

ISMST
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Treatment



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ABSTRACTS

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LBI Trauma



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Modulation of Early Inflammatory Response Prevents from Calcification in an Aortic Valve Xenograft Model

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Device and producing company: Orthogold device with applicator CG050-P (TRT)

Introduction:

Xenografts are used in clinical routine for heart valve replacement. However, chronic inflammatory processes lead to calcification of the grafts thereby limiting durability. We hypothesized that the modulation of the early inflammatory response may reduce the calcification process.

Methods:

Pieces of ascending aorta were harvested from pigs. Half of them were decellularized using sodium-deoxycholate and sodium-dodecyl-sulfate. Native and decellularized pieces were subcutaneously implanted into 10-12 weeks old C57/Bl6 mice (n=6 per group). Mice were randomly subdivided to a treatment and control group. The treatment group received shock wave treatment (250 impulses at 0,1mJ/mm², 5Hz) for inflammatory modulation directly after implantation. Aortic pieces were harvested 4 weeks later.

Results:

Cell invasion was determined in immunohistochemical stainings showing significantly more cells in the treatment group (24.74±4.12) vs. control (15.65±1.7, p=0.002). Gene expression of cytokine TGF-beta was increased in native and decellularized treated pieces (native: 17.32±2.94; decell 12.77±1.44) compared to untreated controls (native: 10.48±1.3, p=0.04; decell: 14.99±1.81, p=0.19). The same effect could be observed for TNF-alpha gene expression (native: 1.86±0.54; decell 1.37±0.38) vs. controls (native: 0.23±0.02, p=0.01; decell: 0.52±0.03, p=0.03). This led to significantly less calcification per area in the treatment groups (native: 1.71±0.64; decell: 5.08±1.86) vs. controls (native: 55.69±12.59, p=0.003; decell 10.99±1.16, p=0.026) as shown by von Kossa staining.

Discussion:

Control of early inflammation after xenograft heart valve implantation decreases calcification in native as well as decellularized aortic pieces.

Conclusion:

Treatment modalities that modulate inflammation via cytokines TGF-beta and TNF-alpha may develop an important adjunct to biological heart valve replacement.

P2

Extracorporeal Shockwave Therapy Modulates Post-Surgical Inflammation and Prevents Postoperative Ileus in Mouse Animal Model

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Device and producing company: DermaGold™, Tissue Regeneration Technologies, LLC, Woodstock, GA USA

Introduction:

Ileus is common outcome related to postsurgical trauma, which is caused by the induction of muscularis inflammatory responses. Our goal was to investigate the therapeutic potential of ESWT pre-conditioning to prevent postoperative ileus (POI).

Methods:

A standardized POI mouse model utilizing non-traumatic gut manipulation (SM24) in combination with 24h ESWT abdominal preconditioning (600 defocused impulses, 0.03mJ/mm², 4Hz) (ESWT24+SM24) was used and compared to controls, and shock alone at specified time points (ESWT-Immediate, 3h, 24h and 48h groups). MSD electrochemiluminescence platform was used to measure serum cytokines and chemokines. qRT-PCR quantified the induction of genes within the jejunal muscularis. An organ bath technique was used to evaluate jejunal circular muscle contractility and myeloperoxidase (MPO+) staining for phagocyte infiltration. Statistical analysis was performed using Krushcal-Wallis and ANOVA.

Results:

ESWT did not cause any abdominal microscopic structural damage or alter gastrointestinal transit in uninjured animals. ESWT prevented the post-operative delay in gastrointestinal transit, maintained circular muscle contractility and reduced MPO+ phagocyte recruitment into the manipulated muscularis. ESWT also suppressed the induction of inflammatory mediators in the serum [INF- γ , IL-1 β , IL-6, IL-10, IL-12 p70 and TNF- α and increase in KC/CXCL1 ($p < 0.05$)], as well as increase in gene expressions of EGR-1 (5 vs. 4 fold), IL-6 (42 vs. 33 fold), IL-10 [15 vs. 7 fold ($p < 0.05$)] and CCL2 (446 vs. 394 fold) in ESWT24+SM24 group vs. SM24 group.

Discussion:

ESWT preconditioning significantly modulates postoperative molecular and cellular inflammatory responses, which ameliorates the suppression in postoperative transit and jejunal muscle function.

Conclusion:

Further evaluation through pre-clinical and clinical research is needed.

P3

Extracellular ATP Enhances Proliferation after *in Vitro* Shockwave Treatment by ERK Dependent Pathways

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Device and producing company: Dermagold100, MTS

Introduction:

Shockwave treatment, a mode of mechanical stress, accelerates wound healing *in vivo*. Yet the mechanisms underlying the beneficial effect of shockwave treatment still remain largely unknown. In this study, we investigated whether shockwave induced ATP release is essential for the proliferative effect of shockwave treatment and if the ERK1/2 signaling pathway is involved in this phenomenon.

Methods:

In our *in vitro* model C3H10T1/2 mouse mesenchymal stem cells were subjected to shockwave treatment and ATP release was assessed. Cell cycle phase distribution after application of shockwaves was evaluated by propidium iodide staining followed by flow cytometry. Proliferating cells were also quantified using a BrdU incorporation assay. Western blot analysis was performed to assess the activation of ERK1/2. Apyrase and suramin were used to evaluate the roles of ATP release and P2 purinergic receptors in the effect of shockwave treatment on proliferation.

