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Shock and Pressure Waves - Magic Tools in Medicine

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Twenty-five years ago extracorporeally generated shock waves revolutionized urological stone therapy. Ten years later healing effects of shock waves were recognized and musculoskeletal indications became an important field of shock wave application. Recently pneumatically generated pressure waves were successfully applied to various maladies such as plantar fasciitis and achillodynia. Although the characteristics of pressure waves and their mechanism of generation significantly differ from shock waves, medical effects seem to be similar at least for superficial applications.

Shock waves are characterized by high peak pressure ($\sim 10\text{-}100$ MPa), short rise time ($t_r \sim 10$ ns) and low tensile wave components. The mechanism of generation requires supersonic processes like explosions (> 1500 m/s in water) or steep increases propagated by non-linear waves. Due to the short pulse duration ($t_d < 1$ μs) shock waves may be focused to small areas (< 10 mm). Shock waves are generated by electro-hydraulic, piezoelectric or electromagnetic principles. Pressure waves are often generated by low velocity impact of masses ($v \sim 1$ m/s) and feature lower peak pressure ($\sim 0\text{-}10$ MPa), longer rise times ($t_r \sim 500$ ns) and longer pulse duration ($t_d \sim 200\text{-}2000$ μs). Contrary to the above mentioned shock waves, focussing of this type of pressure waves to small treatment areas is not possible. Present pressure wave devices utilize pneumatically accelerated pistons which transmit pressure pulses by impact on a bounce plate in close contact with the skin surface. Important parameters to characterize shock and pressure waves are peak pressure (positive and negative), energy and energy flux density. In the case of shock waves, focal size defined as -6dB isobar-lines and 5 MPa isobar-lines is used to describe the dimensions of the treatment area. The technical differences result in diverse device concepts with or without localization modalities.

Shock Wave Energy Deflection due to the Presence of a Model Bone

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The success of Shock Wave Therapy (SWT) for treating various musculoskeletal conditions has been mixed. Fundamentally, the physical mechanisms leading to observed biological responses are not understood. While basic research into specific biological pathways has been gaining momentum, no research is being performed to characterize shock wave propagation through heterogeneous musculoskeletal tissues, and cavitation and shear waves generated by SWT devices. Without an understanding of the physical characteristics and effects of shock wave interactions at the bone interface, it will be difficult to understand (and thus optimize) biological responses. Disarticulated model hard plastic bones were used in these studies. The simple structure of a calcaneus provides a good starting point for model validation and study. An electro hydraulic source was used for cavitation studies, while a ballistic source was used in the pressure field. A high speed camera was used to capture cavitation bubbles generated by SWT, and a needle hydrophone measured the pressure field. High-resolution numerical simulation of SW pulses propagating from a water pillow from an electro hydraulic source into an ankle were performed using the software package CLAWPACK. All three methods (simulations, cavitation and pressure field measurements) show that the presence of bone deflects the energy of the shock wave. Modelling the interaction of the SW with bone yields important information about SW deflection. The degree of deflection will depend on the relative orientation of the SW axis of symmetry and bone structure. These results suggest that focused energy may arise at unexpected locations. (Partially supported by NIH DK43881)

Extracorporeal Shockwaves Manifest Themselves as Biological Mechanotransduction

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The impact of extracorporeal shockwaves (ESWs) on living tissue results in the conversion of mechanical stimuli into biochemical and/or molecular-biological signals. These signals in turn induce a certain flow of information. Subsequent signals are viewed as a biological information unit that brings about certain biological changes in the cell itself for which the signals are meant. This sequence is referred to as mechanotransduction. The tissue structures mainly involved in mechanotransduction are part of the extra cellular matrix that transfers information via so-called adhesion molecules, principally integrins and cadherins, as connecting links to the cytoskeleton. The signals are transmitted to the cell nucleus via the constituent components of the cytoskeleton (i.e. microtubules, actinmicrofilaments and intermediary filaments), thereby inducing gene transcription and expression. In the case of destruction of the cytoskeleton, mechanotransduction is rendered impossible. Specific so-called mechanogated membrane ion channels which belong to the DEG/ENaC super-family are responsible for initial and fast prompting of mechanotransduction. Relevant for mechanotransduction are the frequency, amplitude, intensity and duration of the extracorporeal stimuli which determine - as if by code - the concentration of certain second messengers and, thus, turn on the gene expression. To date, arguably the most prominent example of mechanotransduction through ESWs is the effect on migration activity of mesenchymal stem cells as proven for the first time by the authors. The effect of ESWs on living tissue constitutes a complex, signal-inducing stress situation which manifests itself on several interconnected levels. Additional phenomena are observed and established which at present cannot be exactly classified in the overall context of mechanotransduction. The activation of the, in evolutionary terms, very old protection and defense mechanism of living organisms through ESWs, the so-called heat shock protein system, is an example. As far we are aware, we were the first to produce experimental evidence.

A Trial on the Mechanotransductional Influence of ESWT on Pig Skin and Fibroblastic Activity under the Aspect of Energy Flux Density and Frequency

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The fundamental assumption for the mechanical effect applying extracorporeal generated shockwaves was in the common opinion replaced by a microbiological working mechanism. Hereafter the effect of shockwave is explained in the formation of new blood-vessels while a number of growth-factors are released.

How this mechanism is transformed and where the boarders are, is subject of a number of basic-research studies performed in the society of shockwave application.

Referring to the microbiological working mechanism of ESW the following knowledge is state of the art.

The application of shockwaves induces the release of biologically active substances as NO, VEGF, BMP and further growth-factors. Research work has shown these substances increased during and after shockwave-treatment. This effect is named "bioengineering", meaning to induce the tissue to produce and release biological active substances by itself after stimulation by an outside trigger.

The process of transformation of a mechanic stimulus into a biologic answer is united in the collective name of mechanotransduction. The phenomenon of mechanotransduction is well known, yet not completely understood. It is part of our daily experience of hearing and touching. It also plays a crucial role in the regulation of cell-volume, -shape, -motility and -differentiation. Cells in general may respond to mechanical stresses transmitted over cell surface receptors that physically couple the cytoskeleton to extra cellular matrix or to other cells. Molecular biological and electrophysiological investigations indicate that this rapid process of signal transduction is mediated by mechano-gated membrane ion channels.

Although the effects of mechanical stress could be mediated in part by activation of mechano-sensitive ion channels or by locally and systemically released growth factors, studies have demonstrated that mechanical input itself is able to trigger cellular signalling mechanisms through the process of mechanotransduction.

Sensitivity to mechanical forces appears in all adhesion-dependent cells. This gets evident in the mechanocytes or cells routinely subjected to mechanical forces, such as skeletal muscle cells, osteocytes, chondrocytes, airway smooth muscle cells, cardiomyocytes, vascular endothelial and smooth muscle cells.

Trying to understand these effects and the mode of action we started a number of clinical trials showing the effect of ESW.

In order to show mechanical influence affecting organic-tissue this trial was performed in Hamburg at Beiersdorf giving the opportunity to work with UPE and singulet-oxygen-detecting devices showing the Triboluminiszenz-Effect.

Triboluminiszenz is the emission of elektromagnetic radiation in UV-, VIS or IR-spectrum appearing if activated atoms or molecules rearrange to there former status. This can be detected by UPE - ultraweak Photoemission - quantifying the measure of physical stress.

The stimulation of the pig-skin is performed with the Orthowave by MTS using a regular focussed and a defocused application-head and the Piezason by Wolf.

ESW as a form of mechanical stress will rise the biosynthetic activity of cells by mechanotransduction. Is the mechanical stress too high this will lead to a reduction of biosynthesis and damage might be caused to treated tissue. The variables in this trial are the Frequency and the Energy Flux Density of different devices. Aim is to show a gradient for the highest stimulation of the treated tissue regarding that different tissues will react in different ways and it seems as if every indication will need its own curve. Knowing these curves

a dose-effect-relationship could be realized and therapeutic application could be regulated for the highest induction of cell-proliferation and -regeneration. Of course this will only give a little step in this direction but once understanding the working mechanism of ESW and calculating the biologic answer research will be even more transparent and aimed.

Nitric Oxide and Shock Waves: Another Brick in the Wall

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The clinical observation of immediate vasodilatation and laboratory findings of enhancement of angiogenesis around the ESW-treated area immediately give rise to the hypothesis that ESW may modulate the production of NO. Recently, we have showed that ESW quickly enhance eNOS activity and NO production in human umbilical vein endothelial cells (HUVEC) under either normal or inflammatory conditions. However, we could not show the effect of ESW treatment on iNOS expression. Massive amounts of NO produced by iNOS are potentially harmful. Therefore, evaluation of the ESW effect on iNOS expression is fundamental in further assessing the molecular mechanism of clinically-observed anti-inflammatory action of ESW.

Rat glioma cell line C6, cultured in DMEM supplemented with 10% fetal calf serum, was treated with an electromagnetic lithotripter (MODULITH SLK device Storz Medical AG, Switzerland) as described (FEBS letters 579 2005 6839-6845). Protein extract was subjected to electrophoresis and blotted to a PVDF membrane. Membranes were incubated with anti-eNOS antibody and successively incubated with enhanced chemiluminescent detection reagents. nNOS activity was estimated by measuring the conversion of L-2,3,4,5-[3H]arginine to L-2,3-[3H]citrulline. The production of NO was assayed using the DAF-2DA detection system. NF-kB activation was evaluated by Electrophoretic Mobility Shift Assay. iNOS expression was analyzed by Northern blotting and RT-PCR analysis.

In this study we show that ESW at a low energy density value quickly increase nNOS activity and basal NO production in the rat glioma cell line C6. In addition, the treatment of C6 cells with ESW reverses the decrease of nNOS activity and NO production induced by a mixture of lipopolysaccharides (LPS), interferon-gamma (IFN-gamma) plus tumour necrosis factor-alfa (TNF-alfa). Finally, ESW treatment efficiently suppresses NF-kB activation and NF-kB-dependent gene expression, including iNOS and TNF-alfa. This report suggests a possible molecular mechanism of the anti-inflammatory action of ESW treatment. Further studies are needed to investigate this mechanism in vivo.

Biological Mechanism of Shockwave in Fracture Healing

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The purpose of this study was to investigate the biological mechanism of shock wave treatment in bone healing in rabbits.

A closed fracture of the right femur was created with a three-point bend method and the fracture was stabilized with an intra-medullary pin. Shock waves were applied one week after the fracture. Twenty-four New Zealand white rabbits were randomly divided into three groups. Group 1 (the control) received no shock waves; group 2 received low-energy and group 3 high-energy shock waves. The animals were sacrificed at 24 weeks, and a 5-cm segment of the femur bone including the callus was harvested. The specimens were studied with histomorphological examination, biomechanical analysis and immunohistochemical stains.

The results showed that high-energy shockwaves improved bone healing with significant increase in cortical bone formation and the number of neovascularization in histomorphology, better bone strength and bone mass in biomechanics, and increased expressions of angiogenic growth markers including BMP-2, eNOS, VEGF and PCNA than the control and low-energy shock wave groups. The effect of shock wave treatment appears to be dose-dependent. In conclusion, high-energy shock waves promote bone healing associated with ingrowth of neovascularization and increased expressions of angiogenic growth factors.

Radial Extracorporeal Shock Wave Therapy (rESWT) Induces Bone Formation in Vivo

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Extracorporeal shock wave therapy (ESWT) is presently applied to a variety of bone and soft tissue pathologies in orthopaedics. Compared to the commonly used focused shock waves, radial ESWT (rESWT) is characterized by a larger treatment area, which simplifies application and reflects the pathology zone rather than a point. Therefore, rESWT is expected to be at least as effective as focused ESWT. The purpose of the study was to evaluate if rESWT can induce new bone formation at low energy flux densities and to study the time course of rESWT-induced osteogenesis. New Zealand white rabbits (n=13) were used for the animal model after approval by the responsible ethics committee. After the adaptation phase, radial extracorporeal shock waves (rESW) were applied with the Swiss Dolorclast shock wave device (EMS Electro Medical Systems, Nyon, Switzerland) to one randomized femur of each animal, while the contralateral side served as an intraindividual control. Four thousand pulses of rESW with an energy flux density of 0.16mJ/mm² were applied twice with standard parameters (8Hz, 4 bar, 7-day interval). Animals were sacrificed at 1 week (n=4), 3 weeks (n=4) and 5 weeks (n=5) after the second rESWT. Sections of all femora (thickness 75 microm) were investigated with broad-band fluorescence microscopy (H3 filter, JUST filter) and contact micro radiography for new periosteal and endosteal bone and callus formation, periosteal detachment and cortical and trabecular fractures. Integration of the fluorescent dyes into bands of newly deposited bone could be observed under fluorescence microscopy and were significantly increased after rESWT. Shock wave-induced osteogenesis was already visible at week 1 however, new bone formation was even more pronounced and significantly different to the control group after 3 and 5 weeks. Furthermore we could demonstrate both endosteal and periosteal new bone formation at the dorsal femoral cortex after rESWT, but not in the control. No calcified bone remodelling, resorption or callus formation could be shown in contact micro radiography. Furthermore, neither trabecular nor cortical fractures were observed. No side effect was found but there was some haematoma at the application site.

rESWT offers new perspectives in the therapy of bone pathologies as larger tissue areas could be effectively treated. The osteogenetic effect is a shock wave induced biochemical response resulting from the total energy applied per area rather than high energy-related local mechanical effects found in focused ESWT.

Influence of ESWT on Migration, Cell-Formation and Cell-Differentiation of Endothelial Progenitor-Cells

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The microbiological working-mechanism of ESW has developed to be the main working hypothesis in the last years to understand how shockwaves induce all our good results in clinical studies pointing out different indications to be treated.

At this point mainly the release of several growth-factors could be shown and therefore the model of bioengineering replaced the mechanical effect postulated in the early stages of shockwave application.

It has been shown that shockwave application induces the release of biologically active substances such as NO, VEGF, bFGF.

Our group is following a working-model on mechanotransduction which underlines the direct effect of ESW on the cell. Mechanotransduction does play a role in the regulation of cell-volume, -shape, -motility and -differentiation.

As stem- and progenitor-cells have shown their role in cell and tissue-regeneration we tried to point out the influence of a mechanical stress on endothelial progenitor cells (EPC), induced by shockwaves. These effects are shown in an in-vitro-Trial.

We have shown an induction of endothelial progenitor cells by ESW. This could be related to a vessel-protective and -regenerative effect of shockwave. The positive influence of ESW could be generated by the activation of stem- and progenitor-cells as well as the release of the mentioned biological active substances, VEGF, EPO, bFGF.

These factors have proved their influence on migration and cell differentiation to the endothelial cell-type.

The influence of shockwave on progenitor-cells together with the idea of a chemotactic influence activating the treated tissue and supporting the migrative activity will be one of the points of interest understanding the working-mechanism of shockwaves.

The Effect of Focused Extracorporeal Shockwaves on Migration Activity of Mesenchymal Stem Cells (MSCs) Ex-vivo.

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In contrast to the omnipotent embryonic stem cells which can differentiate into all types of tissue, the so-called adult MSC's, which are primarily found in bone marrow, exhibit a limited potential of differentiation. They can mainly differentiate into muscle, cartilage and bone tissue as well as into connective and fatty tissue. Thus to regenerate these tissues, MSC'S are required. The question arises as to which mechanism provides the route to the locus where they are needed. Up to now, a direct effect on the migration activity of MSC'S through high physical strain in sports activities was established only by one researched team at the Sports University of Cologne. Based on these findings we set out to produce a similar effect through the impact of external mechanical stress. And indeed, through the use of focused extracorporeal shockwaves (ESWs) we were the first to increase significantly the migration of MSC's. The proof was obtained by means of the Boyden-Chamber assay in a pig skin model. The fact that targeted and well-defined activation of MSC's is possible opens up the possibility to observe and monitor further signal and differentiation paths of MSC's. This potentially provides tremendous scope not only for therapeutic benefits of ESWs in the orthopaedic surgical domain, but also for cardiovascular regeneration.

Stem cell De-Programmation by Shockwaves

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We submitted in vitro cell cultures of human precursors from bone and heart to SW treatment, to evaluate the effects on bone mineralization and Extra Cellular Matrix deposition as well as on the activation of regeneration potential of human heart precursors.

