

# Vitality & Health



The ultimate therapy for treatment of osteoporosis as well as the impact of metabolic and degenerative diseases

- Unique operating principle
- Medication-free
- Biomechanical
- Clinically tested
- Simplest application
- No side effects
- Highly effective
- Non invasive
- CE-certified

## The Evolution in Vibration Therapy



# From Theory to Reality

**The LiV therapy developed by Prof. Dr. Clinton Rubin represents a proven procedure for the development of bones and muscles. The vibration therapy with very small mechanical and therefore natural movement impulses is based on the cooperation with the American space agency NASA as well as more than 35 years of research and is described in numerous studies of renowned scientists.**



**Clinton T. Rubin, Ph.D.**

Chief Scientific Officer, SUNY Distinguished Professor & Chair Department of Biomedical Engineering Stony Brook University Stony Brook, New York

I have spent more than 35 years of my scientific career trying to understand how mechanical signals influence the musculoskeletal system. One of our key findings has been that extremely low magnitude mechanical signals, delivered in the form of LiV (Low intensity Vibration), have the capacity to dictate the regeneration patterns of mesenchymal stem cells (MSCs) found within the bone marrow to stimulate the formation of bone and muscle and suppress the formation of fat.

We have discovered, through our many years of scientific research in preclinical and clinical studies\*, that low intensity vibration promotes bone quantity and quality, builds lean muscle mass and the conditioning of muscle reflexes. It is the goal of all biomedical scientists to see the work that we do in the laboratory translate to the clinic, to help the health and well-being of patients. It is very exciting, indeed, that we are finally achieving this goal. Thank you for considering the Marodyne LiV technology as a potential means of restoring and protecting bone and muscle health. It has been a long scientific journey, but we are very, very pleased to see the application of this technology become a reality.

Best Regards

A handwritten signature in black ink, appearing to read 'C.T. Rubin'.

**Clinton T. Rubin, Ph.D.**



\* Information on studies/publications can be found on second to last page.



# Marodyne LiV – at a Glance

**LiV stands for Low intensity Vibration, one of the most modern therapies in the field of vibration training for the safe and drug-free treatment of osteoporosis, immobility and age-related muscle weakness (sarcopenia). With the support of fall prophylaxis as well as good experience with clinical pictures with movement restrictions.**

Marodyne LiV - Low intensity Vibration – is a proven, safe and gentle physical therapy treatment of osteoporosis that builds up bone and muscles.

Marodyne LiV is a high-quality precision instrument, especially designed to increase bone density and quality (e.g. osteoporosis therapy) and to condition the leg muscles at the same time (fall prophylaxis).

- Effective, drug-free therapy for osteoporosis and lack of exercise.
- The therapy is natural, purely mechanical, gentle and safe.
- Described in a variety of studies\*, proven effect, first-class references.
- Simple operation and individual adjustment is automatic as soon as the vibration plate is walked on.
- A precision instrument: a medical product, which produces impulses of 0.4 g constant at 30 Hz and an amplitude of approx. 0.2 mm.
- Easy and comfortable to use at home.
- Best daily use: 10 minutes for your health.

**Marodyne LiV is currently the most modern method of the physical therapy for the safe treatment of osteoporosis and various clinical pictures with restrictions of movement as well as to the structure of the musculature.**

**Training with Marodyne LiV stimulates the bones and promotes their stability. It improves blood circulation, trains the muscles through movement and helps to build muscles. At the same time balance and stability are trained, which leads to more vitality - especially in the second half of life.**



\* Information on studies/publications can be found on second to last page.