Results:

Shockwave treatment released ATP in C3H10T1/2 cells dependent on applied energy and pulse number. Shockwave treatment significantly increased the amount of cells in S-phase in an energy dependent manner. Hydrolysis of released ATP with apyrase completely diminished the proliferative effect of shockwave treatment. Shockwaves induced significant pERK1/2 activation. Pretreatment of cells with the P2 receptor antagonist suramin as well as depletion of ATP prevented this activation.

Discussion:

We conclude that *in vitro* shockwave treatment releases cellular ATP that activates downstream signaling such as ERK1/2 via purinergic receptors, ultimately causing the proliferative effects of shockwave treatment.

Conclusion:

This signaling cascade could be one of the underlying principles of the beneficial effects of shockwave treatment in wound healing.

P4

In Vitro Shockwave Treatment Influences Lymphatic Endothelial Cell Marker Expression and Proliferation

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Device and producing company: MTS Dermagold 100

Introduction:

Shockwave treatment (SWT) holds promise in treating orthopaedic diseases and chronic wounds. Additionally, it has been shown to increase blood and lymphatic vessel densities. In this study we analyzed the effects of shock waves in lymphatic endothelial cells (LECs) in an in vitro setup.

Methods:

LECs were stimulated using an in vitro experimental set-up with an unfocused shockwave device (dermagold100, MTS, Germany). Twenty four hours later, the cells were subjected to flow cytometry for endothelial marker expression. Moreover, 2D as well as 3D migration assays were employed. To analyze the effects of different extracellular matrices, cells were cultured either on fibronectin, collagen or uncoated surfaces.

Results:

LECs reacted with varying proliferation rates when stimulated with different energies. In 2D- and 3D-migration assays LECs did not behave differently upon SWT treatment. The endothelial markers CD31, VE-Cadherin, VEGFR-2 as well as the LEC marker VEGFR-3 expression were not altered after SWT. However, we found an energy-dependent increase in expression of podoplanin, another marker for LECs. In addition, the extracellular matrix was shown to influence podoplanin expression and inducibility upon SWT.

Discussion:

Regeneration of lymphatic vessels is of crucial interest for tissue engineering purposes or for lymphedema patients. SWT has been shown to stimulate the growth of new blood as well as lymphatic vessels. Our results add new insights into SWT-induced changes of LEC behavior and reveal podoplanin as one of the target molecules of SWT.

Conclusion:

Shockwave treatment influences the proliferation of isolated lymphatic endothelial cells and up-regulates podoplanin in these cells.

P5

Adipose derived Stem Cells: In Vitro Treatment with Extracorporeal Shockwaves Enhances Stemness and Preserves Multipotency

Christina M.A.P. Schuh, Andreas H. Teuschl, Anna M. Weihs, Philipp Heher, Rainer Mittermayr, Heinz Redl, Dominik Rünzler

Device and producing company: Dermagold 100, MTS

Introduction:

Adipose derived progenitor/stem cells (ASCs) are a promising tool for tissue engineering, addressing the problem of tissue and organ shortage. Limiting factors for the use of ASCs are donor variation and senescence, loss of differentiation capacity as a consequence to loss of multipotency. Extracorporeal shockwave treatment (ESWT) has been shown to have beneficial effects on regeneration of a variety of tissues in vivo.

Methods:

Human and rat ASCs were treated in vitro with ESWT and evaluated concerning viability with MTT and BrdU assay, concerning stemness with flow cytometry (CD73, CD90, CD105) and concerning multipotency with differentiation into osteogenic lineage (von Kossa staining, PCR), adipogenic lineage (Oilred O staining) and Schwann like cells (flow cytometry: P75, S100b, P0).

Results:

Human and rat ASCs respond strongly to repetitive shockwave treatment in vitro, resulting in maintenance and significant elevation of mesenchymal markers, while cell viability and proliferation remain at a comparable level to control group. Another effect observed was a significant increase in differentiation capacity into osteogenic and adipogenic lineage as well as into Schwann like cells in high passages.

Discussion:

Our results indicate that with ESWT multipotency of ASCs can be preserved in high passages after extensive expansion. Hence, ESWT might be a promising tool to improve ASCs for cell therapy in tissue engineering and regenerative medicine.

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Reactive Oxygen Species and ERK Phosphorylation Mediate Osteoblast Differentiation of Human Adipose Derived Stem Cells (hASC) Induced by Extracorporeal Shock Waves

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Device and producing company: Piezoson 100 (Richard Wolf, Germany)

Introduction:

Human adipose derived stem cells (hASC) are a promising candidate cell type for regenerative medicine and tissue engineering applications due to their capacity of self-renewal and multipotent differentiation. Extracorporeal Shock Waves (ESW) are transient short-term acoustic pulses with high peak pressure. ESW enhancing of both bone and tendon regeneration suggests that they may induce some signals for growth and maturation of mesenchymal progenitors. Aim of the present study was to evaluate the effects and mechanism of action of ESW on the differentiation of hASC towards osteoblasts.

Methods:

hASC cells were obtained from adipose tissue of donors undergoing lipoaspiration. After combined treatment with osteogenic medium and ESW (0.32mJ/mm², 1000 shots) we determined: cell viability by trypan blue exclusion; cell proliferation by WST-1 colorimetric assay; alkaline phosphatase (ALP), Runx2, and BMP2 by RT-real time PCR; Reactive Oxygen Species (ROS) production by DCF-DA dye; ERK1/2 phosphorylation by Western Blotting; ALP activity by enzymatic assay; calcium deposit formation by Alizarin Red staining.