Cultures of human osteoblasts and cardiac cell lineages were submitted to SW and compared to control untreated groups. We studied Ca⁺⁺ deposition, ALP and NOS activities, growth rate and differentiation of human osteoblasts. The precursors and progenitors of cardiomyocyte, smooth muscle, fibroblasts and endothelial cells were identified by immunocytochemistry, and the expression of mRNA and proteins was studied by western blot and RT-PCR.

Shockwaves can inhibit both growth rate and Ca⁺⁺ deposition. They modulate the osteoblasts NOS activity presumably affecting ALP. SW changed the relative number of cardiac precursors and progenitors of all cardiac cell lineages and enhanced the expression of cytoplasmic proteins. The low rate of Ca⁺⁺ deposition may be due to changes in Ca⁺⁺ intra and extracellular flow as well as to decreased enzymatic activities, such as ALP activity, linked to bone mineralization retardation. In regard to the human heart, SW positively influence the differentiation of cardiac primitive cells and could possibly inhibit or retard pathological remodelling and functional degradation of the heart.

Orthopaedic Lithotripsy in Chronic Tendinopathies

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Chronic tendinopathies are very frequent but not a serious problem. Generally, chronic tendinopathies or tendinoses are the consequence of an acute event managed in an incorrect way. The tendon tissue loses elasticity, vascularity and develops angiofibroblastic degeneration. The results of traditional methods such as NSAID's and analgesic drugs or physical therapy, have not proven favorable, leading some patients to surgical procedures. Extracorporeal Shock Wave Therapy is a relatively new procedure (in Mexico since 2002). This treatment method causes neovascularization and biomechanical recovery of tendons. Its mechanisms of action are basically two fold: the direct (traumatic) and the indirect (cavitational) effects, the last being the most important. Shock waves have been used successfully in acute tendinopathies and in recent years they have shown good effectiveness in treating chronic tendinopathies.

In this work we present our experience in the treatment of 40 patients with chronic tendinopathies such as rotator cuff tendonitis, tennis elbow and plantar fasciitis. General indications were reviewed and, based on our results, we discuss the future of this therapeutic option.

We have had good or excellent results in most of our patients, with a minimal rate of complications. The procedure is well tolerated and accepted by our patients.

We found shockwave therapy to be a good option in our patients with chronic tendinopathies. This first case series in Mexican patients is the base for a controlled study in order to determine precise parameters of clinical success.

Therapy with Radial ESWT Combined with Physiotherapy in the Treatment of Soft Tissue Diseases

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The aim of this study was to clinically evaluate the effectiveness of Extracorporeal Shockwave treatment in soft tissue pathologies.

The study was conducted in the Clinic of Physiotherapy and Sports Injuries Rehabilitation in Athens in collaboration with METROPOLITAN HOSPITAL utilizing the EMS device. From January 2005 until June 2005 we treated 42 patients (7 women and 35 men) with Radial Shockwaves for the following diseases: 27 Patients with Plantar Fasciitis (10 athletes basketball A1 category, 8 athletes A2 category, 2 athletes soccer, 1 athlete tennis National team level, 6 patients non-athletes) 8 patients with calcaneal tendonitis, 4 patients with Epicondylitis, 3 patients with Tibial periostitis (1 athlete basketball, 2 athletes tennis) Inclusion criteria were at least 3 months of unsuccessful conservative treatment (cortisone injection, ultrasound, microwaves). The mean follow-up was 9 months. To evaluate the intensity of pain the outcome was assessed in 4 categories using the VAS (Visual analog scale) and Roles and Maudsley. The protocol of treatment included 5-7 treatments with shockwaves 2 times per week. In each treatment we applied 1,700 shockwaves with an intensity of 1.8 bar for the first 600 shocks and 2.5 bar for the remaining 1,100. Once a week kinesiotherapy and massage were applied for the Plantar Fasciitis in the Guff region and Achilles tendon as well as in the fascia around this region. No local or other anaesthesia was administered. All the participants signed an agreement to participate in this study.

The results of the study were as follows: Diseases/Results excellent good moderate poor Plantar Fasciitis 58,3% 25% 6,7% 0 Tendinitis Calcaneal 33,4% 33,4% 22,1% 11,1% Epicondylitis 50% 25% 0 25% Periostitis 100% 0 0 0.

The results of this study lead us to the conclusion that treatment of the above diseases with the use of Radial Extracorporeal Shockwave combined with physiotherapy is safe and effective.

Sport's Injuries of Tendons: our Experience with ESWT with Ultrasound Guide in Line

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The aim of this study is to show our experience utilizing ESWT to treat on tendonopathies of athletes from various sports. Each treatment was performed using ultrasound guide in line to ensure maximum efficiency.

From February 2004 to September 2004, 99 athletes with chronic tendon injuries were treated with ESWT. The age of the patients was between 15 and 35 years (average age = 23.16 years). The treatments were performed with a piezoelectric device (WOLF PIEZOSON 300) with US-imaging guide in line. We performed the treatments in 3-4 sessions (one session weekly or every 2-3 days) using low and mid-level energy. The follow up was performed with the VAS scale 30, 60, 90 and 120 days after the end of therapy.

The best results were reported for enthesitis of the patellar tendon (95% reduction of pain); 30% of the athletes experienced chronic enthesitis of the anterior cruciate ligament using the patellar tendon. For shoulder impingement of the rotator cuff we observed 66% reduction of pain (volleyball, baseball and rugby players); and 100% reduction of pain was reported for enthesitis of the pubic bone (soccer players).

The best results were reported for patellar tendon enthesitis and pathologies of the pubic bone. In these pathologies the injury and area of pain are very small, therefore utilizing a guide with Ultrasound imaging on line in real time increases the effectiveness of the therapy and reduces its side effects (shock waves on the bone, movement of the patient).

Shockwave Biosurgery in Insertional Tendinopathies: Our Experience in Ecuador

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Tendineous pain during sports and daily activities is a major cause of incapacity, and is often hard to manage for patients and physicians alike, as it causes functional disabilities and sometimes leads to pharmacological overuse, or even surgery. Two decades ago ESWT was developed, and has been used successfully in many centers throughout the world. Shockwave Bio surgery started as a treatment option in Ecuador in March 2004.

We have treated 97 patients between 18 and 75 years of age with chronic tendinopathies. Our patients had a diagnosis of Lateral Epicondylitis (22), Patellar Tendonitis(27), Achilles Tendonitis (9), Plantar Fasciitis (36) and Supraspinatus Tendonitis (3). We excluded patients with previous surgical procedures and patients treated with ESWT and Autologous Growth Factors (AGF) combined therapy. We applied 2,000 radial shockwaves (Swiss Dolor Clast - EMS) as analgesia and 2,000 impulses at therapeutic levels (0.06-0.18 mJ/mm²) without anaesthesia, in two sessions at one week intervals.

We have followed 97 patients for an average of 18 months. The average pain score before treatment was 8/10, and became 2/10 after the follow up (80% reduction). All our patients experienced pain relief to some degree and were satisfied with the procedure. Most of them recovered enough to restart their basic daily activities and even sports.

ESWT was effective for most of our patients. By using this technique that is not only non-invasive, but also well tolerated, we avoided the possible complications of surgical procedures and reduced costs in our hospital. We will continue with these protocols and report further results.

Radial Shock Wave Therapy (RSWT) for the Treatment of Chronic Tendonopathies - our Experience

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The aim of this prospective study was to analyze the results obtained during treatments with RSWT for chronic tendonopathy pathologies.

Prospective study. Between January 2002 and December 2004, 112 patients (mean age = 45+/- 14 years) with a diagnosis of chronic tendonopathy pathologies (patellar tendon, Achilles tendon, lateral epicondylitis, plantar heel pain, supraspinatus tendon with or without calcific deposit and bursitis trochanterics), a history of chronic symptoms for at last 4 month (mean chronicity = 18.22±17.67 months), and failure of or poor results from two conventional treatments were treated in our clinic with a radial shock wave device Swiss Dolor Clast (EMS, Switzerland). Of the total patients, 4 did not complete the treatment protocol and 13 could not be evaluated in the follow up period (15% lost patients). The other 95 patients were treated in 3 sessions, at intervals of one week, with 2,000 impulses per session at 2.5-3.5 bars of intensity (energy flux density = 0.1-0.16 mJ/mm²) and a frequency of 6 Hz. A visual analogue scale (VAS) evaluated the pain intensity during diary life activity (DLA) and sports activity (SA). Functional impairment of the corporal segment injured was evaluated by using functional tests according to the indicated pathology. Evaluation was performed immediately before treatment and at 4, 26 and 52 weeks after the final session. During follow up the patients' satisfaction was evaluated on the Roles and Maudsley scale (RM).

The non parametric Wilcoxon test for dependent samples to compare means of VAS and functional test. The pain intensity of DLA and SA decreased significantly ($p < 0,001$) and functional tests showed significant improvement ($p < 0,001$) at 4, 26 and 52 weeks post RSWT. The excellent and good results obtained in 68 patients (73%) at 4 weeks post RSWT remained approximately constant at 26 weeks (74%) and 52 weeks (70%) after treatment. Only minor side effects such as swelling, petechia and discomfort during treatment were reported.

Radial shock wave therapy is an effective and safe method (minor side effects) for the treatment of chronic tendonopathy pathologies with a history of chronic symptoms for at last 4 month and failure of or poor results from two conventional treatments.

Shockwave Therapy for Achilles Tendonopathy: Retrospective Study

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The aim of this study was to evaluate the efficacy and safety of extracorporeal shock wave therapy for the treatment of Achilles tendonopathy in two Brazilian Orthopaedics Clinics. In a multi-center, retrospective study, the effect of shockwave therapy was investigated in 101 cases of 90 patients with Achilles tendon calcifying (or not) tendinosis treated during a period of 37 months, from May 2002 to June 2005. Eleven patients received bilateral treatment. There were 34 women and 56 men with an average age of 58 (range, 33-87) years. The criteria for inclusion were at least three months of unsuccessful conservative therapy or six months of pain. Criteria for exclusion were inflammatory arthritis, corticosteroid injection within the previous 6 weeks, neurological abnormality, gout, malignant diseases, blood coagulation disorders and previous Achilles tendon rupture. Each patient was treated with 1,000 shock waves, a 05 mm focus depth, and with an energy flux density of no more than 0.13 mJ/mm² after local or regional anaesthesia. One treatment was performed on 91 cases, 7 underwent a second treatment and 3 cases underwent a third treatment. The subjects were evaluated by means of a clinical evaluation according to Roles and Maudsley score and subjective outcome on Visual Analogue Scale (VAS) analysis 45, 90 and 180 days after the end of the therapy. The study showed the efficacy and safety of ESWT were excellent in 21.8%, good in 47.5%, acceptable in 19.8%, and poor in 10.9%, 180 days after ESWT.

Efficacy of Extracorporeal Shockwave Therapy (ESWT) in the Treatment of Tendinopathies and Enthesiopathies

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ESWT has been increasingly used to treat tendinopathies and enthesiopathies. A retrospective review of patients who underwent ESWT at our centre was conducted to establish the efficacy and safety of this treatment modality.

The records of patients treated with ESWT between April 2004 and October 2005 were reviewed. All had lesions that were documented on ultrasound sonography. Each course of treatment comprised two sessions performed one week apart. At each session, 2,000 focal shock wave pulses were administered under ultrasound guidance at increasing energy flux densities (between 0.03 mJ/mm² and 0.28 mJ/mm²). No sedation or anaesthetic agents were used, and all patients received a two-week course of non-steroidal anti-inflammatories. Pain was assessed using the Visual Analogue Scale (VAS).

A total of 639 treatments were performed on 264 sites. The patients were predominantly male (62.1%) with a mean age of 42 years (range 13-73 years). Plantar fasciitis (47.7%) was the most common indication, followed by medial/lateral epicondylitis of the elbow (17.8%), patellar tendinopathy (11.4%), supraspinatus tendinopathy (9.8%) and Achilles enthesiopathy (9.1%). Of the treatments, 518 (81.1%) were first courses, 98 (15.3%) were second courses, and 23 (3.6%) were third courses. For all sites, the pre-treatment mean VAS score was 5.4. This was significantly reduced after one session (3.8) and at the two-week (3.0) and three-month (2.5) follow-up. Proximal plantar fascia swelling was also significantly reduced (5.7 mm pre-treatment vs. 4.6 mm after one course). No adverse events were reported.

ESWT is an effective and safe treatment modality for chronic and painful lesions at bone-tendon junctions.

Beginning of Analgesia as a Key Variable in Shockwave Biosurgery

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Even though the therapeutic success of shockwaves in urology, orthopaedics and plastic surgery is a fact, and that new applications under research in cardiology and infectology are promising, there are still tendencies of insurance companies of not approving treatments, perhaps by novelty and cost issues. There is a clear necessity of establishing parameters for the creation of homogenous protocols for ESWT as well as to predict evolution.

We performed an experimental study from September 2004 to May 2005 in 127 patients who received ESWT for different pathologies. Clinical and radiographic parameters, VAS, and patient's satisfaction level were evaluated. Follow up was performed every six weeks for a total period of six months (first stage of study). Descriptive and inferential statistical analysis was performed, based on Pearson's coefficients of correlation and Chi Square analysis.

There was a low correlation (0,02) between number of waves necessary for beginning of analgesia and time of evolution. There also was a clear dependency between level of satisfaction and number of waves at the beginning of analgesia. This last parameter was also dependent with the type of pathology (significance level of 0.001).

The number of necessary waves for the beginning of analgesia, as well as the total number of shockwaves is variable and depends on each pathology, but not on time of evolution. The number of necessary shockwaves for beginning of analgesia could be an useful parameter in predicting the evolution, and treatment protocol in each case. However, further studies are necessary to validate this variable.

Why are Extracorporeal Shock Waves the Last Alternative Therapy?

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The terms tendonitis, tendinosis and paratendonitis or an association of them, should be reserved to specific histopathological features of tendon conditions. Unfortunately the term tendonitis is used in a clinical context and it refers to a clinical syndrome and not to a specific histopathological entity. Tendinosis represents a chronic musculoskeletal disorder that can cause pain and impaired function. Tendon healing is a complex process requiring inflammatory response, neoangiogenesis, fibrillogenesis and matrix remodeling (Enwemeka 1989). Many events can happen to impair the normal healing of tendons. One of them is persistent overuse in sports without time to recover and it can induce the degenerative process.

The term tendinosis, first used by Puddu (Puddu 1976), implies tendon degeneration without clinical or histological signs of intratendinous inflammation and is the final result of a number of pathological processes with slightly different histological manifestations. Many therapeutic options are used by doctors but none of them with optimum results.

Extracorporeal shock waves are used only after other therapies have failed, despite experimental studies demonstrating significant improvement in patellar tendinosis (Wen-Wei Hsu 2004) and promoting healing of collagenase-induced Achilles tendonitis and increased TGF β 1 and IGF-I expression (Chen and Wang 2003). Tendon healing in the early stages depends on the tenocytes growth and neovascularization. The tenocytes have been found to convert biophysical stimulation into a biochemical response leading to release of growth factors and cellular adaptation. TGF β and IGF I can promote tendon regeneration by regulating collagen metabolism and tenocytes proliferation. It is important to avoid repetitive chronic inflammation because this can develop non-healing stages and promote alterations in growth factors. Collagen synthesis is strongly influenced by a number of growth factors. These include TGF β , IL -1, IL-4, PDGF, IGF 1-2 and EGF. In a study on collagen production on rabbits, it was found that TGF β 1 and IGF-2 not only increases collagen production but also differentially affects the ratios of collagen I and III. These effects were most pronounced in 3 week-old scars and were observed to have a decreasing effect at 6 -12 weeks. I believe that to produce a better scar it is necessary to begin with ESWT before the first month.

The best healing is the faster healing and ESWT is an option to promote better results.

Evaluation with Ultrasound and Color Doppler of the Results of Extracorporeal Shock Wave Therapy for the Control of Hyper Vascular Areas in Tendinosis (Preliminary Study)

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There is considerable controversy regarding the origin of insertional pain in chronic tendinosis. Even though tendon biopsies having shown an absence of inflammatory cell infiltration. Recent studies indicate that this pain is closely related to the presence of hypervascularization of the tendon.