# Marodyne LiV – Indications

**If mobility is restricted e.g. caused by illness, the natural aging process or unhealthy lifestyle, the metabolic process slows down. The body reduces muscle and bone mass.**

## Marodyne LiV – Indications

- Osteoporosis: bone becomes porous or brittle
- Osteopenia: bone density is too low
- Adjunctive treatment of osteoporosis fractures
- Postural instability and fall tendency
- Frailty with sarcopenia: age-related loss of skeletal muscle and strength
- Protection of skeleton with
  - spinal cord injury
  - dystrophinopathies
  - cerebral palsy
  - adolescent idiopathic scoliosis
  - Duchenne Muscular Dystrophy
- Adjunctive treatment of bone loss after cancer treatment
- Promotion of mobility for an independent living
- Supplementary treatment for obesity
- Promotion of blood circulation



It can also be used for other metabolic and degenerative diseases to prevent osteoporosis as a result.

## How can the same impulse be effective against so many diseases?

Our research is based on how cells respond to low-intensity vibration. While a 0.4 g acceleration does not feel like much to an individual, it is a strong signal to an individual cell.

Mesenchymal stem cells (MSCs) in adults are found in the bone marrow: these special cells are able to form into various different cell types, including bone cells (osteoblasts), fat cells (adipocytes), collagen cells (fibroblasts), cartilage cells (chondrocytes), and muscle cells (myocytes). Studies\* show the therapeutic potential of mesenchymal stem cells has increased significantly in recent years. As low intensity vibration signals activate the MSCs, its therapeutic benefit is greatly enhanced due to the potential of these cells.

\* Information on studies/publications can be found on second to last page



# Marodyne LiV – Therapy

**The training with Marodyne LiV stands for healthy bones, vitality and increasing mobility. The therapy can also support the development of the basic musculature and stimulates blood and lymphatic flow and joint mobility.**

## **Osteoporosis therapy**

The aim of any osteoporosis therapy is to maintain or rebuild bone stability. The values of the bone density measurement, as used in osteoporosis therapy, are not fixed, they are variable. And this change for the better is the goal of the therapy. The two most important parts of a treatment are proper nutrition and sufficient exercise.

## **Stable and safe motion prevents falls**

Falls are rarely due to only one cause, in most cases several influencing factors work together. Not only what you suffer after a fall is decisive, but also what could have contributed to prevention before the possible fall. This is where training with Marodyne LiV comes into its own: strength in the lower leg muscles, coordination and stability play a role that should not be underestimated.

## **Targeted training of mobility**

Marodyne LiV therapy stimulates muscle growth and metabolism and strengthens muscle fibres. Blood circulation is improved and the cardiovascular system is trained. The faster ingrowth of implants can be promoted. This is why Marodyne LiV is used not only in clinics and sanatoriums but also at home.

## **Restoring motion of joints**

By increasing the blood circulation with the Marodyne LiV therapy, the cells in the cartilage are well supplied and form sufficient cartilage material. A vital cartilage can become active after an injury, the patient can recover from the injury if he is well cared for and nourished.

## **Marodyne LiV can support pain therapy**

Low intensity Vibration LiV can relieve minor muscle aches and pains, including idiopathic chronic low-back pain and is particularly suitable as movement training for drug-free treatment.



10 minutes a day  
for your health

**Safe solution - several decades of research have shown that Low-intensity Vibration can provide a safe alternative. Muscles are stimulated and can build lean mass.**

**The therapy is best carried out daily. Continuous training with this natural treatment promises the best results.**

# Marodyne LiV – Operating Principle

**Marodyne LiV - Low intensity Vibration - the therapy for stimulation and activation of bones and muscles, circulation and cell reproduction to promote health and mobility.**

## NEW & basically different ...

Marodyne LiV is not a piece of sports equipment that shakes your body like you might know it from fitness centers.

The special thing about Marodyne LiV are the fine and effective impulses. Marodyne LiV is a precise medical device that can apply impulses of 0.4 g constantly at 30 Hz and an amplitude of approx. 0.2 mm, which means a high degree of safety and compatibility.