Results:

Treatment combining ESW and osteogenic medium determined a higher expression of osteogenic genes, ALP activity and calcium deposit formation. ESW induced ROS formation and activated MAPK pathway.

Discussion:

Data presented here indicated that ESW acted through ROS formation and ERK phosphorylation and, in combination with osteogenic medium, determined a complete differentiation of hASC towards osteoblasts.

Conclusion:

This study defines the molecular pathway activated by ESW treatment and involved in the osteogenic differentiation of hASC. ESW treatment, in combination with osteogenic medium, can be proposed as a new tool to accelerate stem cell differentiation towards osteoblasts.

P7

Piezoelectric Shockwave Therapy for the Treatment of Calcifying Tendinopathy of the Shoulder

Paulo Roberto Rockett

Institution: Ortosom, Brazil

Device and Producing Company: Piezoson 100 plus

Introduction:

The aim of this study is to evaluate the efficiency of piezoelectric shockwave therapy on the course of a Calcifying Tendinopathy of the Shoulder.

Methods:

Fifty eight patients (65 shoulders) were enrolled in this retrospective study, ages ranging from 32 to 87 years (an average age of 55 years). The treatment was delivered with a piezoelectric SWT generator. The protocol consisted of at least three and a maximum of nine sessions at weekly intervals. In each session 2500 impulses were delivered at a 0, 22 and 0, 32 mJ/mm² energy flux density. The symptoms were classified using the analog visual scale and the clinical evaluation according to the Roles and Maudsley score at 45, 90 and 180 days after the end of the treatment.

Results:

One hundred and eighty days after the treatment, the results were evaluated as excellent in 32,3%; good in 33,9%, acceptable in 15,4% and poor in 18,4% of the patients. Side effects were rare and associated with pain during, or some days after, the applications, but no cases of worsening of previously reported complaints have been observed during follow-up.

Discussion:

The results have been evaluated in a consecutive series of patients who did not achieve satisfactory results after conservative treatment for three months, or with complaints for more than six months. Procedures were performed in the doctor's office without anesthesia.

Conclusion:

Shockwave therapy should be considered as an optional treatment for Calcifying Tendinitis of the Shoulder in cases when the conservative treatment failed. It is a safe alternative, non-invasive, without significant complications, thus reducing risks and costs of a surgical procedure.

P8

High Energy Extracorporeal Shockwave Therapy versus Radial Shockwave Therapy in Lumbar Facet Joint Pain – Searching for Optimal Treatment Protocol

Tomas Nedelka (1), Jiri Nedelka (2), Jakub Schlenker

Institution: (1) Charles University Prague, (2) Center for Rehabilitation and Pain Treatment, Prague, (3) Czech Technical University, Kladno, Czech Republic

Device and producing company: Storz DUOLITH ESWT; BTL SWT5000 rSWT

Introduction:

The facet joints are common sources of chronic low back pain with high prevalence in mid-age population. According to literature, more than 30 percent of patients with chronic non-radicular low back pain suffer from facet syndrome, which is characterized by localized axial pain, elicited by hyperextension in lumbar area, with referred pain to the buttocks and posterior thigh. Therapeutic approaches include pharmacological treatment such as 3rd generation anticonvulsant pregabalin and NSAID or opioids. Semi-invasive approaches to facet joints include diagnostic medial branch blocks, corticosteroids or radiofrequency treatment. In our previous pilot study, we have proved efficacy of radial shockwave therapy in treatment of lumbar facet joint pain, with results better than ultrasound guided corticosteroid injections and practically equal to radiofrequency treatment with favorable treatment effect duration. The aim of this study was to find optimal shockwave therapy procedure and to compare high-energy focused extracorporeal shockwave therapy (ESWT) against rSWT.

Methods:

A prospective study comparing effectiveness of high energy ESWT and rSWT was done in 64 patients fulfilling diagnostic criteria for chronic lumbar facet syndrome and responding to medial branch anesthetic nerve blocks. In all 64 patients (33 women, 31 men), we have provided MRI examination of lumbar spine, those with lumbar stenosis and moderate to severe degeneration lumbar disc disease were not included in our study. In 28 of patients, ^{99m}Tc bone scintigraphy was performed, all the results were positive with appropriate radionuclide accumulation within the facet joints. ESWT was performed in 32 patients (Group A) in 5 weekly sessions. Energy flux density was set to 0.35 mJ/mm², 1000 shocks per session were applied under US guidance, covering 2 segments. rSWT group (Group B) involved 30 patients in 5 weekly sessions and energy flux density was set to 0.12 mJ/mm² (compressor pressure of 3.8 bar), with 3000 shocks per session in 2 segments.

Results:

The data from 62 patients were collected and statistically evaluated, using paired t-test and ANOVA. Pre-treatment average visual analogue scale (VAS) was 5.2 cm in group A and 5.0 cm in group B. Severity of low back pain was measured using the Oswestry low back pain validated score with no changes between groups. Follow-up was set to 2 and 6 months. At 2 months follow up, we registered significant decrease in average VAS against the baseline value in both ESWT and rSWT groups (p=0.01 in group A, p=0.03 in group B). After 6 months, ESWT (group A, p=0.02) and rSWT (group B, p=0.04) shown significant changes in average VAS against the baseline. Mean VAS decrease (in p=50%) was higher in ESWT group (2.9 mm) than in rSWT group (2.0 mm) in 6 months follow-up. In patients with BMI>30 (6 patients in Group A, 5 in Group B, respectively), has shown significant VAS decrease in ESWT group only after 2 and 6

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months.