We studied patients with chronic tendinosis. Tendon hypervascularization was rated mild, moderate, or intense based colour Doppler ultrasound findings. The effect on pain during Achilles tendon loading activity was evaluated using a visual analogue scale (VAS). In this study 14 Achilles tendons in 10 patients with a long duration of pain-symptoms from the mid-portion of the Achilles tendon were included in the investigation. At follow-up, all patients answered a questionnaire assessing their satisfaction with the result of the treatment, the level of present tendon loading activity, and tendon related symptoms.

Clinical and ultrasound follow-up three to six weeks after three treatment by shock wave sonographically-guided , we compare if result indicate an effect on the neovessels similar Eccentric training or US- and CT-guided injections of the sclerosing agent Polidocanol. Neovascularisation was found inside and outside the ventral side of the region with structural tendon changes in all tendons with chronic painful mid-portion Achilles-tendinosis. Before treatment, the mean VAS-score, evaluating the amount of pain during Achilles tendon loading activity, was 70. At the six weeks follow up, 8/10 patients were satisfied with the treatment and mean VAS score had decreased to 10, and in the majority of the tendons all neovessels had decreased. In the 2/10 patients who were not satisfied with the treatment (remaining tendon pain), multiple neovessels remained.

This pilot study indicates an effect of ESWT on the neovessels well correlated with reduced pain but further randomised controlled trials are needed to prove this findings.

Treatment of Chronic Lumbar Pain with Radial Shock Waves

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This paper is about one year experience using radial shock waves as treatment for lumbar pain with trigger-points.

We treated patients with chronic resistant lumbar pain who had no neurological compression or others diseases. We identified the trigger points with clinical examination and perform the treatment using radial shock waves in conjunction with needles. We repeated the application every week for 2 months (8 sessions) with 3,000 shocks.

We evaluated 30 patients using clinical patient opinion relative to pain during activities such as standing, walking and night pain . After 8 sessions, 25 of 30 patients were satisfied with the results. Three months after treatment the patients were still satisfied.

This is an initial report of our experience. More research pre and post treatment needs to be done. We have performed the inactivation of trigger points with needles for the last 8 years with good results. The association with radial shock waves is safe, less invasive and, in our initial opinion, a new option for these hard-to-treat patients.

Morton's Neuroma: Treatment with Extracorporeal Shock Wave Therapy

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Morton's Neuroma is a common pathology of the forefoot. It is characterized by plantar forefoot pain, neuralgia affecting spaces of the toes, burning sensation that increases with digital pressure in between the toes, and a solid node in the proximal space of the toes is evident on the ultrasonographic exam. The conservative treatment is usually successful, however, when it fails, the surgical removal of the tumor can be indicated. While surgery has proven effective, it comes with the risks and complications associated with surgery and necessitates a prolonged recovery.

We reviewed the records of 20 patients presenting with Morton's Neuroma between July 2003 and September 2005. All patients answered a questionnaire regarding satisfaction, pain, restriction of footwear and activity. All patients (20) had tried conservative treatment for a minimum of 6 months without success. Eleven patients (13 feet) were treated with ESWT (1,500 pulses at 0.3 mJ/mm²), on an Orthima-Direx device (electrohydraulic), from directly plantar to the Morton's Neuroma. The mean follow-up was 15.9 (5 - 30) months. Of the total, 61.4%(8 feet) were satisfied and 38.3%(5 feet) were dissatisfied with the outcome, 4 of which underwent surgical treatment. Of the 9 patients (10 feet) submitted to surgical approach through a dorsal incision, 90% (9 feet) were satisfied. The mean follow-up was 16.8 (5-29) months in this group. One patient complained of paraesthesia on the toe 6 months after surgery.

ESWT can be considered an option in the treatment of painful Morton's Neuroma. It does not have complications associated with surgery.

Focused Shock Waves in the Treatment of the Sesamoiditis of the Hallux

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Sesamoiditis is usually present as pain in the plantar base of the first metatarsal, and is often a hidden and ignored pathology.

From September 2004 to February 2005, 44 patients (73% male, 27% female) with an average age of 47 years (range 19-57) with a diagnosis of sesamoiditis were included in the study. Fifty-four percent had sesamoiditis associated with proximal plantar fasciitis and 18% had sesamoiditis associated with hallux valgus. Forty-five percent were active athletes. Patients received ESWT with a focused Orthospec (Medispec) generator, at 0.08-0.16 mJ/mm² with 120 shockwaves/minute in a single session. Follow up was done by analyzing clinical and radiological variables, VAS, gait foot-takeoff analysis, tolerance to mobility and patient's satisfaction. Patients were followed up with every six weeks for a nine month period. Descriptive and inferential statistical analyses were performed, as well as coefficients of correlation and Chi Square analysis, with a significance level of 0.05. We used the beginning of analgesia as a primary variable for evaluation.

Our results showed that the beginning of analgesia was achieved with an average of 494 shockwaves. The average total number of shockwaves per treatment was 930. After a 9-month follow up our patients showed 82% excellent/good results (n=26), 9% fair (n=4), and 9% poor (n=4). VAS showed statistically significant differences, with a variation between initial and end values of p=0.024 and association VAS End satisfaction level p=0.000.

Our results showed a significant improvement in both pain control and patient satisfaction in sesamoiditis treatment, however further studies are necessary to determine a final protocol.

Radial Shockwave Therapy for the Treatment of Rotator Cuff Rupture and Pericapsulitis: A Case Report

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At the international ISMST congress in Vienna, the consensus for shoulder tendinopathies treatment was oriented to focal shockwave therapy. However, there are no scientific publications to our knowledge describing the treatment of rotator cuff rupture and pericapsulitis with RSWT. We present a 57-year-old woman with a rotator cuff rupture of the left shoulder one year after an accidental fall. She received multiple unsuccessful treatments until she was booked for surgery by the orthopaedist. The patient chose a non-surgical treatment before the procedure. Physical examination showed pain (VAS) at rest (3/10), at any movement (9/10), pressure (7/10) and abduction shoulder rise (10/10). There was a clear hyperalgesic area at the deltoid area. She could perform shoulder motion actively against gravity. The MRI reported a subacromial impingement, rotator cuff rupture and biceps tendonitis. We applied RSWT without anaesthesia, with 2,000 impulses at 2.5 BAR maximum and 8 Hz in 3 sessions at one week intervals. We prescribed analgesics, ice packs and pendulum and stretching exercises.

After one month the patient had no hyperalgesia, no pain at rest or starting any movement. She had pain after flexion over 90°. We observed an increase in range of motion. She could raise her hand over 90° of flexion, 70°-80° of abduction and initiate rotation. She still had capsular adhesion but physical therapy could be restarted.

Our findings in this patient showed good results using RSWT in rotator cuff rupture with pericapsulitis. We believe it could be safely used when the conditions are not optimum for surgery.

Clinical Investigation into the Effects of Extracorporeal Shock Waves on Skeletal Muscle Dysfunctions in Patients Affected by Cerebral Palsy

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For some time shock waves have been employed in the management of post-traumatic skeletal muscle injuries to treat contracture. Recently ESWT has found new medical applications and, among these, one of the most interesting is the treatment of muscular contraction in patients affected by Cerebral Palsy (CP). In our department we have been treating equine foot in children with CP for several years with very encouraging results. Nevertheless it is difficult to evaluate objectively the effects of shock waves on skeletal muscle. For this reason we have performed a clinical investigation on the effects of ESWT in skeletal muscle dysfunctions in patients affected by CP by means of gait analysis.

Sixteen patients affected by monolateral equine foot as a complication of CP were treated by ESWT and rehabilitation according to our usual protocol, which consists of 1-5 sessions of treatment at very low energy followed by Physiokinesitherapy. Each patient underwent quantitative gait analysis before and after treatment. Quantitative gait analysis is useful in objective documentation of walking ability in patients with Cerebral Palsy. In all the cases, we observed increased improvement of time, space and kinematics variables at the suffering side; a greater balance between the affected limb and the contralateral was achieved in all areas of measurement. Moreover the overall patient satisfaction level for this treatment modality was high. Once the clinical validity of this methodology is proved, a pathological study of the relationship between shock waves and skeletal muscle tissue will be necessary (and we are already working on this). At the same time we are also evaluating the possibility of applying this methodology to other muscular dysfunctions such as dystrophy.

Shockwave Biosurgery and Autologous Growth Factors Combined Therapy in Equine Suspensory Ligament Injuries

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The use of ESWT in equine tendinopathies results in a good or excellent outcome in most cases. However, some horses have difficulty recovering from swelling and lameness, especially those with an echographic diagnosis of a tendinous defect.

We treated 12 horses with a diagnosis of suspensory ligament injuries graded between 2 and 4, and lameness during daily work graded between 2.5 and 3.5/5. Swelling and pain were present in the proximal metacarpal area. Ultrasound showed intrasubstance defects in the ligament that were also palpable. Before the treatment, we obtained 50 cc of blood and we prepared Autologous Growth Factors (AGF) in a double centrifuge process. In one session and under sedation, we applied 4,000 radial shockwaves to the defect area using a Swiss Dolor Clast Veterinary unit (EMS Switzerland). We used a pressure of 2-4 bar at 6-10 Hz. After shockwave application, the area was disinfected and the activated AGF was injected. We developed and standardized a 2-month workout protocol that progressively allows the horses to walk, trot and gallop under veterinary care and echographic controls.

All horses showed improvement in pain, gait, trot and gallop. Swelling decreased significantly in the first two weeks, and did not recur after the workout protocol. There were no complications. Our encouraging results may reduce the treatment protocols to a single session, improve outcome in tendinopathies with a detectable defect and allow faster recovery of severe suspensory ligament injuries in horses.

Duration of Analgesia Resulting from Extracorporeal Shockwave Therapy in Unilateral Lameness in Horses

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In addition to the potential therapeutic value of ESWT in horses is the consideration of the analgesic affect. The risks to both horse and rider when working without full comprehension of pain is significant. The objective of the study reported here was to determine the short term effect of ESWT on lameness by force plate evaluations.

In the study, 9 horses that had chronic unilateral lameness localized to the forelimb were used. All horses had lameness localized by perineural and/or intraarticular anaesthesia and confirmation of the specific lameness aetiology by radiographic evidence. Force plate data was obtained daily for each horse for 3 days (day -3 to -1) prior to ESWT. In addition, following the force plate analysis on the first day (day -3), local anaesthesia was used to alleviate the lameness and a force plate analysis was completed. On day 0 ESWT was done in the morning and the first post treatment force plate analysis was completed 7 to 8 hours later. Force plate analysis was repeated daily through day 7. A matched pairs t test was used to compare between baseline, the post-block measurement and post-treatment measurements day 0 through 7.

There was a significant difference between baseline PVF and PVF on day 0 (0.003) and 2 (0.0156). The PVF after local anaesthesia was not significantly different (0.14) than the day 2 post-treatment PVF.

There was a significant analgesia following ESWT from 8 hours through 48 hours after treatment. These data can be utilized in the formation of regulations concerning ESWT.

ESWT Treatment in Delayed Union and Pseudoarthrosis

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Institution:

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During 2004 in our Institute we investigated the effectiveness of extracorporeal shock wave therapy in pseudoarthrosis and delayed union of long bones in 30 patients. We extended our work to a total of 80 patients till Jan 2006. This study shows our experience as Radiologists with ESWT.

Our study, started in 2004 with 30 patients, continued till Jan 2006 collecting a group of 80 patients to evaluate the effectiveness of ESWT in treatment of pseudoarthrosis and delayed union. We treated 53 males and 27 females (age ranging from 15 - 68 years), of whom 44 suffered of pseudoarthrosis and 36 of delayed union. Shock wave treatment was administered with a “REFLECTRON” (HMT- System). The protocol consisted in 4 treatments (one per week) with 3000 shocks (frequency 240 shocks/min) each. The target area was selected under fluoroscopic guidance drawing a pen-point on the corresponding skin area. Treatment was given without anesthesiological support, hospitalisation nor immobilisation.

Our experience confirms the primary role of ESWT in the conservative treatment of pseudoarthrosis and delayed union of long bones.

Shockwave Biosurgery and Autologous Growth Factors Combined Therapy in Minimally Invasive Treatment of an Intertrochanteric Fracture Non-union: a Case Report

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A significant number of hip fractures are produced by high energy trauma that causes complex fractures which are difficult to manage with closed or open reduction and internal fixation. Some patients present low energy trauma fractures that are mostly incomplete or not displaced. These fractures are difficult to diagnose and can lead to complications like pseudarthrosis, non-unions or fracture displacement.

We treated a 38-year-old man with a non-displaced intertrochanteric fracture non-union. The first treatment option was to perform an open reduction with cure of pseudarthrosis and bone grafting. However, the adequate stability of the fracture and the difficulty in performing surgery on an overweight patient led us to propose a non-invasive treatment option. Given our experience with RSWT & Autologous Growth Factors (AGF) combined therapy, we choose such a treatment for this patient. We applied 4,000 shockwaves at 4 BAR at the trochanteric area without anaesthesia. Previously, we obtained 30 cc of blood that was processed in a double centrifuge process. The AGF was activated and mixed with morselized bone allograft, and applied percutaneously into the non-union. Our patient was allowed to walk with crutches post-treatment. Pain was controlled and no complications occurred. X-rays showed bone bridges after 2 weeks and a solid bone callus after 4 weeks.

RSWT and AGF combined therapy may be a useful procedure to treat non-unions of intertrochanteric non-displaced fractures. We believe this therapy could be performed in acute incomplete or not displaced fractures of the hip.

The Effects of Extracorporeal Shockwaves on Acute High-Energy Long Bone Fractures of the Lower Extremity

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Institution: Chang Gung Memorial Hospital-Kaohsiung Medical Center Kaohsiung, Taiwan

High-energy long bone fractures of the lower extremity are at risk of poor fracture healing and high rate of non-union. Extracorporeal shockwaves have proven to be effective to heal non-union of long bone fractures. However, the effect of shockwaves on acute fractures is unknown. The purpose of this study was to investigate the effects of shockwaves on acute high-energy fractures of the lower extremity. **Materials and Methods:** Between January and October 2004, 56 patients with 59 acute high-energy fractures were enrolled in this study. Patients were randomly divided into two groups: 28 patients with 28 fractures in the study group and 28 patients with 31 fractures in the control group. Both groups showed similar age, gender, type of fracture and follow-up time. Patients in the study group received open reduction and internal fixation and shockwave treatment immediately after surgery on odd-numbered days of the week, whereas patients in the control group received open reduction and internal fixation without shockwave treatment on even-numbered days of the week. The evaluation parameters included clinical assessments of pain score and weight bearing status of the affected leg and serial radiographs at 3, 6 and 12 months. The primary end-point is the rate of non-union at 12 months, and the secondary end point is the rate of fracture healing at 3, 6 and 12 months. **Results:** At 12 months, the rate of non-union was 11% for the study group versus 20% for the control group ($P < 0.001$). A significantly better rate of fracture healing was noted in the study group over the control group at 3, 6 and 12 months ($P < 0.001$). **Conclusion:** Extracorporeal shockwave is effective in promoting fracture healing and decreasing the rate of non-union in acute high-energy fractures of the lower extremity. High-energy long bone fractures of the lower extremity are at risk of poor fracture healing and high rate of non-union. Extracorporeal shockwaves have proven to be effective to heal non-union of long bone fractures. However, the effect of shockwaves on acute fractures is unknown. The purpose of this study was to investigate the effects of shockwaves on acute high-energy fractures of the lower extremity. Between January and October 2004, 56 patients with 59 acute high-energy fractures were enrolled in this study. Patients were randomly divided into two groups: 28 patients with 28 fractures in the study group and 28 patients with 31 fractures in the control group. Both groups showed similar age, gender, type of fracture and follow-up time. Patients in the study group received open reduction and internal fixation and shockwave treatment immediately after surgery on odd-numbered days of the week, whereas patients in the control group received open reduction and internal fixation without shockwave treatment on even-numbered days of the week. The evaluation parameters included clinical assessments of pain score and weight bearing status of the affected leg and serial radiographs at 3, 6 and 12 months. The primary end-point is the rate of non-union at 12 months, and the secondary end point is the rate of fracture healing at 3, 6 and 12 months. At 12 months, the rate of non-union was 11% for the study group versus 20% for the control group ($P < 0.001$). A significantly better rate of fracture healing was noted in the study group over the control group at 3, 6 and 12 months ($P < 0.001$). Extracorporeal shockwaves are effective in promoting fracture healing and decreasing the rate of non-union in acute high-energy fractures of the lower extremity.

