that Magnetic Resonance Therapy (MBST®) is a highly effective method for the conservative treatment of arthritis.

# Evaluation of the effect of MBST® on cartilage regeneration



This study was conducted by: German University of Sports, Cologne, Institute for Rehabilitation, I. Froböse; Munich University, Großhadern Clinic, Department for Diagnostic Radiology, M. Reiser; Munich University, Institute of Anatomy, F. Englmeier; Institute for Radiology, Cologne, J. Assheuer; ReAgil Therapy Centre, G. Breitgraf

Three-dimensional quantification of cartilage structures using MRI before and after the treatment of 14 patients with a clinical diagnosis of gonarthrosis (Wirth stages II and III) using Magnetic Resonance Therapy. All participants received one hour of treatment a day and a total of nine hours of treatment.

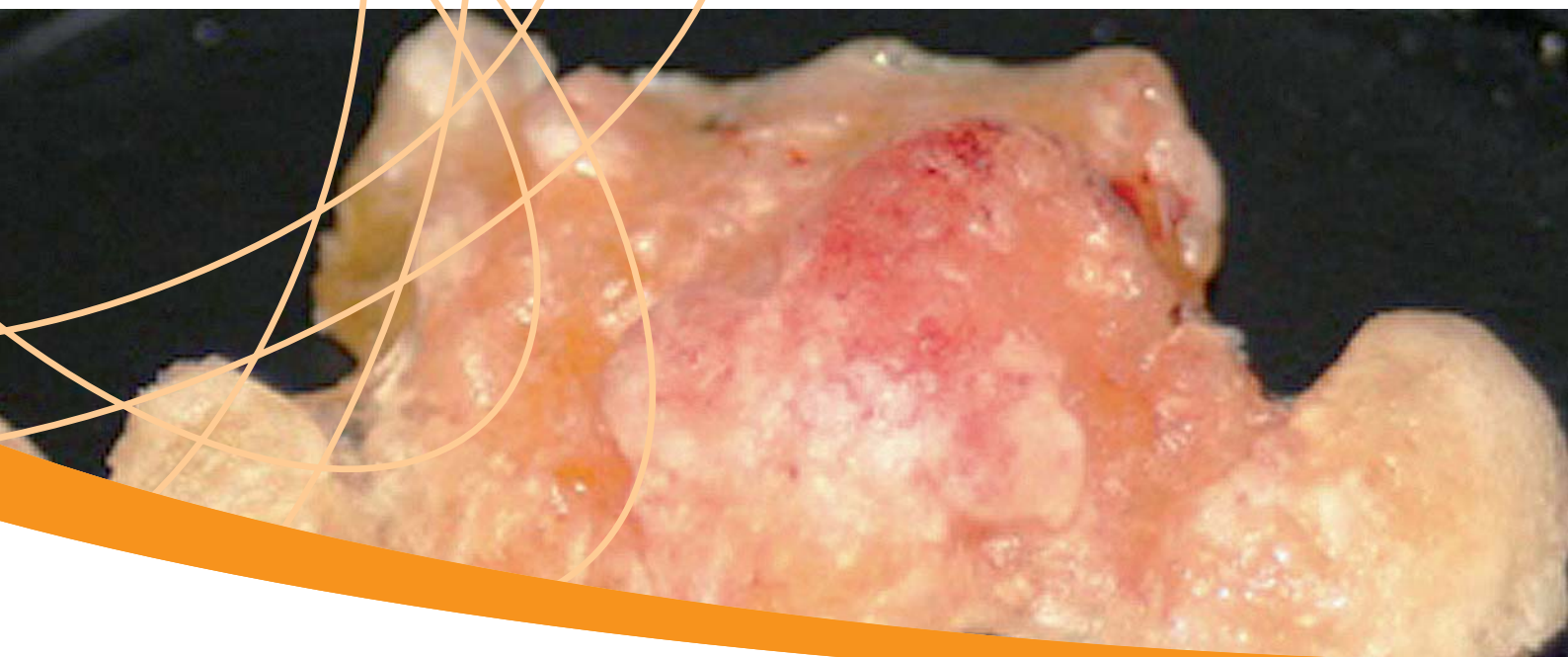
Results				
		before Therapy	after Therapy	p-value
Patella	Interpolated volume	2109.28 cm <sup>3</sup>	2459.48 cm <sup>3</sup>	p < 0.001
	Mean thickness	1,93 mm	2,24 mm	p < 0,001
Tibia lateral	Interpolated volume	1706.83 cm <sup>3</sup>	1739.23 cm <sup>3</sup>	p < 0.05
	Mean thickness	1.64 mm	1.67 mm	p < 0.01
Tibia medial	Interpolated volume	1343.36 cm <sup>3</sup>	1511.67 cm <sup>3</sup>	p < 0.05
	Mean thickness	1.25 mm	1.37 mm	p < 0.05

Published in:  
Orthopädische Praxis 8/2000, 63th Volume,  
p. 510-515

## Conclusion

The results of this study represent quantitative proof that Magnetic Resonance Therapy stimulates metabolic processes and the regeneration of cartilage tissue!