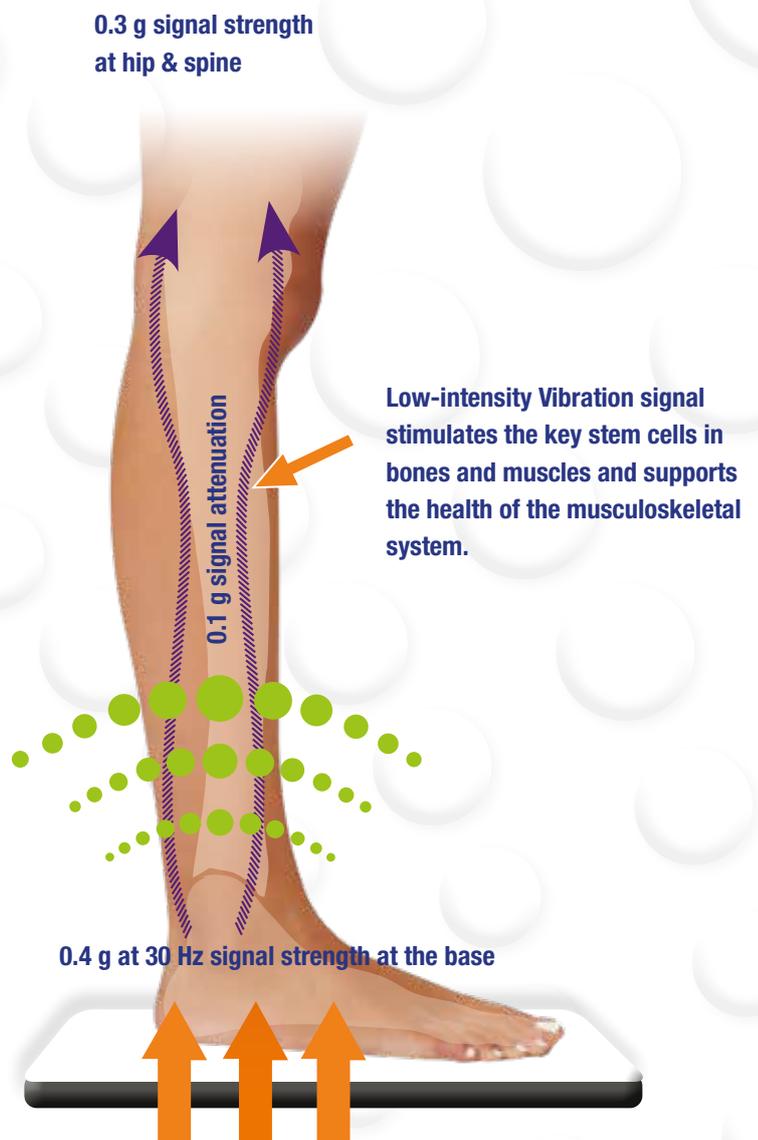
## LiV – Low intensity Vibration

Therapy is based on a stimulation of the physical environment and thus enables a non-invasive influence on the cell functions.

Diseases such as osteoporosis, which are caused by a weakening of the bones leads to a loss or endangerment of mobility, this vibration therapy is helpful because it essentially imitates the natural mechanical component and thereby stimulates the body's natural reactions to these biophysical impulses to form new bone tissue.

More than 35 years of research have shown that diseases of the musculoskeletal system can be safely treated with vibration training. An intact musculoskeletal system is of utmost importance for a healthy ageing process.

Marodyne LiV operates at a frequency of 30 Hz. An impulse of 0.4 g is applied to the base (sole of the foot), approx. 0.1 g is damped in the leg area and 0.3g is passed on to the hip and spine (,g' stands for gravity - our acceleration due to gravity with  $\sim 9.81 \text{ m/s}^2$ ).

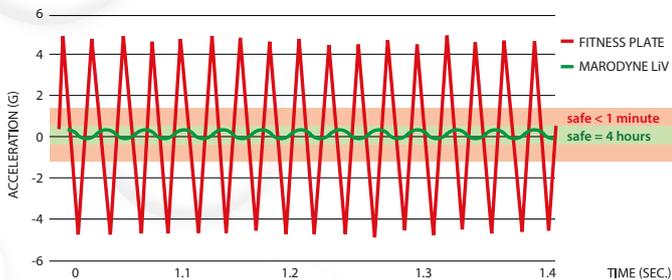


**With 10 minutes of low-intensity vibration daily, you will achieve the highest effect on bones, muscles and stem cells.**

The Marodyne LiV impulses correspond to natural, mechanical movement impulses - i.e. impulses that are picked up on the skeleton step by step, for example, when descending a staircase. The adjustment is automatic, individually for each user - this weight measurement and adjustment to each user, controlled by a micro-processor, ensures safety.