Standard of Care for the Treatment of Non-Unions

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Considering that non-union results from one or both factors (instability and impaired vascularization), the treatment is directed to overcome the causing factors. Many non-unions have been existing for long time, and some with previous surgeries. The consequences are that beside the lack of bone union, it may be present misalignment, skin scars, dead bone, loose implants and particularly important bone atrophy (disuse) and joint stiffness (or impaired ROM). Treatment must consider all these parallel factors, which have to be overcome in order to bring back to the patients the best possible conditions to achieve better daily activities, and even going back to sports. Diagnosis is usually easy to be established through plain X-Rays, moreover if they are consecutive. Seldom it is necessary to have CT scan or MRI. Assessment of function pre-op is mandatory. Treatment objectives are to correct not only non-union, but also to restore length, angulations and rotational deformities, and especially articular function. Today the best way to fulfill these requirements is with surgical treatments, which offer required stability so bone can heal, correct deformities, allow to add bone graft when necessary and permits early movements of joints. All these factors together offer good results in over 80% in surgically treated non-unions with stable osteosynthesis.

Extracorporeal Shockwave Therapy for Non-Unions and Delayed Healing Fractures

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Institution: Trauma Centre Meidling, Vienna, Austria

The objective of every fracture treatment is to reunite the fracture fragments in an anatomical position and completely restore the function of the injured portion of the skeleton as quickly as possible. Despite today's sophisticated technologies and good primary treatment, 1-3% of all bone fractures develop into pseudarthrosis. Surgical treatment with debridement of the pseudoarthrotic tissue, cleaning of the fragment edges, insertion of autologous spongiosa and stabilization with osteosynthesis material is considered the "gold standard" for the treatment of pseudarthrosis. However, these surgical procedures are extremely traumatic for the patient. They are also costly, time-consuming, and associated with a high rate of complications. Therefore in December 1998, after successful pilot studies, the Trauma Centre Meidling commenced a large-scale prospective study using shockwave therapy to treat non-unions.

To date, more than 1,100 non-unions have been treated with shockwave therapy in the Trauma Centre Meidling. We have used different electrohydraulic devices (Orthowave 280, MTS; OssaTron, HMT) and have even compared different technologies by also using an electromagnetic device (Modulith, Storz Medical) from April 2004 until January 2005.

From the start of the study, more than 50 patient-specific data items were stored in a database developed especially to permit the combination of a broad range of parameters. This database structure serves as the basis for quality assurance measures and enables the researchers to determine the optimal treatment parameters and other important criteria. This database containing a documentation of the treatment of pseudarthrosis with ESWT is made available to all interested parties free of charge; it can be ordered from the authors.

Treatment was basically envisaged as a single treatment. Depending on the region to be treated, shockwave therapy is administered under general, regional or local anaesthesia. The patients are positioned such that the pseudarthrosis gap is clearly visualized in the anterior-posterior projection. The shockwave focus is positioned on the pseudarthrosis gap and between 2,000 and 4,000 pulses are applied (1,000 pulses per treatment location). We use an energy flow density (EFD) of 0.3 to 0.4 ml/mm² for all bone treatments.

Following shockwave therapy the pseudarthrosis is immobilized like a fresh fracture. This is usually done with a plaster cast or plastic splint; in 7 patients with especially mobile tibia non-unions, an external fixator was used. Fixation is not necessary when the pseudarthrosis has been treated with appropriate osteosynthesis material and this material exhibits no signs of loosening upon clinical or radiological examination. It can be assumed that the healing process is initially accompanied by neovascularization; for this reason, we try to prevent micro-movements of the non-union during the first 3-4 weeks after treatment to preclude tearing of the new capillaries. It may be necessary, in some cases, for the patient to avoid full weight bearing on the affected extremity during this period. The patient's cooperation must be elicited by a detailed briefing since most patients are asymptomatic directly after the treatment, owing to the analgesic effects of the shockwaves, and want to put their full weight on the affected extremity again.

If the cardinal symptoms (i.e. pain upon bending or compression, swelling, reddening and hyperthermia) subside during the early post-treatment phase (i.e. the first 2-3 months after ESWT), the physician can afford to take a "wait and see" attitude. This applies even if the x-ray findings are ambiguous, since the clinical findings constitute a more reliable measure of therapeutic success at this stage.

A pseudarthrosis gap with a width greater than 5 mm shows a poor prognosis.

In cases where bony remodelling of the non-union could not be demonstrated after 3 to 6 months, patients were given the option of surgical repair. Numerous patients, especially those who had undergone multiple

operations previously, refused this option. This led to a relatively high number (18%) of repeat treatments. In exceptional cases, a third or fourth (and in one instance, even a fifth) treatment was performed. The group of patients undergoing repeat ESWT included patients for whom a complicated pseudarthrosis operation was contraindicated for internal reasons or could have been done only at considerable risk to the patient. Osseous union was achieved in 67% to 75% (depending on the device) of the pseudarthroses. As expected, the best therapeutic results were obtained in patients with delayed osseous union - in this group, ESWT was administered 3-6 months after the injury or the last operation on bone - and healing was achieved in 75% to 85% of these patients. Of the patients with pseudoarthrosis with an onset more than six months previous, 60% to 70% experienced osseous union.

Among the more than 1,100 patients treated at the Trauma Center Meidling, no complications occurred other than the adverse reactions that have already been observed following shockwave therapy (i.e. local swelling, petechial bleeding, haematoma). Even though the mechanism of action of shockwave therapy has not yet been fully explored, we are convinced that ESWT is an effective, inexpensive and time-saving therapeutic modality with an almost zero rate of complications. Therefore we consider ESWT as the first choice therapy for non-unions and delayed unions that do not require surgical realignment.

Standard of Care for the Treatment of Avascular Necrosis (AVN) of the Femoral Head

Author: Dr. João Matheus Guimarães

Avascular necrosis (AVN) of the femoral head is a pathologic process resulting from interruption of blood supply to bone.

AVN of the hip is poorly understood but is the final common pathway of traumatic or non-traumatic factors that compromise the already precarious circulation of the femoral head. Femoral head ischemia results in the death of bone marrow and osteocytes and usually results in the collapse of the necrotic segment.

AVN of the femoral head is a debilitating disease that usually leads to osteoarthritis of the hip joint in relatively young adults. The goal in treating avascular necrosis is to improve the patient's use of the affected joint, stop further damage to the bone, and ensure bone and joint survival.

Non-operative treatment and surgical treatment options are available, their risks and benefits, potential limitations and complications will be discussed.

Treatment for Osteonecrosis of the Femoral Head: Comparison of Extracorporeal Shock Waves with Core Decompression and Bone-Grafting

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Institution: Investigation performed at the Departments of Orthopaedic Surgery, Medical Research, Diagnostic Radiology, and Pathology, Chang Gung Memorial Hospital Medical Center, Kaohsiung, Taiwan

There is continuing controversy regarding the optimal treatment for patients with symptomatic early-stage osteonecrosis of the femoral head. We compared the results of noninvasive treatment with extracorporeal shock waves with those of core decompression and bone-grafting in similar groups of patients.

Patients with stage-I, II, or III osteonecrosis were randomly assigned to be treated either with shock waves or with core decompression and nonvascularized fibular grafting. The shock-wave group consisted of twenty-three patients (twenty-nine hips), and the surgical group consisted of twenty-five patients (twenty-eight hips). The patients in the two groups had similar demographic characteristics, duration and stage of disease, and duration of follow-up. The patients in the shock-wave group received a single treatment with 6000 impulses of shock waves at 28 kV to the affected hip. The evaluation parameters included clinical assessment of pain with a visual analog pain scale, Harris hip scores, and an assessment of activities of daily living and work capacity. Radiographic assessment was performed with serial plain radiographs and magnetic resonance imaging.

Before treatment, the two groups had similar pain and Harris hip scores. At an average of twenty-five months after treatment, the pain and Harris hip scores in the shock-wave group were significantly improved compared with the pretreatment scores ($p < 0.001$). In this group, 79% of the hips were improved, 10% were unchanged, and 10% were worse. Of the hips treated with a nonvascularized fibular graft, 29% were improved, 36% were unchanged, and 36% were worse. In the shock-wave group, imaging studies showed regression of five of the thirteen lesions that had been designated as stage I or II before treatment and no regression of a stage-III lesion. Two stage-II and two stage-III lesions progressed. In the surgical group, four lesions regressed and fifteen (of the nineteen graded as stage I or II) progressed. The remaining nine lesions were unchanged.

Extracorporeal shock-wave treatment appeared to be more effective than core decompression and nonvascularized fibular grafting in patients with early-stage osteonecrosis of the femoral head. Long-term results are needed to determine whether the effect of this novel method of treatment for osteonecrosis of the femoral head endures.

New Application of Shock Waves in Arthritis and other Osteochondropathies: Clinical Data, Biological Considerations and Future Perspectives

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Recent reports in medical literature have shown that pain in arthritis and osteochondropathies, not to mention inflammation, can be due to bone marrow oedema. The aim of our study was to examine the effects of Extracorporeal Shock Waves (ESW) on these pathologies and to underline their potential positive interference on the evolution of chondro-osseous degeneration.

Forty-five patients suffering from knee, ankle or foot pain due to arthritis or other degenerative osteochondropathies, all of them characterized by bone marrow oedema, were subjected to high energy ESW (1 or more series of 3 treatments; 4,000 - 5,000 shocks/treatment; 0.15 - 0.4 mJ/mm²). After each treatment, patients were on crutches for 20 - 25 days. Results were evaluated according to subjective and objective clinical findings and MRI imaging (pre and post treatments).

More than two-thirds of the patients reported positive results after ESW, in regard to pain, swelling or joint stiffness, and bone marrow oedema. Pain resolution was strictly related to an improvement of MRI imaging (> 90%). No local nor general side effects were reported.

Bone marrow oedema, responsible for pain in arthritis and other osteochondropathies, recently has been described as a negative prognostic factor regarding their degenerative evolution. According to our promising data, ESW seems to positively interfere not only with symptoms but also with the pathogenetic mechanism of degeneration. The authors are going to explain the rationale of this new therapeutic application, of which its "protective" effects against tissue degeneration are underlined.

Osteochondral Lesions as an Indication for ESWT

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Institution: IZS - Berlin

The treatment of osteochondral lesions is realized in the field of high-end-technologies. In arthroscopic techniques the cartilage tissue is refreshed by abrasion and retrograde drilling. For the localized chondral defect various types of cartilage-transplantation such as OATS and mosaic-plasty are applied.

Aim of the treatment of cartilage damage of the joint always is to restore the congruent surface of the joint and the complete covering with cartilage tissue. ESW showed in vitro a proliferation of chondrocytes and even in vivo we were able to show these results in single-case-publications. The idea of the working-mechanism of extracorporeal shockwaves has expelled from primarily assumptions of the mechanical destruction of the treated tissue and therefore causing a remodelling process. The shockwave rather shows an aimed induction of bioengineering process in the sense of activating the cell metabolism via “second-messenger”-cascades. Mediators like NO appeared in the focus of interest. Such signal transducing substances are able to cause a transformation of transmembranous proteins and activating them. By “second-messenger”-Pathways the intracellular metabolism is affected. The transformation of mechanical stress, produced by ESW, into a cellular answer is named mechanotransduction. Regarding the cartilage-tissue cell-regeneration is induced by the mechanical stress. Chondrocytes have a very slow metabolism. In terms of an intact tissue-formation an expanding growth is not necessary. This information is processed by the intracellular and transmembranous adhesion-molecules. If there is a defect detected this will lead to the activation of repairing processes. In cartilage-tissue this process remains slowly and therefore shows a remaining defect or a less thickened coverage of the joint. The aim is to stimulate these mechanisms by ESW and therefore gaining a thickened covering of the chondral defect with a primary cartilage tissue. The shockwave treatment is performed in combination with a diagnostic arthroscopy in order to get a documentation of the chondral defect of the surface and the stage of the osteochondrosis. The study included 87 patients, 59 male and 28 female. Following to the pictorial report the patients with an OD or a degenerative/traumatic chondral lesion receive a single treatment with an electrohydraulic generated shockwave in general anaesthesia.

After shockwave treatment an immobilisation of the joint and a waiting period for sportive activities is performed for 2-6 weeks. Clinical controls and MRI-examination show the outcome. If the patients agree a “second-look”-arthroscopy and histologic findings will be performed, but in reality most of the now pain-free patients do not agree to undergo a second arthroscopy. As shown in previous publications the treatment of the OD shows a very good and good result in 70% and in another 14% the progression of the affected area could be stopped. Additional to the good subjective results we have never seen any treatable side effects.

At this time we are not able to reveal valid data on the treatment of degenerative/traumatic chondral lesions and therefore we can only show single-cases.

For treating chondral-lesions in the sense of arthritic disease there will be further pilot-trials that are performed in the mean-time. It is to be shown how the microbiologic effects of shockwaves are transformed to the cells, hardening the hypothesis of a bioengineering effect of shockwaves. Afterwards a valid animal-experiment has to be studied. In the scientific research and clinical studies the positive effect of shockwaves on cartilage has been shown. These effects and the hypothesis of a mechanotransductional effect are to be investigated in comprehensive study. In order of the efficacy, the lack of complications and the slight effort applying shockwaves this could be a sensible alternative to the acknowledged methods in the treatment of chondral damage.

Effectiveness of Shock Waves in Bone Marrow Edema Syndrome of the Hip: new Cases and More Pathogenetic Hypothesis

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“Bone Marrow Oedema Syndrome of the Hip” (BMESH) is a painful syndrome of still unknown origin. The aim of our study was to examine the efficacy of Extracorporeal Shock Waves (ESW) in rapidly relieving this condition and to underline some important biological implications.

A total of 110 patients, affected by BMESH, were subjected to high energy ESW (1 - 2 series of 2 - 3 treatments; 3,000 - 4,000 shocks; 0.3 - 0.6 mmJ/mm²). After treatment, patients went on crutches for approximately 25 - 30 days. Patients were evaluated before and after treatment by Visual Analog Scale for pain and by MRI imaging for bone marrow oedema.

ESW showed to have rapid positive effects in almost 80% of the patients, with regard to both pain and bone marrow oedema. Few patients showed aseptic osteonecrosis of the femoral head after bone marrow oedema resolution. No local nor general side effects were recorded after ESW. BMESH, according to some of the authors, if it persists, may produce aseptic osteonecrosis of the femoral head. It can have spontaneous resolution, but it takes many months. Medical and surgical therapies are reported to be effective, but take a relatively long time as well. From our study, ESW seems to be a valid, safe, non-invasive tool in rapidly relieving BMESH. Moreover, on the basis of clinical data, the authors are going to propose ESW as first therapeutic choice, due to the potential protective effect against further vascular impairment and irreversible tissue damage.

Two-Year Results of Patients with Gonarthrosis Treated with Intermittent Extracorporeal Shockwaves and Intra-Articular Application of Hyaluronic Acid

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Within the scope of a multicenter study about the effects of extracorporeal shockwaves in combination with intra-articular applications of hyaluronic acid, 9 patients were observed for a period of over two years. After MRI examination, the sensitivity to pain was proved by VAS (visual analogue scale) and the functional maximum load by Lysholm and HSS (hospital of special surgery) score. ESWT was applied using Piezoson 100 (Fa.Wolf, Knittlingen, Germany) on 9 patients (5 women, 4 men) between 29 and 75 years of age. The treatment was performed five times at one-week intervals. Three patients (2 women, 1 man) who were under medical supervision for 30 months reported total elimination of their pain with a significant improvement of the Lysholm and HSS-score. Two patients had a significant and two a mediocre improvement in their pain. Two patients required surgery.

The treatment of gonarthrosis in a not-so-advanced state that combines ESW with intra-articular hyaluronic acid injection seems to be a good alternative to other therapies.