Discussion:

In our previous study (Nedelka et al., 2012), we have found that rSWT could be the considerable therapeutic option with similar or higher efficacy, compared to ultrasound guided steroid injection. Advantages of rSWT were safety, absence of damage to facet joints and absence of local side effects – inflammatory reaction or medial branch denervations. Important pitfall of rSWT was depth of application, which restricted the usage of radial SWT to patients with BMI lower than 28. Energy administration in focused ESWT seems to be more suitable for use in facet joints. According to our recent results, ESWT confirmed increased efficacy in comparison to radial procedure almost with no limitations.

Conclusion:

Both ESWT and rSWT were effective in treatment of chronic lumbar facet joint pain. However, ESWT has shown its added value in superior pain relief with equal tolerability compared to rSWT. We have proved efficacy of ESWT also in obese patients, where rSWT usually fails due to insufficient depth of penetration.

P9

First High Definition 3 Tesla MRI-Imaging Pictures Before and After Piezoelectric Focused ESWT with Low Energy Level of a Myofascial Trigger Point

Hannes Müller-Ehrenberg (1), Birgit Ertl-Wagner (2), (3) Florian Heinen

Institution: (1) Orthopaedic Private Office, Münster; (2) Ludwig Maximilians University, Munich; (3) Dr. von Hauner'schen Children's Hospital, Munich; Germany

Device and producing company: Piezowave (Richard Wolf, Germany)

Introduction:

Myofascial Trigger Points (MTrP) are considered to be an important reason for musculo-skeletal pain. Focused ESWT have shown to be a good method to treat MTrP successfully. The exact mechanisms are yet unclear.

Methods:

A MTrP in a patient suffering from neck pain and headache has been identified by clinical examination and 3 Tesla MRI scan in the trapezius muscle. After identification a direct focused ESWT with low energy level has been applied on the MTrP. About 40 min after ESWT 3 Tesla MRI scan has been repeated.

Results:

On the second MRI-Scan significant changes of the MTrP have been shown.

Discussion:

With low energy levels of focused ESWT no kind of tissue damage has ever been reported. The changes that have been found seem to be the result of activation of specific ESWT induced biological activity.

Conclusion:

The imaging pictures of 3 Tesla MRI can show MTrP and effects of piezoelectric focused ESWT on MTrP.

P10

The effects of Shockwave Application Frequency on Pain in Normal Subjects

Carlos Leal, Diana Lemus, Maria Camila Gallo

Institution: Fenway Medical, Bogota, Colombia

Device and producing company: BTL5000 POWER

Introduction:

For over ten years we have applied Radial SWT for chronic tendinopathies. We have found subjectively that using a progressive protocol starting with high number of repetitions per second and low energy, the patient feels less pain. This way, and using a two session treatment, we have been able to avoid the use of anesthetics, get the results we desire and match the data published in the literature. However, there are no reports of these findings, probably because pain control is a very difficult issue to analyze, and there is a great variability in evaluating this particular emotional sensation. We designed a simple case control study in normal subjects to determine the differences in pain generated by the application of Radial Pressure Waves on their hands, comparing a progressive protocol with a continuous protocol.

Methods:

We performed a case control study on 104 volunteer subjects with no medical records. They were divided in two groups of 52. They all signed an informed consent. We chose the hypothenar region of the right hand, because it is easily available, and a well-innervated area, with submuscular bone and no major nerves or vessels in the nearby region. In all cases we used a Radial SWT generator (BTL 5000 Power – BTL Industries Czech Rep). All subjects were tested and evaluated by the ISMST & ONLAT Certified authors. In the Cases Group we applied a progressive protocol using 200 shocks on 15 Hz, 200 shocks on 10 Hz and 200 shocks on 5 Hz. In the Control Group we used a constant of 600 shocks on 10 Hz. The Pressure was constant in both groups, using 2.0 BAR. In order to determine any differences between subjects, both Cases and Control Groups volunteers were asked to try the opposite protocol on the opposite hand. We also recorded these data, as we wanted to determine if there were any differences within the subjects and avoid or find any placebo effect. We used numerical Visual Analogue Scale n/10, blinded for the patient. All data was recorded and analyzed using a One-Way ANOVA, and the P value was based in <0.01. We also analyzed intergroup differences, gender and age, and a Normalized analysis of differences at the beginning and end of the trials. We had 76 males and 28 females with an average age of 31.5 y/o (17-46 y/o). All adverse effects were recorded.

Results:

The progressive protocol group experienced 29% less pain as compared with the continuous protocol group at the beginning of the test, with a VAS of 7,9 and 5,1 respectively. At the end of the test the differences were of 57% with VAS scores of 7,25 and 1,54 respectively. There was an average of in 43% in total pain reduction (P<0.01). The normalized analysis comparing the differences in VAS scores at the beginning and end of each test on each group also showed a pain reduction of 34,6% in the progressive group as compared with a 7,2% in the continuous group, with a statistically significant difference of 27.4%. There were no significant differences in the data collected from the contralateral hands as compared with the primary tested hands. There were no differences in gender or age related data. There were no adverse effects in any

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subject.