### Activation of stem cells

A primary effect of the signals (= impulses or dynamic force peaks) between muscle tissue and bone is the stimulation of mesenchymal stem cells (MSC). These stem cells are multipotent, i.e. they can still develop into a multitude of cells, e.g. bone, cartilage or fat cells. In this way, they can compensate for cell loss and thus replace old, defective cells.



Younger, active people with a healthy muscle mass have fast, strong, endogenous signals (= impulses or dynamic force peaks) that are strong enough to stimulate the MSC towards bone formation (osteoblasts). Older or less active people usually have fewer or weaker signals, which in turn contribute to increased production of fat cells and reduced production of new bone graft cells. This means more fat instead of bone mass.

Marodyne LiV imitates the stronger signals (of a younger body) and replicates the behaviour of a healthy muscle structure to reduce the build-up of fat cells and activate the production of bone cells - more precisely, it stimulates the bone-forming processes within the mesenchymal stem cells. In this way, the therapy contributes to stopping the degradation of bone mass and to starting to build up a healthy musculoskeletal system (musculoskeletal = concerning the musculature and the skeleton).

**The low intensity vibration signal provided by Marodyne LiV is categorised as safe for daily use at a threshold level of up to 4 hours in relation to the human vibration tolerance by the International Safety Organisation (ISO). See graph ISO 2631 (cf. also » ISO 2631 Mechanical vibration and shock -- Evaluation of human exposure to whole-body vibration).**



# Osteoporose Diagnosis & Treatment

**Osteoporosis means a loss of bone mass and decrease in bone density due to poor repair mechanisms and poor bone quality. This often results in painful fractures because the bone has lost its stability - this is where therapy with Marodyne LiV can be effective.**



The bone, e.g. the upper part of our thigh (see pictures on the left) consists of a strong, dense structure of tissue fibres, this is the cortical bone. Inside is the spongy, trabecular bone with fine bone balls (trabecula), which is the area mainly affected by osteoporosis.

## **Osteoporosis & bone resorption**

Almost every third woman and every fourth man are threatened by bone loss or osteoporosis in old age. Osteoporosis is a disease that breaks down bones and thus gradually destroys their structure. The bones become increasingly less resilient and lose stability. Osteoporosis describes three simultaneous changes in bone tissue:

- low bone density
- defective repair mechanisms
- inferior bone substance

From the middle of life onwards, the loss of bone density is normal, as is the decrease in physical activity with age. In many older people (60+), however, the performance of the muscles and/or the muscle fibre activity decreases disproportionately. During bone remodeling, more bone substance is broken down than built up. The former balance of the activity of breakdown cells (osteoclasts) and build-up cells (osteoblasts) shifts.

The consequence: The body usually reduces bone density and mass imperceptibly, but clearly measurably. The type and extent of bone loss are determined by genetic predisposition, individual activity, lifestyle and hormone status.

## **Osteoporosis & muscle fibre activity**

A large number of metabolic processes are determined by the work of the internal muscles - the activity of the heart and circulation, blood flow and, above all, blood return from the legs or the stability with which we walk and stand. These are tiny muscle fibres that control a multitude of processes in our organism and determine the smooth flow of various processes as well as the metabolism. As we age, the internal activity of the muscle fibres diminishes. This has consequences that often go unnoticed for years. For example, less stress impulses are placed on the bones by the muscle fibres and these are therefore less stressed. Less stress on the other hand often leads to the degradation of bone substance.

Consequence: Osteoporosis threatens. The connection between physical activity and the stress bone and osteoporosis is well known.