Histological Findings in Human Osteoarthritis (OA) Treated with ESWT

Author: M. Branes, L. Contreras , L. Guiloff , J.A. Branes

Institution: Santiago - Chile

ESWT has been used for treatment in different pathologies that compromise cartilage and corresponding subchondral bone . The aim of this report is to evaluate the effects of shock waves on this special anatomical region and compare them with our histopathological results in ESWT-treated soft-tissue shoulder pathologies. From July 2004 to November 2005 , 15 patients (6 male , 9 female, mean age = 61 years.) with knee OA (13), elbow OA (1) and trapezius-mtc OA (1), were accepted for a single treatment of shockwaves (2,000 shocks /0.33mJ/mm², Orthospec/Medispec) focused on the area of OA clearly displayed in MRI-gadolinium. According to protocol, these patients underwent delayed arthroscopic treatment and osteochondral biopsies (6 to 10 weeks post-ESWT application). During the same period we collected 15 osteochondral biopsies from patients with OA, and 5 osteochondral samples from patients with prosthetic solutions for complex joint fractures. All biopsies underwent the same treatment of habitual stains for this kind of tissue and examination under light microscope.

HISTOLOGICAL RESULTS: 1. There were no differences in the histopathological aspect of OA between the treated and control cases, suggesting that ESWT does not produce distortion or more damage in these tissues. 2. In the cartilage of OA-ESWT cases there was no observed necrosis of cartilage cells or damage to isogenic groups, which were surrounded by a normal matrix with normal collagen arcades as in normal control cases. 3. Cartilage in treated cases remained quiescent with no observation of mitosis, but in some patients there was an intense matrix basophilic reaction. 4. The review of subchondral bone and bone marrow features between three groups of samples depicted no large differences; however in some material there was an observed increase of neo-hypermuskularized active vessels with more cellularity associated in bone marrow areas, quite similar to those seen in shoulder tendinosis treated with ESWT. 5. There was no evidence of scarring, fibrosis, necrosis or anaplasia- displasia phenomena.

The reactive features of bone marrow blood-vessels are quite similar to those found in others ESWT-treated tissues. The fact that some blood vessels cross over to rest in calcified cartilage (Clark ,1990) and the probable relationship between these blood vessels and the reparative process in this special anatomical area are particularly interesting in light of our findings that shockwaves could improve epiphyseal microcirculation. This deserves more research efforts. Our histological observations in different human tissues indicate that ESWT treatment does not cause more structural damage or cellular lesions and that the neo-vascular response is consistent in doses of 2,000 to 4,000 shocks at 0.33/mJ/mm².

Standard of Care for Lateral Epicondylitis

Author: M. Campos

Institution: Brazil

Lateral epicondylitis, or tennis elbow, is the most common overuse syndrome of the elbow. A bit of controversy exists about not only the treatment of this condition but also the exact pathophysiology. Most often this injury is encountered in industrial workers and also has been encountered in professional musicians, people who spend a great deal of time at a computer or keyboard that is set up with poor ergonomics and the tennis' s player or racquet sports. Discontinuing activities that cause the pain is the first step to proper treatment of Lateral Epicondylitis and due recurrence of this condition is common, return to activity should not occur too quickly, and preventive exercises should be done consistently.

Treatment is aimed at pain relief and reducing inflammation and the conservative treatment include nonsteroidal anti-inflammatory medications ,local injection of cortisone, immobilization of the forearm and elbow and physical therapy.

The surgical treatment is available to treat tennis elbow if the conservative treatment fails and a variety of procedures have been designed to excise the inflammation and scar tissue. We will discuss the efficacy and risks of the surgical treatment.

Shockwave Therapy for Lateral Epicondylitis of the Elbow : Retrospective Study

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Institution: Cortrel (Rio de Janeiro/RJ) - Ortosom (Porto Alegre/RS) - Orthomaster (Sao Paulo/SP), Brazil

The aim of this study was to evaluate the efficacy and safety of extracorporeal shock wave therapy for the treatment of Lateral Epicondylitis of the elbow in three Brazilian Orthopaedics Clinics. In a multi-center, retrospective study, the effect of shockwave therapy was investigated in 93 elbows of 89 patients with Lateral Epicondylitis of the elbow treated for a period of 51 months, from March 2001 to June 2005. Four patients received bilateral treatment. There were 37 women and 52 men with an average age of 51 (range, 33-74) years. The criteria for inclusion were at least three months of unsuccessful conservative therapy or six months of pain. Criteria for exclusion were inflammatory arthritis, corticosteroid injection within the previous 6 weeks, acute infection, gout, malignant diseases or blood coagulation disorders. Each patient was treated with 1,200 shock wave impulses, a 5 mm focus depth, and with an energy flux density of no more than 0.13 mJ/mm² after local or regional anaesthesia. One treatment was performed on 80 elbows, 12 elbows underwent a second treatment and 1 a third. The subjects were evaluated by means of a clinical evaluation according to Roles and Maudsley score and subjective outcome on Visual Analogue Scale (VAS) analysis, 45, 90 and 180 days after the end of the therapy. The study showed the efficacy and safety of ESWT were excellent in 39.8%, good in 32.3%, acceptable in 10.8%, and poor in 17.1%, 180 days after ESWT.

Radial or Focused Shockwave Biosurgery In Lateral Epicondylitis?

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Institution: OWC Biosurgery Orthopaedic Research Laboratory Bosque University Orthopaedics Bogotá, Colombia

In this review we present our case series of RSWT and compare them with our 2003 Focused Shockwave Bio surgery results. In 134 cases of lateral epicondylitis treated with RSWT we used a two-session protocol with 4,000 shockwaves progressing from less than 2 Bar ($<0.06\text{mJ}/\text{mm}^2$) and 10Hz to 4bar ($0.18\text{mJ}/\text{mm}^2$) and 4Hz, without anaesthesia. We evaluated patients at three, six and twelve months with VAS, ASES-e score, and the ability to return to sports. After three months 97 patients showed a VAS pain reduction of 68%, 62% returned to sports at a similar level, 32% at a lower level, and 6% had persistent pain. Sixty-five percent had good or excellent functional scores. After twelve months, 89 patients showed a VAS pain reduction of 61%, 70% returned to sports at a similar level, 26% at a lower level and 4% had persistent pain. No patients required surgery, and the functional scale analysis improved to 84% with good or excellent results.

Similar results were reported after one year for both types of shockwaves. We found some differences: RSWT allowed a shorter treatment time, a variation in energy and frequency, and the ability to quickly change the point of application. Treatment with focused shockwaves is better for immediate pain relief, is a hand-free procedure for the operator, and patients feel they are receiving more an orthopaedic procedure rather than physical therapy. Economic issues are beyond this paper. Having both devices allows our unit to use Shockwave Bio surgery in a wide variety of applications.

Recommendation for the Treatment of Tennis Elbow with ESWT

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Over the past decade in Germany extracorporeal shock wave therapy (ESWT) has become a serious alternative in the treatment of the tennis elbow.

In the last 10 years, we have observed the results of ESWT in 272 athletes who have had Epicondylitis Humeri Radialis (EHR). We applied 1,500 impulses with an energy of 0.08mJ/mm² on different areas of the lateral epicondyle in relation to the individual pain sensation of the patient. The treatment was done at weekly intervals.

The evaluation of the results with various times of observation showed that directly after ESWT 171 athletes (approx. 63%) reported good to very good results. A slight improvement was reported in 27.2% (74). Nearly 10% (27) of the athletes showed no improvement. During the first evaluation 6 weeks post-treatment, the good and excellent results increased from 63% to 72.1%. After 6 months the increase of good to excellent results reached 76.1% (207 PB). After more than 3 years, 72% (195 PB) of the athletes showed a good to excellent result. Only 12 of the athletes had a recurrence. After more than 10 years we were able to reach nearly 80% (151 PB) of the athletes who showed good to excellent results in the 3 year follow up. Only 9 (6%) had a recurrence.

Due to our 13 years experience we recommend that ESWT should be done without local anaesthesia because in such cases the patient is not able to give exact feedback regarding his individual pain areas. The shockwaves should be applied on different areas of the lateral epicondyle in relation to the individual pain sensation of the patient (Dynamical Treatment). The final results should be evaluated after a time period of more than 3 months, because of the long term effect of ESWT.

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Extracorporeal Shockwave Therapy for Lateral Epicondylitis of the Humerus

Author: Vinzenz Auersperg

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It is hard to find in the literature high evidence for any treatment of the lateral epicondylitis of the elbow. There are only a few papers with high scientific level concerning conservative treatment and surgical procedures respectively. Regarding the literature about extracorporeal shock wave therapy at the lateral epicondylitis we find some papers to discuss:

ESWT without therapy success: Haake (2002)^(I), Speed (2002)^(II).

ESWT with therapy success: Rompe (1996)^(III), Pettrone (2002)^(IV), Rompe (2004)^(V), Pettrone (2005)^(VI).

Some ESWT-studies with lower level of evidence: Wang (2002)^(VII), Ko (2001)^(VIII), Decker (2002)^(IX), Maier (2000)^(X). These studies are not randomized, so they are not accepted to use them for the development of guidelines (concerning the AGREE-instrument for guideline-development).

Very important because of the huge impact and worldwide attention about all Cochrane publications is the Cochrane analysis of Buchbinder (2002)^(XI). In that publication the study data of the publications of Rompe (1996) und Haake (2002) have been consolidated together and the results showed no significant benefit of ESWT. Therefore Buchbinder refused the treatment with ESWT.

Problems at the assessment of ESWT studies in general:

- Unequal parameters used (impulse frequency, energy flux density, maximum energy and pressure etc.).
- No agreement about the energy levels of high energy ESWT and low energy ESWT.
- Different shock wave devices (with different parameters) in one study [Haake-Studie (2002)], so the randomization has been at least weak.
- Only two papers have the same protocols and comparable parameters [Rompe (2004) und Pettrone (2005)].
- The clinical results of the published studies about lateral epicondylitis are mostly not comparable due to the biometrical and technical differences though the studies are of high quality levels.
- There is high probability that local anaesthesia has a decreasing effect on ESWT [Labek (2005)^(XII), Rompe (2005)^(XIII), Klonschinski (2005)^(XIV)].

Conclusion:

- The clinical results of the ESWT studies are despite the high biometrical quality levels almost not comparable.
- Local anaesthesia is probably of bad influence on (low energy) ESWT.
- A strict standardization would be helpful, for the clinical use and for the studies. A standard should be developed for operating procedures, which should be used by all users of ESWT (by the national and international societies).
- ESWT has almost no complications and risks. Despite the controversial literature ESWT should be offered for lateral epicondylitis before those particular patients undergo surgery. No other therapy has high grade of evidence due to the ebm criteria. We will offer ESWT to our patients also in the future.

References:

- (I) Haake M, König I.R, Decker T, Riedel C, Buch M, Müller H.H: *Extracorporeal shock wave therapy in the treatment of lateral epicondylitis: a randomized multicenter trial.* - J Bone Joint Surg Am. 2002 Nov.; 84-A(11): 1982-1991
- (II) Speed CA, Nichols D, Richards C, Humphreys H, Wies JT, Burnet S, Hazleman BL: *Extracorporeal shock wave therapy for lateral epicondylitis - a double blind randomized controlled trial,* J Orthop Res 2002; 20: 895-898
- (III) Rompe JD, Decking J, Schoellner C, Theis C: *Repetitive low-energy shock wave treatment for chronic lateral epicondylitis in tennis players.* Am J Sports Med 2004, Vol. 32, 734-743
- (IV) Pettrone F: *Randomized clinical Study to evaluate the safety and efficiency of the Siemens Sonocur ESWT System in treating patients with lateral epicondylitis (chronic tennis elbow);*
<http://www.fda.gov/cdrh/pdf/P010039b.pdf>
- (V) Rompe JD, Decking J, Schoellner C, Theis C: *Repetitive low-energy shock wave treatment for chronic lateral epicondylitis in tennis players.* Am J Sports Med 2004, Vol. 32, 734-743
- (VI) Pettrone F, McCall BR: *Extracorporeal Shock Wave Therapy without Local Anesthesia for Chronic Lateral Epicondylitis.* JBJS (Am.). 2005;87:1297-1304.
- (VII) Wang CJ, Chen HS: *Shock wave therapy for patients with lateral Epicondylitis of the Elbow,* Am J Sports Med 2002 May-Jun; 30(3): 422-425
- (VIII) Ko JY, Chen HS, Chen LM: *Treatment of lateral epicondylitis of the elbow with shock waves,* CORR 2001 Jun; (387): 60-67
- (IX) Decker T, Kuhne B, Gobel F: *Extrakorporale Stoßwellentherapie bei Epicondylitis humeri radialis.* Orthopäde 7-2002, 633-636
- (X) Maier M, Dürr H.R, Köhler S, Staupendahl D, Pfahler M, Refior H.J: *Analgetische Wirkung niederenergetischer extrakorporaler Stoßwellen bei Tendinosis calcarea, Epicondylitis humeri radialis und Plantarfasziitis;* Z Orthop. 2000 Jan-Feb; 138 (1): 34-38
- (XI) Buchbinder R, Green S, White M, Barnsley L, Smidt N, Assendelft WJ: *Shock wave therapy for lateral elbow pain;* Cochrane Database Syst Rev. 2002; (1): CD003524
- (XII) Labek G, Auersperg V, Ziernhöld M, Poulos N, Böhler N: *Einfluss von Lokalanästhesie und Energiedichte bei niederenergetischer Extrakorporaler Stoßwellentherapie der chronischen Plantaren Fasziiitis.* Z Orthop 2005; 143: 240-246
- (XIII) Rompe JD, Meurer A, Nafe B, Hofmann A, Gerdesmeyer L: *Repetitive low-energy shock wave application without local anesthesia is more efficient than repetitive low-energy shock wave application with local anesthesia in the treatment of chronic plantar fasciitis.* J Orthop Res Vol 23, Issue 4 , July 2005, Pages 931-941

^(XIV) Klonschinski T, Ament S, Schleret T, Birklein F, Rompe JD: Reduzierte Effektivität niedrigenergetischer Stoßwellen bei simultaner Lokalanästhesie - Aufklärung des Wirkmechanismus. Vortrag Nr. 324, 53. Jahrestagung der Vereinigung Süddeutscher Orthopäden e.V., 28.4.-1.5.2005 in Baden-Baden, Deutschland; Orthopädische Praxis Sonderausgabe "Kurzreferate der Vorträge" Seite 184 (www.opfermann.de)

Pain in the Medial Calcaneal Tuberosity - Summary

Author: C.A. Jasmin

Institution: Brazil

From January 1997 to December 2001 all patients who suffered from pain in the medial calcaneal tuberosity without any association with a trauma or rheumatic diseases were submitted to x-ray of the symptomatic foot either with foot leaned on the table and another with the heel lifted by a device which simulated the use of 2 to 3 cm high heeled shoe. The distance between the medial calcaneal tuberosity and the head of the first metatarsal was measured in two incidences, which confirmed that the use of high-heeled shoes reduces the distance between those points. This fact led us to believe that this would also promote the relaxation of the plantar structures originated in the medial calcaneal tuberosity. Since then, these patients were asked to keep their heels lifted from 2 to 3 cm higher than their toes through the use of high heeled shoes or some sort of shoe insoles.

250 patients were invited to follow-up examinations performed in January 2002. 128 patients were available and 27 were excluded for having associated rheumatic diseases and other for having burned the foot.

The evaluation included:

1. Duration of the symptoms after the beginning of the treatment.
2. The re-starting of the symptoms after an overall clinical recovery.
3. The presence of spontaneous pain or under thumb pressure.
4. In which way, the therapeutic orientation was followed.

70 patients (82 feet - 68,33%) were painfree. 24 patients (29 feet - 24,16%) felt better with the treatment but reported that the symptoms were back after abandoning the use of the required shoes. These same patients also reported that they started to follow the therapeutical proposal again obtaining speedy recovery. 6 patients (9feet - 7,51%) did not use the proposed method and kept on having the symptoms anyway.