## Does low Energy NMR have an Effect on moderate Gonarthrosis



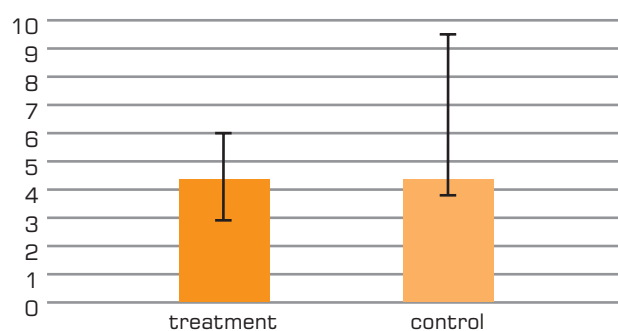
This study was conducted by: Clinic and Polyclinic for Trauma, Hand and Reconstructive Surgery of the University Hospital of the Westphalian Wilhelms University of Münster, H. Jansen, T. Brockamp, JRJ. Paletta, S. Ockmann, MJ. Raschke, RH. Meffert

This randomised, double-blind study involved the treatment of a test group of 12 rabbits with surgically induced instabilities of the knee and post-traumatic gonarthrosis with one hour of MBST® a day over a period of seven days. The control group did not receive any MBST® treatments.

The results of this study were presented at the 52nd Annual Meeting of the Orthopaedic Research Society, Chicago, USA, March 2006; and at the Joint Congress for Orthopaedic Medicine and Trauma Surgery, October 2006, Berlin

### Results

The MBST® group had a significantly lower rate of osteophyte-formation than the control group.



### Conclusion

The treatment with MBST® had a significant macroscopic effect on moderate post-traumatic gonarthrosis in rabbits. This effect was particularly evident in the (reduced) formation of osteophytes

# Effects of Magnetic Resonance Therapy on in vitro cell cultures

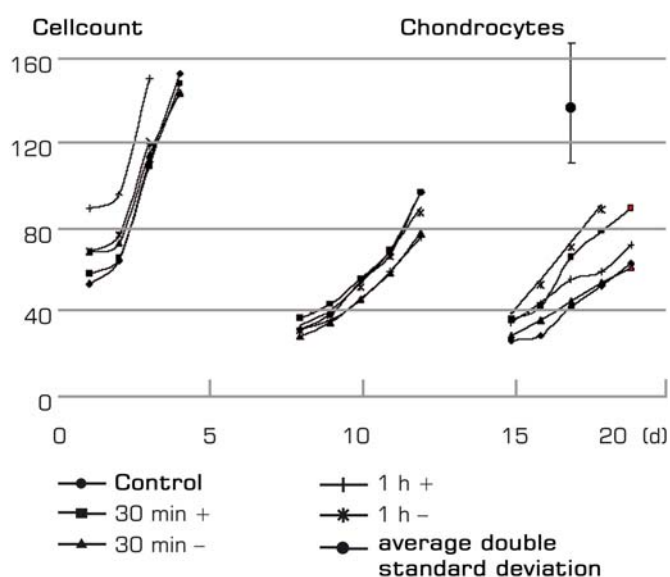


A study performed by the Bioengineering Centre of Competence of the University of Applied Science Aachen, Jülich, Prof. Dr. G. M. Artmann

Cell division rate, cell death and viability of human chondrocytes and osteoblasts before and after exposure to MBST® - a double-blind, randomised and placebo-controlled study. Published in: *Methods and Findings Exp. Clin. Pharmacol.*: 27 (6): 391-394.

## Results

Treatment with magnetic resonance did not cause cell death nor shorten the cells' lifespan. Upon cell count, the number of chondrocytes had increased by 271 percent and the number of osteoblasts by 290 percent in the treatment group versus the placebo group.



## Important completed and ongoing international studies on MBST® Kern-Spin approved by the relevant Ethics Commissions:

University of Aberdeen, Scotland, UK: 100 patients with knee arthritis, MRI quantification before/after MBST®, double-blind, randomised, placebo-controlled.

Orthopaedic Clinic Speising, Vienna, Austria: 60 patients with spinal nerve irritation and lower back pain, double-blind, randomised, placebo-controlled.

University of Würzburg, Germany: In-vitro investigation of the effect of Magnetic Resonance Therapy on osteoblasts.

General Hospital Vienna and Ludwig Boltzmann Institute, Saalfelden, Austria: Molecular-biological investigation on the effects of Magnetic Resonance Therapy on the ion channels of human cells.

Sonnenhof Clinic, Department of Sports Orthopaedics, Bern, Switzerland: Investigation of the effectiveness of Magnetic Resonance Therapy on arthroscopically diagnosed chondromalacia patella of the knee joint and gonarthrosis – a double-blind, randomised and placebo-controlled study of 60 patients.

University of Applied Science Aachen / Jülich, Germany: The effect of MBST® (NMR stimulation) on skin cells at the proteome level; an in-vitro investigation using primary cultures of normal human dermal fibroblasts.

IEB Institute, Wetzlar, Germany: Multi-Centre study: 337 patients, effectiveness of Magnetic Resonance Therapy in coxarthrosis, 8 to 12 weeks, 6 months and 1 year after treatment.

Further scientific studies on request



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