**The consequences of osteoporosis:  
Frequent bone fractures, severe pain  
and possible disability to the point of  
needing care.**

## **Bone density & musculature**

Up to the time in the middle of life, for example, physical exercise and strain on the bones and muscles as well as active basic muscles (type IIA muscle fibres) are used to achieve a stable bone structure and sufficient bone quality. This creates a balance between the build-up and breakdown of bone substance.

The activity of the bone building cells (osteoblasts) and the bone resorption cells (osteoclasts) is balanced. This reconstruction is decisive for the stability of the bones as well as their mass and density.

## Osteoporosis – what to do?

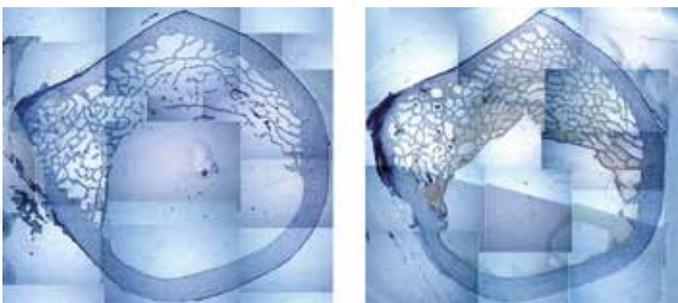
After an osteoporosis diagnosis, many people ask themselves the question: What to do? There are a number of factors that favour the development of osteoporosis. Some are genetically determined, others are lifestyle-related. It is precisely here, with a change in lifestyle, that the individual affected can have the greatest influence on the further development of osteoporosis: Nutrition and exercise - in all facets - help to keep the bone stable and counteract further osteoporosis. Your own activity is important.

## Therapy & bone formation with Marodyne LiV

It is possible to prevent a disease and it can also be treated specifically. With Marodyne LiV everyone can actively do a lot against osteoporosis. Also for already existing and pronounced osteoporosis and at any age. Only, as with many diseases, personal initiative and the willingness to help oneself are at the top of the therapy.

With the right training you can counteract bone resorption: The bone building cells (osteoblasts) are activated in their metabolic processes, the building up of new bone substance is promoted and bone stability is continuously improved.

The quality of the bones is essentially determined by the repair mechanisms and the development of new, high-quality bone substance as well as the cross-linking of the trabeculae inside the bones.



For comparison, the sectional images above show the development of the bone structure:

On the left the initial situation, on the right after one year of therapy. According to computer tomography, skeletal morphology in the trabecular structure shows an increase in bone density of 34%, an increase in cross-linking of 45% and an increase in bone volume of 32%.

\* Information on studies/publications can be found on second to last page

## Aims of the therapy with Marodyne LiV

Marodyne LiV works with natural, purely mechanical movement impulses. While standing, a precise, gentle and tolerable vibration is transmitted to the bones and muscles. The impulses are controlled individually for each user. 10 minutes per day are ideal to strengthen your bones and muscles. The special impulses influence the growth and regeneration of bone and muscle tissue. The therapy works on the cellular level and stimulates the development of bone cells and muscle fibres.

Studies\* have shown that a significant increase in bone density (BMD) can be achieved - for example in women with a low body mass index (BMI), as this group carries a particularly high risk and is particularly prone to fracture. Rubin, Recker et al. (2004) speak of a relative increase in bone density in the lumbar spine of 1.5% and in the trochanter of 2.2% after one year of Marodyne LiV application.

# 10 minutes daily for your health

**Objective 1 – Bone formation:**  
Building up bone substance and improving the bone quality in the areas of the femoral neck and lumbar spine at risk of osteoporosis.

**Objective 2 – Muscle building:**  
The risk of falling increases due to the age-related decrease in muscle power (sarcopenia) in the lower leg.