Shockwave Therapy for Plantar Fasciitis : Retrospective Study

Author: PR. Rockett, AC.Souza, PR. Santos, F. Arcader

Institution: Ortosom (Porto Alegre/RS); Cortrel (Rio de Janeiro/RJ); Orthomaster (Sao Paulo/SP), Brazil

The aim of this study was to evaluate the efficacy and safety of extracorporeal shock wave therapy for the treatment of plantar fasciitis in three Brazilian Orthopaedics Clinics. In a multi-center, retrospective study, the effect of shockwave therapy was investigated in 142 cases of plantar fasciitis in 130 patients treated in the 51-month period from March 2001 to June 2005. Twelve patients received bilateral treatment. There were 67 women and 63 men with an average age of 55 (range, 25-90) years. The criteria for inclusion were at least three months of unsuccessful conservative therapy or six months of pain. Criteria for exclusion were inflammatory arthritis, corticosteroid injection within the previous 6 weeks, acute infection, neurological abnormality, gout, malignant diseases, blood coagulation disorders and ruptures of the plantar fascia. Each patient was treated with 1,200 - 1,500 shock waves, a 20 mm focus depth, and with an energy flux density of no more than 0.14 mJ/mm² after local anaesthesia or ankle block. One treatment was performed in 128 cases, 11 cases underwent a second treatment and 3 underwent a third treatment. The subjects were evaluated by means of a clinical evaluation according to Roles and Maudsley score and subjective outcome on Visual Analogue Scale (VAS) analysis, 45, 90 and 180 days after the end of the therapy. The study showed the efficacy and safety of ESWT were excellent in 36%, good in 33%, acceptable in 11.3%, and poor in 19.7%, 180 days after ESWT.

The Application of Piezoelectrically Generated Shock Waves at a 6 Hz Frequency for the Treatment of Plantar Fasciitis

Author: M.C. Ottone, S.R. Ferraro

Institution:

ASL 20 - Servizio Assistenza Sanitaria Territoriale Tortona (AL) Italy

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Plantar fasciitis is a common clinical problem and a common cause of heel pain. The success rates of conservative treatment are often unsatisfactory. The aim of this study is to demonstrate the efficacy of treatment with piezoelectrically generated shock waves at a 6 Hz frequency.

We studied a group of 60 patients with painful heel. Each patient received 4 applications of 2,000 shock waves (energy density = 0.20 mJ/mm², frequency = 6 Hz), at intervals of 48-72 hours. After a follow up of six months, pain was measured on a Visual Analogue Scale (VAS) and on the basis of the patients' satisfaction according to a four-step score (excellent, good, acceptable, poor - according to SITOD classification). The success rate (excellent and good results) was 75% and no patient needed surgical treatment.

Extracorporeal shock wave therapy (ESWT) seems to be useful as a conservative alternative in patients who were unsuccessfully treated for plantar fasciitis. ESWT was able to decrease pain and increase the amount of comfortable walking time in patients with previously unsuccessful non-surgical treatment.

Extracorporeal Shockwave Therapy for the Treatment of Plantar Fasciitis - Comparative Study of Focused ESWT Versus Combined Focused and Radial ESWT

Author: G. Verratti

Institution: Servicios Medicos Ortho-Shock, Venezuela

The purpose of the study is the evaluation of results, in the short and medium term, of focused ESWT versus combined focused and radial ESWT for the treatment of chronic heel pain due to plantar Fasciitis. Focused ESWT was applied in 3 sessions once a week. Patients complained of pain between the 2nd and 3rd sessions. The third session was then replaced by 2 sessions of radial ESWT once a week, in an attempt to reduce the pain after the 2nd session of focused ESWT. This study aims to present the results of this second method versus the 3 weekly sessions of focused only ESWT.

Since August 2005 a prospective comparative study was conducted on 142 heels of patients with a minimum of 6 months of pain. All patients had been treated with at least 2 methods of conservative treatment. The average age was 55. All patients were sedated for each session. No local anaesthesia was applied. 2 groups were created for the comparison of results. Group 1 consisted of 72 patients that were treated with 3 sessions of focused ESWT (once a week for 3 weeks). Each patient was treated with 2000 pulses with an energy flux density of no more than 0.15mJ/mm² during each session. Ultrasound was used to measure thickness of the plantar fascia before each session. Group 2 consisted of 70 patients that were treated with combined sessions of 2 focal (once a week for 2 weeks) and 2 radial (once a week for 2 weeks) ESWT. The focused sessions were conducted in an identical manner to those of the focused only patients. The 2 subsequent sessions (once a week for 2 weeks) of radial ESWT were performed with 3500 shocks at a frequency of no more than 8Hz and a pressure of 3 to 3.5 Bars.

Patient satisfaction, pain caused by manual pressure, pain whilst walking, were scored with the Visual Analogue Scale - VAS.

Both methods used in the comparative study produced the same overall results. However, Group 2 experienced faster improvement with less pain during the recovery period than Group 1.

A Two Year Retrospective Review of the Effectiveness of Extracorporeal Shockwave Therapy for the Treatment of Chronic Plantar Fasciitis

Author: K. Eickmeier¹, B. Werber², D. Norris³, D. Boryana⁴

Institution:

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This study compares the results of surveys of patients who in 2003 had undergone ESWT for chronic plantar fasciitis. A post-operative survey was sent to 874 patients following ESWT, and in 2004 a follow-up survey was sent to the same patients who were treated in 2003 to see if the effects of the original treatment were effective over a longer period of time. Eighty-five percent of patients who rated their pre-treatment pain level as severe (>8) on a 1-10 pain scale, experienced sharp declines in their level of post-treatment pain in 2004, where sharp decline is considered to be a difference in pain level before and after the treatment of 3 or higher, ($p > [z] = .0000$; $z = 10.098$), compared to seventy percent in 2003 ($p > [z] = .0000$; $z = 12.627$). In addition, 87 percent of patients who rated their pre-treatment immobility as severe (>8) on a 1-10 scale, experienced sharp declines in their level of post-treatment immobility in 2004 ($p > [z] = .0000$; $z = 7.910$) compared to 66 percent in 2003 ($p > [z] = .0000$; $z = 9.004$). The differences in the percentage of people who experienced sharp decline in pain and immobility after treatment were statistically significant at the 1 percent level. A significantly higher percentage of respondents reported lower pain levels, increased mobility, fewer visits to physicians and other health professionals and took fewer medications in 2004 than in 2003.

Long-term Results of Extracorporeal Shockwave Treatment for Plantar Fasciitis

Author: Ching-Jen Wang, Feng-Sheng Wang*, Kuender D. Yang*, Lin-Hsiu Weng, Jih-Yang Ko

Institution: From the Department of Orthopedic Surgery and *the Department of Medical Research, Chang Gung Memorial Hospital at Kaohsiung, Kaohsiung, Taiwan

Background: Extracorporeal shockwave treatment has shown mixed short-term results for plantar fasciitis. However, the long-term results are not available. **Hypothesis:** Long-term results of shockwave treatment are comparable with short-term results. **Study Design:** Randomized controlled clinical trial; Level of evidence, 1. **Methods:** This prospective study consisted of 149 patients (168 heels) with an established diagnosis of chronic plantar fasciitis, including 79 patients (85 heels) in the shockwave treatment group and 70 patients (83 heels) in the control group. In the shockwave group, patients received 1,500 shock wave impulses at 16 kV on the affected heel in a single session. Patients in the control group received conservative treatment consisting of nonsteroidal anti-inflammatory drugs, orthotics, physical therapy, an exercise program, and/or a local cortisone injection. Patients were evaluated at 60 to 72 months (shockwave group) or 34 to 64 months (control group) with a 100-point scoring system including 70 points for pain and 30 points for function. The clinical outcomes were rated as excellent, good, fair, or poor. **Results:** Before treatment, the groups showed no significant differences in the scores for pain and function. After treatment, the shockwave group showed significantly better pain and function scores as compared with the control group. The overall results were 69.1% excellent, 13.6% good, 6.2% fair, and 11.1% poor for the shockwave group; and 0% excellent, 55% good, 36% fair, and 9% poor for the control group ($P < .001$). The recurrence rate was 12% (9/81 heels) for the shockwave group versus 55% (43/78 heels) for the control group ($P < .001$). There were no systemic or local complications or device-related problems. **Conclusion:** Extracorporeal shockwave treatment is effective and safe for patients with plantar fasciitis, with good long-term results.

Extracorporeal shockwave treatment has shown mixed short-term results for plantar fasciitis. However, the long-term results are not available.

This prospective study consisted of 149 patients (168 heels) with an established diagnosis of chronic plantar fasciitis, including 79 patients (85 heels) in the shockwave treatment group and 70 patients (83 heels) in the control group. In the shockwave group, patients received 1,500 shock wave impulses at 16 kV on the affected heel in a single session. Patients in the control group received conservative treatment consisting of nonsteroidal anti-inflammatory drugs, orthotics, physical therapy, an exercise program, and/or a local cortisone injection. Patients were evaluated at 60 to 72 months (shockwave group) or 34 to 64 months (control group) with a 100-point scoring system including 70 points for pain and 30 points for function. The clinical outcomes were rated as excellent, good, fair, or poor.

Before treatment, the groups showed no significant differences in the scores for pain and function. After treatment, the shockwave group showed significantly better pain and function scores as compared with the control group. The overall results were 69.1% excellent, 13.6% good, 6.2% fair, and 11.1% poor for the shockwave group; and 0% excellent, 55% good, 36% fair, and 9% poor for the control group ($P < .001$). The recurrence rate was 12% (9/81 heels) for the shockwave group versus 55% (43/78 heels) for the control group ($P < .001$). There were no systemic or local complications or device-related problems. Extracorporeal shockwave treatment is effective and safe for patients with plantar fasciitis, with good long-term results.

Plantar Fasciitis - Conservative & Surgical Therapy - Radial and Focused ESWT - Review of the Literature

Author: M. Buch

Institution: Kassel, Germany

Shock waves are used to treat tendinopathies like plantar fasciitis since years. In the meantime radial pressure pulses are used for treatment aswell. The presentation gives a review of the literature of studies being performed according to GCP (randomized, double blinded, placebo controlled).

A review of 291 studies is presented using the National library of medicine 1985 - 2006 with keywords "plantar fasciitis" & "heel spur". Six studies were found using ESWT, 1 study using radial pressure pulses that met GCP criteria. No investigation of other conservative treatment modalities showed any effect more than placebo. A comparison of the studies is difficult as different primary efficacy criteria and treatment parameters were used (Number of treatments and impulses, energy, use of local anesthesia. ESWT is one of the best investigated tools in tendinopathies. The efficacy is more than placebo effect.

Standard of Care for Stress Fractures

Author: Prof. Dr. Moises Cohen

Institution: Brazil

The first clinical description a stress fracture was registered by Breithaupt, a German military surgeon, in 1855. Widely studied in human beings, overuse training and stress fracture had been described in submitted animals. In 1897, the first radiographic aspect of a stress fracture in the military army is reported. Nowadays in the literature there is a doubt which is the best synonym: “stress fracture” or “fatigue fracture”.

The predisponent factors for a stress fracture are related to the biomechanical and enviroment aspects, as for example, the age, gender, race, physical conditioning, endocrinologic and diet disturbance and biomechanic characteristics. The repetitive microtraumas associated to the extrinsic factors and the acute overload, taking to the muscular fatigue may lead to a stress fracture. These are the more accepted phisiopathological mechanisms.

The stress fracture represents 10% of all sports injuries, mainly in running athletes. The patient with a stress fracture presents insidions and gradually pain limitation during sports activities. Usually radiological diagnosis methods of imaging are: x-ray, bone scan, CT and MRI. The treatment of the stress fracture varies despite of their characteristics. Initially the treatment is clinical, with use of non steroid antiinflamatory, physiotherapy and correction of the biomechanic factors. The weight bearing is allowed just for daily activities. The option for surgical treatment occur when there is failure of the clinical treatment.

Shockwave Biosurgery for Stress Fractures

Author: C. Leal

Institution: Bosque University Orthopaedics Bogotá, DC Colombia

The current treatment protocols for stress fractures are based on a progressive retraining that takes the athlete out of active competition from twelve weeks to sometimes over a year. The patients usually progress from mild pain to no pain after a long rehabilitation protocol that in many cases lead to an athletic career retirement. Shockwave therapy has shown relevant effects in bone healing metabolism.

The generation of endogenous growth factors through the percutaneous stimulation with high energy focalised or radial shockwaves, has been used successfully for bone healing enhancement in pathologies like non-unions and avascular necrosis. The use of shockwaves in a bone pathology caused by repetitive loadings that override the healing capacity of the tissue could be helpful in reducing healing time and obtaining a faster recovery with fewer incidences of recidives. We have reported in the past five years the results of the application of shockwave biosurgery in stress fractures. Our first study showed a significant reduction in time recovery in tibial stress fractures as compared with contralateral controls in military recruits. A five year follow up has showed no recidives. From that point we have treated 32 patients with stress fractures, including high performance professional tennis players and Olympic athletes. We use a 4000 focused shockwave single session protocol, with top energy levels of 0.3 mJ/mm². We keep a strict rehabilitation protocol, and our patients are usually back in sports with significant pain reduction after six weeks.

This simple harmless technique has allowed us to cut in half the recovery time in patients with stress fractures, and avoid invasive procedures in all of our cases.

ESWT Treatment in Calcific Tendinitis of the Shoulder

Author: D. Rozzati, A. Littera, E. Cignini, S. Festari, G. Sessa , A. Carriero

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The objective of our study was to evaluate the effectiveness of ESWT treatment for symptomatic calcific tendonitis of the shoulder.

Our 2 years experience lasted from Jan. 2004 to Jan. 2006. We treated 110 patients, 44 males and 66 females, (age ranging from 32 to 83 years) with painful shoulder calcific tendinitis who were unresponsive to other conservative therapies. We used a REFLECTRON - HMT ESWT System using a protocol which consisted in one treatment of 500 shocks (frequency 240 shocks/min) each week for three weeks.

The treatment was successful in 83 patients with symptomatic resolution. In 21 patients we observed at the post-treatment X-Ray control the complete vanishing of periarticular calcifications. In 39 patients there was a volumetric reduction of the calcifications. 20 patients experienced no change. 1 patient presented a volumetric increase of the calcification. 2 patients showed a symptomatic improvement.

Conclusions: In our experience ESWT can be accepted as a valid conservative treatment in calcific tendinitis of the shoulder leading to a symptomatic, functional and radiological improvement.

Shockwave Therapy for Tendinosis of the Shoulder: Retrospective Study

Author: AC.Souza, PR. Rockett, MB. Lui

Institution: Cortrel (Rio de Janeiro/RJ); Ortosom (Porto Alegre/RS), Brazil

The aim of this study was to evaluate the efficacy and safety of extracorporeal shock wave therapy for the treatment of tendinosis of the shoulder in two Brazilian Orthopaedics Clinics. In a multi-center, retrospective study, the effect of shockwave therapy was investigated in 65 shoulders of 60 patients with tendinosis of the shoulder treated over a period of 37 months, from May 2002 to June 2005. Five patients were treated in both shoulders. There were 21 women and 39 men with an average age of 53 (range, 19-83) years. The criteria for inclusion were at least three months of unsuccessful conservative therapy or six months of pain. Criteria for exclusion were inflammatory arthritis, corticosteroid injection within the previous 6 weeks, acute infection, gout, malignant diseases or blood coagulation disorders. Each patient was treated with 1,500 shock wave impulses, a 35 mm focus depth, and with an energy flux density of no more than 0.14 mJ/mm² after local or regional anaesthesia. One treatment was performed on 59 shoulders, 4 shoulders underwent a second and 2 shoulders underwent a third treatment. The subjects were evaluated by means of a clinical evaluation according to Roles and Maudsley Score and subjective outcome on Visual Analogue Scale (VAS) analysis 45, 90 and 180 days after the end of the therapy.

The study showed the efficacy and safety of ESWT were excellent in 30.8%, good in 43%, acceptable in 7.7%, and poor in 18.5%, 180 days after ESWT.

Extracorporeal Shock Wave Therapy (ESWT) for Treatment of Calcific Tendonitis of the Shoulder One-Year Experience

Author: Capasso T. M, Gonzalez C. O, Guedez M.