Discussion:

The use of high repetitions with low energy seemed to favor pain control in normal subjects, as compared with a continuous protocol with the same energy and number of shockwaves delivered. The progression from high repetitions to low repetitions showed the best pain control in our series. Even though these results match our subjective clinical findings in tendinopathy patients, it calls our attention the lower progressive pain control in the continuous protocols. We have the feeling that there is also a good pain reduction in continuous protocols in our patients. We did not find a placebo effect in our study, and the results in primary or secondary tested hands were similar. We did not find any adverse effects. There was a clear and obvious apprehension in our subjects, being this pain study. All patients revealed they felt a discomfort sensation more than pain, but evaluated this sensation in very high VAS numbers. Our main limitation is having the tests done in normal subjects and not in tendinopathy patients. However, this solid data does show an effect with people that have the same pain baseline: none, something very difficult to standardize in symptomatic patients.

Conclusion:

Based on these results, we do recommend a progressive shockwave protocol in the treatment of tendinopathies, delivering a minimum dose of therapeutic impulses preceded by a progressive number of analgesic shockwaves. Further studies in clinical cases must be performed to determine these doses.

P11

Extracorporeal Radial Shockwave Therapy for the Treatment of Achilles Tendinopathies

Edson Antonio Serrano

Institution: NEOMEDICA, Lima, Peru

Device and producing company: BTL 5000, BTL 6000

Introduction:

Extracorporeal shockwave therapy has been shown to be effective in the treatment of chronic tendon pathology in the elbow, shoulder, Achilles tendinopathy and plantar fascia. This prospective study shows the efficacy of extracorporeal radial shockwave therapy in the treatment insertional and not insertional Achilles tendinopathy.

Methods:

We performed a prospective intervention study, with thirty-two patients with Achilles tendinopathy were enrolled; 26 not insertional and 8 insertional. for treatment this group received three to five applications (every week) of 6000 impulses of radial shock waves with progressive protocol, this protocol has 2000 shockwaves neurostimulation, 2000 shockwave treatment and 2000 of neurostimulation at the end of the session. Follow-up examinations were performed at a month, then every month up to 6 months using visual analog scale (VAS) of pain (0 to 10) in morning and activity pain.

Results:

Twenty four patients (75%) were very satisfied, 6 (18.76%) were satisfied, 1 (3.1%) were improved the condition, and 1 (3.1%) said it did not affect the preview condition. Ninety-three percent of patients said they would choose as first choice treatment of radial shock waves. After 6 months of follow-up the mean of VAS for morning pain decreased from 7.2 to 2.1 and activity pain decreased from 8.3 to 3.

Discussion:

This is a preliminary study demonstrates the effectiveness of radial shock waves not only in insertional tendinopathy, also no insertional tendinopathy with intra tendinous calcifications, using progressive protocol, however requires higher studies.

Conclusion:

Extracorporeal radial shockwave therapy has been shown to be effective in the treatment of patients with lateral Achilles tendinopathy.

P13

ESWT as the Treatment of Choice for Plantar Fasciitis - 12 Years' Experience

Kandiah Raveendran

Institution: Fatimah Hospital, Ipoh, Malaysia

Device and producing company: Evotron

Introduction:

Plantar Fasciitis is a common cause of painful heel in the Malaysian population. This paper describes a 12 years' experience to assess the efficacy and acceptability of this modality of treatment in a country where the use of ESWT is still in its infancy.

Methods:

This paper describes two studies. The first being a prospective study on the use of ESWT on 148 heels conducted from 2003 to 2004.

The second study was a retrospective study on 83 heels. The paper compares the two timeframes to see whether there has been any change in the methods and results including the popularity of the treatment with the patients. It also assessed the need for more than one treatment using the Evotron.

Results:

The first study showed that 74% had no or minimal pain without any complications noted. 18 heels had to have a second treatment.

The second study of 83 heels treated showed a 71% improvement after the first treatment but 25 heels had a second treatment and 5 heels a third treatment and the final result was 84% with no or minimal pain again with no complications.

Discussion:

The Malaysian patients have gradually accepted ESWT as the first choice of treatment in our institution. We have also been more confident to recommend second and third treatments for the recalcitrant painful heel with a consequent improvement in results and probably a reduced recurrence rate.

Conclusion:

ESWT has been the most effective treatment modality for the treatment of plantar fasciitis in the Malaysian population. It has become acceptable in spite of it being a painful procedure. We offer it very soon after the failure of conservative therapy. In the last 12 years the number of patients undergoing surgery has dropped drastically.

P14

Plantar Fasciitis Treatment - Physical Therapy with Ultrasound versus Extracorporeal Shock Wave Therapy. A Long-Term Follow-Up

Sara Messina (1), Paolo Buselli (2)

Institution: (1) School of Specialties in Physical Medicine and Rehabilitation, University of Pavia, (2) Istituti Ospitalieri di Cremona, Italy

Device and producing company: Ossatron OSA 140

Introduction:

In 2009 we presented a work on ESWT versus other therapies, particularly versus Ultra Sound (US) physical therapy. With respect to this, we are now presenting the results of a long-term follow-up related to the same patients.