**Important: build-up of calf muscles to prevent falls.**



# Preservation & Increase of Bone Mass in Children & Adolescents

**Bone loss in children and adolescents as a result of metabolic, genetic, disability or disease treatment can lead to poor bone formation and a higher risk of osteoporosis in adulthood. In addition, the risk of fracture may increase in childhood. Low intensity vibration (LiV) has been shown to increase bone formation in at risk children.**



Children with disabilities, including cerebral palsy, used LiV for six months and showed an improvement in proximal tibial trabecular bone quality of 18% compared to the placebo group.

A second study showed an increase in cortical bone strength after six months of LiV application. This is important to reduce the risk of fracture.

In a recent placebo-controlled study in boys with Duchenne muscular dystrophy, significant bone improvements were observed in LiV over 12 months.

The summary of publications on vibration in children with disabilities concluded that low intensity vibration (LiV) is safe and efficient to use and has overall positive effects.

## A decisive factor for skeletal health

Bone mass is built up from birth to around the age of 30, after which we slowly begin to lose bone mass and density. The search for therapies to increase maximum bone mass in children is crucial if they are to develop metabolic, genetic, physical and emotional functions. Disability, illness or other limitations that prevent them from being active, as this usually leads to poor bone formation in early years.

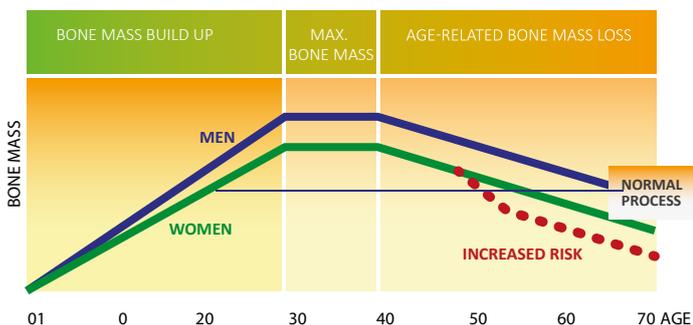
Marodyne LiV provides safe, non-pharmacological intervention for children and adolescents with conditions that impede normal bone formation, such as Duchenne muscular dystrophy, cerebral palsy, eating disorders or medications such as corticosteroids. Low-intensity Vibration (LiV) has been shown to reduce the bone formation in children at risk, which is of great benefit, as the maximum bone mass is a critical factor for the for the life-long health of the skeleton.

A study of childhood cancer survivors, five years after diagnosis, found that bone mineral density and tibial trabecular bone increased significantly compared to placebo within twelve months of using a LiV device.

In girls with adolescent idiopathic scoliosis, LiV was used for 12 months and significant BMD increases were observed in the femoral neck and lumbar vertebrae.



In children who still have a high anabolic capacity, LiV has been shown to improve maximum bone mass. The additional mechanical stimulus can compensate for the loss they have suffered during the disease or during its treatment.



**LiV is a safe and effective, medication-free treatment of bone loss in children of all ages without side effects.**

# Clinically Proven – Publications & Studies

**Decades of research and many scientific publications show that LiV therapy supports muscle building and better bone quality. Please do not hesitate to contact us for further information.**