Institution: Orthoshock, Caracas- Venezuela

The purpose of this study was to assess the results of the extracorporeal shock wave therapy for calcific tendonitis of the shoulder.

This retrospective study was conducted at the Orthoshock Shock Wave Center based in Caracas, Venezuela. From January, 2005 to January 2006, 39 patients, aged 41 to 65 years old, were treated (28 female, 11 male) for a total of 44 shoulders (5 bilateral). Inclusion criteria included diagnosis of calcific tendonitis of the rotator cuff with chronic pain, restriction of over 50% in range of joint motion and resistant to conservative treatment for at least six months. Patients received shock wave therapy under the standard protocol; a weekly session for three weeks, level 7 of energy (3000 impact/0.36 mj/mm²) under sedation. The equipment used was a Dornier electromagnetic generator (Compact S and Epos Ultra) with a focus guided by ultrasound of 7.5 Mhz. Patients were evaluated according to a Visual Analog Scale and radiological monitoring following each session. Clinic, radiological and echographic scans were taken one month and one year after the end of the treatment.

A total of 37 patients (94%) had reduced pain after the therapy. Thirty-seven patients (94%) recovered significantly the joint motion range. Three patients (7.69%) showed total calcium resorption and 34 patients (87.1%) experienced partial calcium resorption (radiological and echographic scans). There were no adverse events.

High-energy focal shock waves proved to be an effective therapy for treatment of calcific tendonitis of the rotator cuff. Shock waves are a safe, effective choice for treatment of calcific tendonitis of the shoulder, reduced pain and better motion range.

Shockwave Therapy for Tendinosis Calcarea of the Shoulder : Retrospective Study

Author: PR. Rockett, AC. Souza, PR. Santos

Institution: Ortosom (Porto Alegre/RS); Cortrel (Rio de Janeiro/RJ); Orthomaster (Sao Paulo/SP), Brazil

The aim of this study was to evaluate the efficacy and safety of extracorporeal shock wave therapy for the treatment of tendinosis calcarea of the shoulder in three Brazilian Orthopaedics Clinics.

In a multi-center, retrospective study, the effect of shockwave therapy was investigated in 166 shoulders of 159 patients with tendinosis calcarea of the shoulder treated in the 51 months from April 2001 to July 2005. Seven patients received treatment in both shoulders. There were 82 women and 77 men with an average age of 56 (range, 25-79) years. The criteria for inclusion were at least three months of unsuccessful conservative therapy or six months of pain and calcifications grade I or II from Gärtner's classification. Criteria for exclusion were inflammatory arthritis, corticosteroid injection within the previous 6 weeks, acute infection, gout, malignant diseases and blood coagulation disorders. Each patient was treated with 1,500 - 2,000 shock waves, a 35 mm focus depth, and with an energy flux density of no more than 0.14 mJ/mm² after local or regional anaesthesia. One treatment was performed on 145 shoulders, 17 underwent a second treatment and 4 shoulders underwent a third treatment. The subjects were evaluated by means of a clinical evaluation according to Roles and Maudsley score, subjective outcome on Visual Analogue Scale (VAS), X-rays and ultrasound analysis, 45, 90 and 180 days after the end of the therapy.

The study showed the efficacy and safety of ESWT were excellent in 26.5%, good in 38.6%, acceptable in 13.9%, and poor in 21%, 180 days after ESWT.

Economic Aspects in the Treatment of Tendinosis Calcarea of the Shoulder

Author: J. Eid

Institution: Clinica Ortopedica Brasil Sao Paulo - Capital Brazil

The aim of this presentation is to compare the effective costs of ESWT versus the theoretical costs of arthroscopic surgery and the assessment of the cost benefits of this procedures in a retrospective study. From 1998 until 2005 we have done 420 applications of ESWT in 140 patients with tendinosis calcarea. Each patient received 3 weekly sessions. No one received anesthesia. The device used was a eletromagnetic generator Dornier Epos ultra with 2000 pulses each session. The treatment was done in a private clinic. The parameters used for the theoretical costs of arthroscopy was the average price of 3 private hospitals in the city of Sao Paulo. We used the Medical Procedures Brazilian Classification (4th edition - 2005) for ESWT and surgical honoraries for the medical procedures.

Although 78% of good and excellent results considering improvement of function and pain and also considering that we had no systemic or local complications, for this retrospective study the costs assessment was only about the resorption of the calcification, which occurred in 69% of the patients, and in 31% the calcification did not disappear. The direct costs of arthroscopy for tendinosis calcarea is 6,4 times higher than for shockwave therapy.

The costs benefits of shockwave therapy, is significantly compared to surgical arthroscopy, even if including the unsuccessful results of shockwave therapy. From the medical and economical point of view , ESWT offers an effective, safe, and simple procedure considering the risks of potential complications and the risk of no disintegration of the calcification (10 - 18%) after surgical procedure. The treatment of tendinosis calcarea of the shoulder with ESWT should be considered a routine procedure, on the other hand arthroscopy is an alternative only when no disintegration occurs after ESWT. Although the parameters of this study is the 4th Edition of CBHPM (Medical Procedure Brazilian Classification), the approval of this classification depends of a law's project by the government.

Shoulder Tendinosis and Related Clinical Entities Treated with ESWT. Histopathological and Clinical Correlation

Author: M. Branes, L. Contreras , L. Guiloff , J.A. Branes

Institution: Santiago, Chile.

Shoulder Tendinosis, Shoulder Tendinosis with mid-substance tear and Calcified Shoulder Tendinosis account for a significant number of orthopaedic disorders. All of them share a common and defined histopathologic substrate called “tendinosis”. Based on our experience with Calcified Tendinosis and ESWT, we extended the application for shock waves to other specific clinical conditions.

Between December 2003 and June 2005, 90 patients with shoulder pain and dysfunction for 6 months or longer and without prior shoulder surgical procedures were diagnosed using x-rays and echography, in one of three described categories. Cases of intramural tears were reviewed with an Echographist in order to accept only those patients with intratendineous lesion (65 female, 25 male, mean age = 58 years). They were evaluated using VAS and percentage of dysfunction compared to the normal shoulder. Treatment was applied using an Orthospec (Medispec) device, 4,000 impacts/0.33mJ/mm², in a single session without anaesthesia. Sonographic control at 12 weeks and x-rays and sonography 24 weeks later. In this series, 12 patients complicated with Frozen Shoulder and therefore received a short course of oral corticoids and PT. For histopathologic comparison, samples were collected from 10 patients that underwent surgical repair for the same clinical indications at other treatment centers; five of them received the ESWT schedule immediately prior to surgery.

Seventy percent of the patients rated the procedure a “success” because they were pain free and experienced good shoulder function (with improving images of the tendon including calcium resorption). Twenty percent rated the procedure a “partial success” (8 of them had Frozen Shoulder) and 10% declared it a “failure”. Thirteen patients (14%) opted for surgical resolution because of a lack of subsidence of pain/shoulder dysfunction, being the source for histopathologic studies.

HISTOPATHOLOGIC RESULTS: became evident to light microscopy with usual stains that tendon tissue showed a consistent hypervascularization, characterized by hypertrophic new blood-vessels and new cellularity with fibroconnective repair. This reparative aspect of the tissues was also seen in the edge of intramural tears in tendinopathic areas. In many fields was possible to see areas of normal tendon close to tendinopathic lesion and in between appearing neo-vascularity without distortion or reaction of resident blood vessels. It was also evident that the repair mechanism did not occur through scarring tissue but through deposition of proteinaceous material, according to Toluidine Blue Stain results. During the histopathologic observations there were areas of necrosis or tissue distortion or signs of anaplasia/displasia or scarring. The histopathologic features of neo-vascularization induced by ESWT have always been quite similar in different areas and different tissues either from the same patient or among different patients.

The histopathological research on human tissues that have been treated with ESWT for specific clinical conditions is showing remarkable results, characterized by new vascularity and fibroconnective tissue repair, both conditions supported by well-described human healing capabilities

The Effectiveness of Extracorporeal Shock Wave Therapy on Tendinitis of the Shoulder

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Calcified lesions of the shoulder of the rotator cuff are a common problem in orthopaedic practice. The incidence vary from 2.5% to 20% in patients with asymptomatic shoulders and as much as 54% in patients with shoulder pain. The lesions are mostly located in the supraspinatus tendon close to the insertion area in the critical zone. Patients with calcifying tendinosis were usually treated conservatively (physiotherapy, analgesics, subacromial injection, ...). Uthoff described the circle of the disease which is mostly self-limiting and at least 10% of patients may require open or arthroscopic surgery.

Extracorporeal shock wave therapy (ESWT) in treatment of these calcified lesions was first described by Dahmen in Germany. Two different shock wave therapy techniques were known. The low energy one with a mean energy flux density lower than 0.08 mJ/mm^2 and the high energy one with energy levels of more than 0.28 mJ/mm^2 . Dahmen first used the low energy shock wave and described an analgetic effect. Loew used the high energy level and found a pain relief and also changings of the lesions in most cases.

There is an increasing number of clinical trials showing a success in 60% to 80% of patients. Mostly these trials were uncontrolled prospective designed. A better trial was published by Loew et al. They reported there results and stated the high energy ESWT is effective.

But at least there is no trial with a design in accordance to the ICH/GCP guidelines. Only these trials have the statistical power and evidence to show the efficacy of a treatment method.

Haake et al showed that the application of ESWT must be controlled to verify the position of the ESWT focus. Treatment techniques without control mechanism showed a worse outcome than techniques with an exact fluoroscopic controlled focussing application.

Materials and methods: First we completed a feasibility study to find out the treatment effect size and calculate the sample size. A prospective randomized placebo controlled study in accordance to the ICH and GCP guidelines was designed based on the results of the feasibility trial. We treated 48 patients in low energetic, high energetic and control group each to have the right statistic power.

One treatment group received 2 x 1500 high energetic shock waves with mean energy flux density of 0.32 mJ/mm^2 and the other one got 2 x 6000 low energetic shock waves with mean energy flux density of 0.08 mJ/mm^2 , 48 patients of the blinded placebo group received a sham therapy. We used the same device in all patients so we could exclude device related effects. The device we used called EPOS FLUORO®, manufactured by DORNIER MED TECH®. The primary criteria was the Constant-Murley-Score, second criterias the visuell analogue scale and changings of deposit size in x-ray examination. The ESWT was indicated after failed complete conservative therapies. Between the two application settings we have a time interval of two weeks. In all sessions the patients could get an analgesation if the pain was uncomfortable. An air chambered foil inhibits the transmission of the shock waves from ESWT emitter into the shoulder in the controlgroup.

The clinical and radiological examinations were done by a blinded observer, during the whole trial phase an independent monitor guaranteed that the protocol was followed by the coworkers. The statistic evaluations, data monitoring and auditing were done independently from applicator and blinded observer. The patients were randomized after they have fulfilled the inclusion and exclusion criterias and after they have given a written informed consent to get the ESWT and to take part of the trial.

Comparative analyses were done on an intention-to-treat basis. No prospective cessation rules were defined and no interim analysis was planned. The study protocol was approved of by the ethics committee at

the authors' institution.

Results:

24 weeks after ESWT the patients treated with high and low energetic ESWT have a significant better outcome as the sham group by scoring the Constant-Murley-Score ($p < 0.001$). The second-criteria as the visual analogue scale and the morphological appearance of the deposits changed with high statistical difference ($p < 0.001$). No severe side effects caused by shock waves were observed. In some cases we observed a transient reddening and small cutaneous petechial bleeding but all of them disappeared within 6 weeks when the patients came to the first follow up visit. The comparison between high and low energetic ESWT showed significant better outcome after high energetic ESWT.

Discussion:

The exact mechanisms of the therapeutic effect of extracorporeal shock wave therapy for treatment of calcified lesions of the shoulder are still uncertain. Although some investigations show a direct mechanical effect that leads to a mechanical disintegrating effect on the deposit. Other authors prefer a long-lasting hyperstimulation analgesia. The shock waves initiate an increase of blood flow with increasing oxygen supply of the critical zone. That can induce the further ongoing of the natural selfhealing cycle. In chronic calcified tendinitis of the rotator cuff, the cycle, described by Uthoff rests in the calcific stage. The application of extracorporeal shock waves pushes the cycle further to the postcalcific stage that leads to a complete restitutio. Because of the natural history and the normally self limiting disease of the tendinosis, the shock waves treatment should not be used in acute patients. Most of these patients with an acute tendinitis still move from the calcific stage to the postcalcific stage and should only be treated in a symptomatic analgetic or antiphlogistic way. Compared to other published data regarding calcific tendinitis of the shoulder, no study fulfils the requirements of GCP guidelines to show efficacy.

Conclusion:

The high energetic shock wave therapy is the best evidence based treatment in calcified lesions of the shoulder and must be indicated before operative intervention.

Effectiveness of Transcutaneous Electrical Nerve Stimulation on Relieving Pain During Radial Extracorporeal Shock Wave Therapy, in Tennis Elbow

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Radial extracorporeal shock wave therapy (rESWT) is widely used as an alternative treatment option in chronic tendinopathies. Besides tennis elbow and chronic plantar fasciitis rESWT was effectively used in chronic calcific tendonitis of the shoulder and also in chronic patella syndrome. Good and excellent results were found in clinical trials which also reported no relevant clinical side effects. rESWT is designed as a local anaesthesia-free procedure (Gerdesmeyer, 2004), although for most patients with tennis elbow, rESWT is an uncomfortable and often painful procedure. On the other hand, the influence of local anaesthesia on the clinical outcome of ESWT is in discussion. The results of ESWT on plantar heel spurs without local anaesthesia have been significantly better than with local anaesthesia (Auersperg 2002, Rompe 2004, Labek 2005). These problems have stimulated a search for safe and effective analgesia. Transcutaneous electrical nerve stimulation (TENS) is a widely used and safe analgesic which is effective in both acute and chronic pain. TENS has also been used successfully as an analgesic during painful procedures in children, and there have been no significant side effects (Lander 1993). The use of TENS is effective in decreasing the analgesic requirements during extracorporeal shock wave lithotripsy (Reichelt 1999, Karamaz 2004, Resim 2005). The aim of this prospective, randomised, sham-controlled study was to evaluate the efficacy of TENS on relieving pain during rESWT in tennis elbow.

Between June 2005 and January 2006, a total of 32 patients with tennis elbow (18 men, 14 women) aged 26-61 years (mean 49) were treated. Inclusion criteria: Chronic symptoms (history of at least 6 months) and an unsuccessful conservative treatment. A randomized, sham-controlled study was utilized. The patients were randomly assigned to two groups: Group I (n=16): Conventional TENS. Parameters: Pulse duration: 100 microseconds. Frequency: 80 Hz. Waveform: Biphasic symmetrical square. Intensity: tingling sensation (15-45 mA). Group II (n=16): Placebo ("sham TENS"): Identical and fully functional unit but with non-functioning output leads. The TENS machine used in the study was the Megasonic 313 (Electromedicarin-Spain) TENS and Placebo was administered for the 10 minutes before rESWT, during the procedure, and for 10 minutes afterwards. The rESWT was applied on the lateral epicondyle and the pain center was detected by biofeedback. Electrodes were positioned around the treatment area (bipolar electrode configuration). The patients were informed that they may or may not experience a slight tingling sensation. The rESWT device used was Swiss Dolor Clast (EMS-Switzerland). Parameters: 2,000 shockwaves. Pressure of 2.4 bar (Energy flux density: 0.08 mJ/mm² approx.) and frequency of 8 Hz. The pain intensity perceived during radial extracorporeal shock wave therapy was evaluated using a Standard 100-mm visual analogue scale (VAS). The patients were treated in 3 sessions (at intervals of one week). The evaluation was performed only during the first session. Analyses: The differences between groups were carried out using U of Mann-Whitney test. Some factors that had no effect, such as age and sex were evaluated using multivariate logistic regression analysis. The statistical analysis was carried out without knowledge of the treatments used (TENS or Placebo). There were no statistically significant differences between the two groups. ($P < 0.05$). The median VAS score was 52 (range 20-100) in the TENS group and 60 (range 20-100) in the Placebo group. The patients in the TENS group had lower median VAS scores than patients in the Placebo group, but this difference was not significant ($P = 0.402$). Side effects and complications were not observed.