Methods:

After having performed a systematic analysis of the patients affected by plantar fasciitis coming to our practice for totally 3 years (2006-2009), we made a second evaluation per telephone about the health of such patients after 1 and 3 years.

We checked three patient groups treated respectively with ESWT only (Group 1), US therapy with good results (Group 2A) and with ESWT after an US treatment without good clinical results (Group 2B). Afterwards we evaluated the long-term efficacy of the treatment performed with ESWT (Group 1 and Group 2B), compared to that of the treatment with physical therapies (Group 2A).

Results:

Significant clinical improvement was obtained both in Group 1 and in Group 2B. We observed no statistical significance on the results of ESWT versus US. The analysis of the self-control group showed good clinical and functional results of ESWT after US therapy. The analysis of the long-term data has confirmed the better results achieved in the ESWT group, both in the follow-up after one year and in the one after 3 years, despite the drop-out number, being, however, equally distributed within the three patient groups.

Discussion:

Despite the difficulties in contacting patients after some time, the data presented show a better long-term result in the patient group treated with ESWT compared to the one treated with other physical therapies (Group 2A).

Conclusion:

ESWT shows a long-term efficacy in the treatment of plantar fasciitis. The long-term results confirm that ESWT represents the first choice treatment for chronic plantar fasciitis.

P16

Evaluation of Factors Possibly Influencing the Outcome of Focused Extracorporeal Shockwave Treatment (ESWT) of Recalcitrant Plantar Fasciitis with Calcaneal Spur

Raphael Scheuer (1), Martin Friedrich (1), Julia Hahne (2), Matthias Pallamar (1)

Institution: (1) Orthopaedic Hospital Speising; (2) CEOPS - Centre of excellence for Orthopaedic Pain Management Speising, Vienna, Austria

Device and producing company: Storz Duolith SD1 Tower

Introduction:

There are several trials suggesting that radial as well as focused shockwave therapies show satisfying results as treatment options of plantar fasciitis. This study was performed to examine whether there are further patient or treatment related factors influencing the outcome of focused ESWT as treatment option for plantar fasciitis enabling physicians to estimate the possible benefit and to eventually improve efficacy.

Methods:

284 patients (363 feet with plantar fasciitis) received focused ESWT for plantar fasciitis and answered a questionnaire inquiring epidemiologic and anamnestic treatment data immediately before as well as 19 to 77 weeks after the first application.

Results:

74 percent of patients are satisfied, 72 percent received treatment with focused ESWT only once. The individual result was independent of the energy applied, the physician applying ESWT as well as epidemiologic data assessed, but there was a negative correlation with the number of past injections with corticosteroids.

Discussion:

We observed treatment benefits like satisfying results with no complications and no immobilization. These results were reproducible and were achieved with in most cases with one, in some cases with up to three treatment sessions. In contrast to other authors who stated that ESWT should rather be regarded as an end stage treatment we would recommend ESWT in even earlier stages to prevent chronification because of its better results compared to many other conservative treatment options.

Conclusion:

Focused ESWT is a safe and feasible treatment option for plantar fasciitis, its efficacy is consistent over different physicians. Hence, ESWT can be recommended even as early treatment option for plantar fasciitis.

P17

Evaluation of the Fibrillar Pattern as an Ultrasound Parameter for Clinical Correlation in Patients with Plantar Fasciitis treated with Shock Wave Therapy. One Year Follow-Up

Gabriele Verratti

Institution: Servicios Medicos OrthoShock, Caracas, Venezuela

Device and producing company: Epos Ultra, Dornier, Swiss Dolorclast

Introduction:

The purpose of this study was to analyze the sonographic features in the behavior of the return of the fibrillar pattern in serving insertional plantar fasciitis as a prognostic indicator of clinical resolution in the shockwave treatment.

Methods:

We performed a retrospective study in 113 patients who received ESWT between April 2011 and April 2013. We applied a treatment protocol that consisted of an ultrasound evaluation of the plantar fascia and a pain score (VAS) before, during and after treatment over a period of 3, 6, and 12 months. Applying 2 sessions of focused shockwaves, 3200 impulses with an EFD of 0.43mJ/mm² at an interval of 7 days and two sessions of Radial SW, 3500 impulses with a pressure of 2.5 bar with an interval of 15 days. All procedures were performed under sedation.

Results:

95 of 113 patients with a clinical resolution ultrasound behavior obtained a restitution of the fibrillar pattern similar during and after treatment. 18 patients had failed resolution during and after treatment, with sonographic patterns different from the above ones.

Discussion:

This communication attempts to find a correlation between the ultrasound findings in plantar fascia after treatment and the clinical improvement.

Conclusion:

Ultrasound evaluation of the return of the fibrillar pattern before, during and after treatment of insertional plantar fasciitis is a reliable imaging parameter for prognosis in shock wave therapy, which allows us to evaluate and define the clinical resolution.

P18

Extracorporeal Shock Wave Therapy Could Induce an Up- and Down-Regulation of Vascularity in Patients with Chronic Plantar Fasciitis

Siu ngor Fu, Holly Chen

Institution: The Hong Kong Polytechnic University, Hongkong

Device and producing company: Duolith SL1, Storz Medical, Switzerland

Introduction:

The purpose of this study was to explore the effects of Extracorporeal Shock Wave Therapy (ESWT) on the vascularization in patients with chronic plantar fasciitis.