## References:

- Safety and severity of accelerations delivered from whole body vibration exercise devices to standing adults** Jesse Muir, Douglas Kiel, Clinton Rubin, *Journal of Science and Medicine in Sport*, Nov;16(6):526-31 (2013)
- Mechanical signals as anabolic agents in bone.** Engin Ozcivici, Janet Rubin, Stefan Judex, Clinton T. Rubin et al., *Nature Reviews Rheumatology* 6, 50-59, 2009 (January 2010)
- Anabolism: Low mechanical signals strengthen long bones.** Clinton Rubin, A. Simon Turner, Steven Bain, Craig Mallinckrodt, Kenneth McLeod, *Nature*, Band 412, 603-604 (August 2001)
- Changes in postural muscle dynamics as a function of age.** Huang RP, Rubin CT, McLeod KJ, *The Journals of Gerontology Series A Biological Sciences and Medical Sciences* (1999)
- Quantity and Quality of Trabecular Bone in the Femur Are Enhanced by a Strongly Anabolic, Noninvasive Mechanical Intervention.** Rubin CT et al., *Journal of Bone and Mineral Research* (2002)
- Low-Magnitude, High-Frequency Vibration Enhances Fracture Healing and Rehabilitation in Elderly with Intertrochanteric Fractures** Leung, KS; Cheung, WH et. al., *ORS Annual Meeting*. Long Beach, CA, USA. Jan 13-16, 2011. Podium presentation (2011)
- Low-Magnitude Mechanical Stimulation to Improve Bone Density in Persons of Advanced Age. A Randomized, Placebo-Controlled Trial.** Kiel DP, Hannan MT, Barton BA, Bouxsein ML, Sisson E, Lang T, Allaire B, Dewkett D, Carroll D, Magaziner J, Shane E, Leary ET, Zimmerman S, Rubin CT., *Journal of Bone and Mineral Research* Jul;30(7):1319-28 (2015)
- Nonlinear dependence of loading intensity and cycle number in the maintenance of bone mass and morphology.** Qin YX, Rubin CT, McLeod KJ, *Journal of Orthopaedic Research* Jul;16(4):482-9 (1998)
- Low Magnitude Mechanical Loading Is Osteogenic in Children With Disabling Conditions** Ward, K., Alsop, C., Caulton, J., Rubin, C., Adams, J. & Mughal, Z. *Journal of Bone and Mineral Research* (2004)
- Effects of 18-month low-magnitude high-frequency vibration on fall rate and fracture risks in 710 community elderly - a cluster-randomized controlled trial** *Osteoporosis International* Jun;25(6):1785-95 (2014)
- Effect of High-frequency, Low-magnitude Vibration on Bone and Muscle in Children With Cerebral Palsy** Wren TLA, Lee DC, Hara R, Rethlefsen SA, Kay RM, Dorey FJ & Gilsanz, V. *J Pediatr Orthop* (2010)
- Effect of whole body vibration (WBV) therapy on bone density and bone quality in osteopenic girls with adolescent idiopathic scoliosis: a randomized, controlled trial.** Lam, T. P., Ng, B. K. W., Cheung, L. W. H., Lee, K. M., Qin, L., & Cheng, J. C. Y., *Osteoporosis International*, 24, 1623–1636 (2013)
- Effects of Low-Magnitude High-Frequency Vibration on Bone Density, Bone Resorption and Muscular Strength in Ambulant Children Affected by Duchenne Muscular Dystrophy** Bianchi ML., Vai S., Morandi S., Baranello G., Pasanisi B., & Rubin C., *ASMBR Oral Paper* (2013)
- Effect of Whole-Body Vibration Therapy on Health-Related Physical Fitness in Children and Adolescents With Disabilities: A Systematic Review** Matute-Llorente, González-Aguero, Gómez-Cabello A., Vicente-Rodríguez G., & Casajús Mallén JA. *Journal of Adolescent Health* (2014)
- The effects of low magnitude high frequency mechanical stimulation (LMS) on bone density in childhood cancer survivors (CCS)** Ness K., Mogil R., Scobey K., Karlage R., & Kaste S., *Oral Paper APTA CSM* (2015)
- Prevention of postmenopausal bone loss by a low-magnitude, high-frequency mechanical stimuli...** Rubin C, Recker R, Cullen D, Ryaby J, McCabe J, McLeod K., *Journal of Bone and Mineral Research* 2004 Mar, 19(3):343-351
- Weißbuch Osteoporose** Hrsg.: Berufsverband der Fachärzte für Orthopädie e.V., Berlin, (2004)
- Effect of 12 months of whole-body vibration therapy on bone density and structure in postmenopausal women: a randomized trial.** Slatkowska L et al., *Annals of Internal Medicine* Dec 20;155(12):860 (2011)

# Be active: Get Your Marodyne LiV

The Marodyne LiV therapy system is now available to you as a certified medical device for daily use.

- Inform yourself about your personal concerns.
- How can you best use the therapy?
- Call us, talk to us!



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