We conclude that the use of TENS is not effective in decreasing the pain intensity perceived during radial extracorporeal shock wave therapy in tennis elbow. Further studies of significantly larger groups of patients are necessary to underline the results of this investigation.

Shockwave Therapy for Hip Bursitis: Retrospective Study

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The aim of this study was to evaluate the efficacy and safety of extracorporeal shock wave therapy for the treatment of Hip Bursitis in two Brazilian Orthopaedics Clinics. In a multi-center, retrospective study, the effect of shockwave therapy was investigated in 46 cases of 43 patients with Hip Bursitis treated over a 35-month period from June 2002 to May 2005. Three patients received bilateral treatment. There were 36 women and 7 men with an average age of 60 (range, 27-79) years. The criteria for inclusion were at least three months of unsuccessful conservative therapy or six months of pain. Criteria for exclusion were inflammatory arthritis, corticosteroid injection within the previous 6 weeks, neurological abnormality, gout, malignant diseases or blood coagulation disorders. Each patient was treated with 1,200 shock wave impulses, a 35 mm focus depth, and with an energy flux density of no more than 0.14 mJ/mm² after local anaesthesia. One treatment was performed on 42 cases and 4 underwent a second treatment. The subjects were evaluated by means of a clinical evaluation according to Roles and Maudsley score and subjective outcome on Visual Analogue Scale (VAS) analysis 45, 90 and 180 days after the end of the therapy. The study showed the efficacy and safety of ESWT were excellent in 37%, good in 54.4% and poor in 8.6%, 180 days after ESWT.

Shockwave Biosurgery and Autologous Growth Factors Combined Therapy in Severe Patellar Tendinopathies

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Patellar tendinopathies represent a challenge for physicians because the response to treatment is poor, the rehabilitation is long and the leave from competitive sports very frequent. Treatment with ESWT has been reported for patellar tendinosis, but good results are evident only after months of treatment.

We performed a pilot protocol of ESWT and Autologous Growth Factors (AGF) combined therapy for chronic patellar tendinosis. Ten volunteer patients aged between 20 and 44 years with at least one year of proximal patellar tendinosis were recruited. Patients had previous treatments including at least two steroid injections, failed rehabilitation protocols and pain during daily activities. MRI studies reported areas of degenerative tendinosis in the proximal insertion of the tendon. We applied 4,000 shockwaves without anaesthesia using an electro hydraulic generator. We used a progressive pressure of 15-22 mV at 2 shocks/second. Prior to treatment, we extracted 30 cc of blood to obtain AGF that was activated and applied into the tendinous defect after ESWT. Patients started a rehabilitation protocol restraining jumping and running activities for three weeks, allowing walking short distances, and using open kinetic chain exercises.

We found a decrease in pain level and a faster return to athletic activity. Recurrence of pain was lower than with conventional ESWT. The pain relief pattern became occasional and episodic. Good or excellent results were reported by 79% of patients. Combined ESWT & AGF bio surgery could be an excellent alternative treatment for large defects or degenerative areas of large tendons. Further studies must be done to recommend this protocol.

Treatment of Jumper's Knee with Extracorporeal Shock Wave Therapy

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Jumper's knee affects mostly individuals who play sports particularly jumping athletes. In this study we have included 73 sports patients, 54 male and 19 female, age range between 15 and 69 (mean age: 32). Since 10 patients were affected by bilateral tendinopathy, a total of 83 tendons were treated.

All patients underwent clinical and instrumental diagnosis in order to recognize the presence, the location and the seriousness of the specific tendinopathy associated or not with calcific areas of metaplasia in the tendon to be diagnosed. The pain symptomatology was classified using VAS and according to a 5 stage clinical evaluation range. The treatment was performed using 2 different devices, produced by STORZ, both equipped with electromagnetic generators with cylindrical coil and providing ultrasonography capability. The protocol, identical for both generators, called for an average of 4 sessions (min. 3 - max. 5), administered in 2 to 7-day time intervals with 1,500-2,500 shocks applied with an EDF between 0.08 and 0.44 mJ/mm². The evaluation of the post-treatment results was assessed on the basis of the average VAS score and on the subjective clinical evaluation range. In conclusion, we obtained satisfactory results in 73.5% of cases (Excellent in 54.2% and Good in 19.3%). The successful treatment in performing athletes (16 tendons) was satisfactory in 87.5% with an average time of resuming sport at approximately 6 weeks.

In our opinion, shock waves are a valid conservative therapy for the treatment of jumper's knee, in accordance with what is found in literature.

Post Traumatic Reduction of the Range of Motion and Impairment of the Athletic Gesture - Therapeutic Potential of Shock Waves

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Occasional traumas, often occurring outside sports activity, may lead to a reduction of the muscle extension. After a traumatic event, residual muscular-tendinous pain and significant difficulty in performing the typical movements of a given sports activity is often reported by patients, both when training and when playing sport professionally. The evolution signs of post-traumatic stiffness appear at a very early stage, after a few weeks. The traditional therapeutic approach uses different physical therapies, ranging from mesotherapy to manual debridement. Shock waves may represent an interesting therapeutic opportunity to restore the physiological conditions of the muscle-tendon extensibility.

Materials:

Over the past few years I have been able to evaluate various post-traumatic cases (12) concerning athletes affected by reduced articular mobility (between 40 and 180 days after trauma) showing a subjective significant impairment in performing sports activity. The subjects had suffered from direct contusive traumas or stab wounds mainly affecting the thigh (7 quadriceps, 2 abductors, 1 bicep of thigh, 1 bicep of arm, 1 sural triceps). In some cases they had also been immobilized due to concurrent bone lesions. All subjects had already undergone physical and rehabilitation therapies without reporting satisfactory results. **Methods:** The treatment modality was ESWT (with an OSSATRON OSA 140 device from HMT) performed in different sessions (from 2 to 4), at intervals of at least 3 weeks apart. Neither local nor general anesthesia was used. During each treatment an average of 1,350 shock waves were administered with an average intensity of approx. 16 kV. The therapy was coupled with a rehabilitation treatment performed both by a rehabilitation therapist and by the patient himself. The patient's examination included a clinical evaluation (with the following score: 0-null, 1-fairly good, 2-good, 3-very good), ROM deficit measuring, a VAS test (from 0 to 10) and Fisher algometer (from 1 to 6). Follow-up was made every month until resumption of sports activity.

Results:

The first signs of clinical recovery were reported only 48 hours after the first shock wave treatment, becoming more and more evident within the first 14 days. Additional significant improvement was reported after each subsequent treatment. At least two therapy sessions were conducted to recover complete functionality. The clinical result was positive for all patients 1 month after the final shockwave treatment. At the end of the observation period the result proved to be very good in 9 cases (4 subjects were even able to resume the same professional level of play they had experienced before trauma only three months after end of therapy), good in 2 cases, and fairly good in 1 case. The radiological evidence proved peculiar since the x-ray did not show any significant variation during the first 6 months after ending therapy, despite a satisfying clinical recovery. Only the examination 12 months after cessation of therapy showed a reduction of calcific deposits.

Conclusions:

ESWT coupled with appropriate rehabilitation represents an efficient method to treat post-traumatic results with reduced muscle-tendon extensibility. The therapy proves to be effective when performed at an early stage and shows a clinical as well as a functional recovery that differ from the radiological evidence, which at present cannot be easily interpreted.

ESWT in La Peyronie's Disease : Experience of Therapy with Equipment with US Guide in Line

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ESWT therapy in La Peyronie's Disease in recent years has shown good results with its effects on cavernous bodies and against the fibrosis of the albuginea of cavernous bodies. In this study ESWT has been applied by protocols similar to those applied in orthopaedic diseases (one application weekly for 4 weeks). In this study the patients after the 2nd session of therapy reported an improvement in their symptoms. From January to May 2005, 22 patients with Induratio Penis Plastica (IPP) were treated with ESWT. The age of the patients was between 48 and 75 years (average age 62.2). The lesions of the induratio were single plates (72%), some of them with calcification (9 of 22). The treatments were performed on flaccid penis with a piezoelectric device (WOLF PIEZOSON 300) with Ultrasound (US) imaging-guide in line. We performed our treatments weekly in 4-5 sessions of therapy.

Seventeen of 22 of the patients who were included in this study (77.2%) showed a decrease of the curvature of the penis, and 3 patients who had reported pain, reported the disappearance of this pain after 2 sessions of therapy. The plates that showed the largest improvement were those with calcification and those located on the middle of penis.

The importance of therapy with US guide is demonstrated by the results: the plates with calcifications showed the largest improvement because of their easier localization, moreover they are the most important lesions because they cause the highest degree of curvature. In the plates without calcifications, ESWT with US guide quickly resulted in a decrease in pain. This therapy showed its effectiveness by reducing the most important lesion of the disease which is the curvature of the penis.

Shock Waves After Severe Hand Traumas: Description of a “Trophic Effect” on Bone and Soft Tissue

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Bone healing disorders can be a serious problem after severe traumas of the hand, as bone fractures are often associated with wide soft tissue injuries. The authors will report their experience using Extracorporeal Shock Waves (ESW) in “hand surgery” and discuss the principles of their application in this field, also suggesting a new effect in severe soft tissue atrophy. From April 2002 to date, 40 patients suffering from a bone healing disorder of the hand were subjected to high-energy ESW (1 - 2 cycles of 3 treatments, 0.25 - 0.40 mJ/mm²), under local anaesthesia.

The highest success rate (> 90%) was recorded for phalanxes and metacarpals, while the lowest was reported for scaphoids (50 - 60%). As a collateral (but non-negligible) observation, all patients who had severe sequences from soft tissue loss, objectively showed a recovery of soft tissue atrophy. Subjectively, they described their fingers as, “softer, more sensitive, less painful”.

From the critical analysis of their clinical experience, the Authors will discuss some conclusions: 1) ESW are a valid tool for bone healing disorders, not only of scaphoid but also of the whole skeleton of the hand, but only in presence of mechanical stability (phalanxes need to be surgically stabilized before treatment); 2) Even if not justified to treat acute traumas, early ESW (when supported by biological and clinical suspicion of delay) can change the manner of healing; 3) ESW seem to have an important “trophic effect” also on soft tissue, even with skin integrity, thus confirming a strong angiogenetic action.

Shockwave Therapy for Peyronie's Disease - Comparison of Outcomes for Acute (Inflammatory) Versus the Stable Disease States

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29 patients with Peyronie's disease underwent SWT with the Epos Ultra Shockwave Lithotripter (Dornier). The degree of penile angulation was determined by photography, plaque size was estimated by ultrasound measurement, visual analogue scale (VAS) was used to assess pain; International Index of Erectile Function (IIEF) was used to measure erectile dysfunction. Patients were assessed prior to and after treatment. Patients were treated with a single shock wave therapy session with 6000 shocks at power level 9 (0.57mJ/mm²). Follow-up was from 4 to 14 months.

26 patients completed follow-up. Of the 17 patients treated in the Acute (Inflammatory) phase, 71% had a decrease of greater than 34° in the curvature, and 47% reported a subjective decrease in plaque size. 68.75% of the 13 patients with painful erections had immediate relief of pain after treatment. Of the 12 patients with stable painless disease, 33% were found to have a decrease in curvature with treatment. 65% of the patients with chronic disease also had significant erectile dysfunction and 64% scored higher on the IIEF after treatment. Erythema and or mild initial haematuria was found in 31% of patients.

Peyronie's disease is an evolving inflammatory process whose response to shockwave therapy depends greatly on the evolutionary stage of the disease.

ESWT: a Tool Against Neurogenic Inflammation in “Pillar Pain” Disease

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“Pillar pain” is a painful syndrome, probably due to neurogenic inflammation, locally complicating 20% of carpal tunnel releases. The aim of this study was to confirm our previous preliminary results about the effectiveness of Extracorporeal Shock Waves (ESW) in this disease, and to postulate further explanations about the mechanism of action.

Forty patients suffering from subcutaneous painful swelling in the interthenar area, scar redness, thenar and/or hypothenar discomfort, 2 to 3 months after surgery, were subjected to ESW (3 weekly treatments, 0.03 mJ/mm², 2,500 - 3,000 shocks/session), under “in- line” ultrasound examination. Some of them, before and after treatment, were subjected to wrist NMR or ultrasound and Doppler examination.

The results confirmed our previous observations about the effectiveness of ESW in rapid relief of pillar pain. More than 90% of the patients reported complete recovery within approximately 1 month; many of them had significant improvement after the first treatment; usually, pain relief followed swelling and scar redness resolution. Moreover, there was a strict correlation between pathological NMR and ultrasound findings and clinical data. No side effects were observed during or after ESW treatment.

Pillar pain is a self-relieving condition, but it takes a relatively long time for pain resolution. ESW proved to be a valid tool, with a strong positive effect in rapidly resolving pain, swelling and scar redness. The authors, on the basis of these results and some theoretical and experimental data from the literature, will discuss the pathophysiological basis of ESW efficacy in neurogenic inflammation, thus providing new perspectives in this field.

Localized Calcifications in a Patient with Limited Scleroderma, Treated with ESWT - Case Report

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The aim of this case report was to evaluate the efficacy of the ESWT to reduce pain and the size of cutaneous calcifications in a patient with Limited Scleroderma (LS). Scleroderma is a heterogeneous disease (Diffuse, limited and localized) characterized by overproduction of collagen and extracellular matrix, damage of small vessels endothelium with tissue ischemia, and activation of immune system.

The Limited variant of scleroderma (previously defined C.R.E.S.T) is often characterized by subcutaneous calcium hydroxapatite deposits mainly distributed in the digital pads and periarticular tissues. The presence of calcinosis causes digital ulcers and severe pain. At the moment no definitive effective treatments are available for this complication. With this background we begin to treat these patients with ESWT with the purpose to reduce pain and, possibly the size of calcifications. Due to the peripheral localization of the calcifications no major adverse effect are expected by the ESWT treatment. An X-ray of hands was performed to localize the presence and dimension of cutaneous calcinosis. We identified 2 areas of treatment: one on right thumb and one on the third left finger. The protocol consisted in six applications (one a week) with the lowest level of energy using a Wolf Piezoson 3000.

End points were to evaluate pain reduction (VAS scale) and the size of calcifications (on control X-ray).

Reduction of pain on thumb (VAS): from 6 to 0 at the third treatment.

Reduction of pain on third left finger (VAS): from 8 to 4 at the sixth treatment.

Reduction of size of calcification: no significative reduction of size was observed.

ESWT seems to be a safe and useful treatment for reduction of pain due to subcutaneous calcifications in LS patients. At the moment no reduction of size of the calcification was observed. Larger number of patients are required to confirm the result of this case report.

Extracorporeal Shockwave Therapy for Chronic Skin Lesions: Cases Reports

Author: P. Santos, A. Souza, P. Rockett, M. Guedes

Institution: Paulo Santos-Orthomaster - Sao Paulo Marco Guedes - Centro Marion Weiss-Sao Paulo Ana Souza-Cortrel - Rio de Janeiro Paulo Rockett-Porto Alegre - Brazil

The aim of this study was to evaluate the efficacy and safety of extra corporeal shock wave therapy for the treatment of chronic skin lesions.

The study consisted of patients with ulcer cruris or ulcers at their extremities as well as chronic open wounds, septic or aseptic. To be included in the study, patients must have had the disease for a minimum of 3 months and it should be categorized as chronic disease; and to have failed conservative therapy for at least 3 months. Patients aged 18 and older were included in the study.

Exclusion criteria :

Malignant mutations in the therapy area;
Anatomic anomalies in the therapy area;
Acute inflammation in the therapy area;
Treatments at the head or neck;
Coagulopathies;
Pregnancy;
and children.

Since October 2005, we have treated 12 patients with different etiologies (diabetes type I and II and venous ulcer) using a Reflectron device (HMT) with a special therapy head. The patients were separated into 2 groups:

Group 1 - one application / week

Group 2 - one application every 2 weeks

The energy flux density was 0.03 mJ/mm^2 to 0.06 mJ/mm^2 . The treatment was performed without anaesthesia.

The study showed promising results with complete or partial healing in most of the patients . Prospective randomized trials have to be performed in order to prove safety, efficacy and stability of the results of shockwave therapy to treat chronic skin lesions.