Methods:

Forty-six subjects with chronic plantar fasciitis participated in this study. Subjects were randomly assigned to undergo ESWT for 3 or 6 sessions at maximum intensity for 1500 impulse at 4 Hz at a weekly interval. There was a control group without any intervention. Power Doppler was used to measure vascularization of the proximal plantar fascia. A vascular index (VI) was computed to represent the percentage of vascularization in the fascia.

Results:

Modulation in vascularity was detected in the intervention but not in the control group. In the intervention group, modulation of vascularity was significantly different in patients with and without vascularization ($p < 0.05$). In patients with vascularized plantar fascia, down-regulation of vascularity from 4.35% to 3.73% was observed. In the non -vascularized group, the VI increased from 1.51% to 2.14%.

Discussion:

ESWT-induced neovascularization was first reported in healthy Achilles tendons harvested from dogs and rabbits. Healthy tendons have low vascularization, and up-regulation was induced from a single session of ESWT. In patients with chronic supraspinatus tendinopathy with increased oxygen saturation, a decrease in oxygen saturation was reported after ESWT. Our study demonstrated that ESWT could induce bi-directional regulation of vascularity in patients with chronic plantar fasciitis. Pre-intervention vascularity is one of the factors.

Conclusion:

ESWT could induce an up- and down-regulation of vascularity in patients with chronic plantar fasciitis.

P19

Results of Shockwave Treatment in Lateral Epicondylitis in Relation to Tendon Changes in Power Doppler

Markus Gleitz

Institution: Orthopaedic Practice, Luxembourg, Luxembourg

Device and producing company: Orthogold 100 (MTS) with planar applicator, Storz Duolith

Introduction:

Although ESW treatment of lateral epicondylitis is judged as a standard indication according to the ISMST/DIGEST guidelines, results vary more than for other standard indications. As ESWT is considered as a regenerative treatment stimulating tissue repair the question arises, whether the pre-treatment tissue conditions might have an influence on the treatment results.

Methods:

In a prospective study of 41 patients with chronic unilateral epicondylitis (> 3 months) ultrasound examinations including grey-scale changes and Power Doppler were performed (1 examiner, not blinded) before and 3 months after 3 ESWT sessions, that have been applied at weekly intervals. Power Doppler changes were quantified according to the percentage of surface of neovessels within the common extensor insertion area. Treatment results after 3 months were evaluated using the Visual Analogue Scale (VAS in mm, 0-100) during function. The correlation between pre-treatment ultrasonographic changes and the treatment pain as well as the VAS during function 3 months after ESWT was calculated.

Results:

The amount of neovessels correlated with the treatment pain during ESWT ($r=0.68$, $p<0.05$), making the use of significantly lower treatment energies necessary. The VAS during function 3 months after ESWT was significantly higher ($r=0.76$, $p<0.05$) in patients with an increased amount of neovessels before ESWT.

No correlation was found between the amount of neovascularity and the duration of symptoms before ESWT and the amount of neovascularity and the mean pain VAS before ESWT.

Discussion:

Hypervascularity is considered to be associated with an active inflammatory response and is highly correlated with pain severity. The presence of neovessels and accompanying nerves in areas of tendinopathy are associated with an increased tendon pain.

Neovascularity in Power Doppler seems to be a valid parameter for the estimation of pain during ESWT and predictive estimation of treatment results.

The classical parameters (duration of symptoms, functional scores) are of minor use for the estimation of treatment results.

The unknown presence of neovessels might be the reason for the heterogeneous study results in the literature, as this parameter has never been considered in the highly ranked studies that are usually taken as a reference.

Conclusion:

Pre-treatment tissue conditions vary and determine the treatment results. For this reason ultrasound examinations using grey-scale pictures and Power Doppler should be performed as a routine before ESWT.

P20

Consideration of Energy Flux Density on the Modulation of Vascularity and Pain for Extracorporeal Shock Wave Therapy in Patients with Chronic Plantar Fasciitis

Siu ngor Fu, Holly Chen

Institution: The Hong Kong Polytechnic University, Hongkong

Device and producing company: Duolith SL1, Storz Medical, Switzerland

Introduction:

The present study aimed to examine the effect of treatment dosage with extracorporeal shock wave therapy on the modulation of vascularity and pain in patients with chronic plantar fasciitis.

Methods:

Thirty patients with unilaterally affected chronic plantar fasciitis (CPF) received extracorporeal shock wave therapy (ESWT) at maximum intensity for 3 or 6 sessions at 8 Hz and with 1500 impulses using a Storz Duolith SL1 shock wave apparatus. Vascularity of the proximal plantar fascia and pain intensity were assessed at pre-, post and 1-month after intervention.

Results:

In 30 patients with CPF, 43.3% had a significant increase in vascularity. The total energy flux density (EFD) was found negatively related to the vascularity change at post ($r = 0.68$ and -0.80 , all $p < 0.05$) and post-1 month (-0.54 and -0.42 , all $p < 0.05$) in the vascularized and non-vascularized patients, respectively. The total EFD was found related to the change in the intensity of pain in the vascularized group at post ($r = 0.53$, $p = 0.062$) and 1-month ($r = 0.60$, $p = 0.031$). An EFD of 0.48 mJ/mm^2 for 1500 impulses was required for a successful reduction in pain at post and 1 month after intervention.

Discussion:

The effect of ESWT depends on the total energy applied. Higher energy was found to cause a greater decrease in vascularity. In the vascularized patients, a threshold of total energy is required for successful treatment.

Conclusion:

The total energy flux from ESWT needs to reach a threshold for successful treatment in patients with chronic plantar fasciitis with vascularized fascia at post and 1 month after intervention.

P21

International Survey on Extracorporeal Shockwave Therapy for the Treatment of Rotator Cuff Calcific Tendinopathies

Daniel Moya

Institution: No

Device and producing company: NA

Introduction:

Extracorporeal shockwave is considered an approved standard indication for the treatment of rotator cuff calcific tendinopathies. The aim of this survey is to evaluate the level of consensus on this topic among ISMST members.

Methods:

A survey was sent by e-mail to 238 members of the International Society for Medical Shockwave Treatment, inquiring about their general attitude, preferred diagnostic tools, therapeutic strategies and analysis of three clinical cases.

Results:

Seventy five members from 35 countries started the survey (general response rate: 31.5%) and 53 (70.7%) completed it. Focal shockwaves was the preferred method to treat calcific tendinopathies for 68.2% of ISMST members whereas 31.8 % chose radial shockwaves. Radial shockwaves were clearly more popular among respondents with less experience in the shockwave field. X Rays were the first choice for diagnostic assessment and follow-up. We found a fair inter-observer agreement not only for the Gärtner classification but also for associated rotator cuff tear findings. The dose of energy chose per pulse ranged from 0.03 to 0.6 mJ/mm² and there was a very low coincidence rate about the level of cumulative energy dose. We did not find significant differences on expected outcomes.

Discussion:

Several level 1 studies support extracorporeal shockwaves as an indication for the treatment of rotator cuff calcific tendinopathies, but they do not necessary represent what happens in everyday medical practice. Although we found no significant differences in the expected outcomes there is a clear lack of consensus in the area of diagnosis and methodology.

Conclusion:

The results of this survey put in evidence the need of guidelines based on scientific data and consensus.

P22

A Survey about how Brazilian Doctors are working with ESWT

Paulo Kertzman

Institution: SBTOC, Sao Paulo, Brazil

Device and producing company: EMS, Direx, HMT, Storz

Introduction:

We are interested to know who the doctors are, how many sessions per week they perform, what kind of equipment they use, the number of sessions per treatment per pathology, the level of energy and some economic aspects.

Methods:

The directory of the Brazilian Shock wave Society has applied a survey to all 162 SBTOC members and 56 submitted their answers. The goal of this survey was to have an idea about how Brazilian doctors who use ESWT are working and how they help us to define some protocols.

Results:

Most of the doctors are seniors with more than 15 years of medical practice, have less than 5 years using ESWT, perform less than 10 sessions per week, use 3 to 4 sessions with one week interval and prefer to use low energy for soft tissue treatments.

Discussion:

We think that the definition of protocols is difficult and each doctor is free to work but, with the practical clinical evidences support and with the basic sciences that help or confuse us, we want to collaborate with the scientific growth of ESWT medical practice with our survey.

Conclusion:

We think that surveys like that could help us to understand how the colleagues are working.

P23

Referral Regulations and Economic Valorization of the ESWT within the Framework of the Health Technology Assessment in Italy in the Lombardy Region

Paolo Buselli (1), Sara Messina (2)

Institution: (1) Istituti Ospitalieri di Cremona; (2) University of Pavia, Italy

Device and producing company: Orthogold 100

Introduction:

The structuring of the reimbursement provided for the different healthcare services depends on the way the services have been rendered, i.e. as an inpatient or as an out-patient treatment. As to the shock wave therapy, not all Italian regions have introduced specific rules regulating such therapy within the different Regional Healthcare Systems.

Methods:

We are going to present the situation in the Lombardy Region together with the data provided by the Lombardy Region itself, with reference to the demands for reimbursement of the different accredited centers administering ESWT.

Results:

The data are being processed according to the possible interferences with the population density and territorial location of the therapy centers without any special statistical correlation element. The data are then referred to the frequency of the pathology being treated; such analysis reveals a clear predominance of treatments for calcific tendinopathy of the shoulder and plantar fasciitis. The ESWT treatments prescribed are then being compared with the data found in literature related to the average incidence of the different pathologies; such data processing shows a clear correspondence between the incidence of the pathology and the frequency of the treatment.

Discussion:

The results show a fair congruity of the ESWT prescription. Furthermore, there is a great predominance of demands for reimbursement related to therapies performed with focused shock waves with respect to therapies performed with ballistic shock waves.

Conclusion:

There is the need for an exhaustive evaluation of Health Technology Assessment based on analytical data about cost formation and on scientific data about the efficacy of the therapy, in order to get an adequate economic valorization of ESWT within our Public Healthcare System.

P24

How to create a Shockwave Competence Center

Frank Bätje

Institution: Shockwave Competence Center Hannover, Hannover, Germany

Device and producing company: STORZ Modulith SLK, STORZ Duolith SD1, STORZ Duolith Ultra, STORZMEDICAL, Switzerland; SIEMENS Modularis Variostar, Germany

Introduction:

Within twelve years our German family practice has become a center of excellence for post-traumatic surgical, orthopedic and urological shockwave therapy. We have one of the very few institutions in Europe, led by a general practitioner. Annually hundreds of qualified treatments are performed. The Competence Center focuses on technology innovation, collegiality, transparency and internet acquisitions. The annual turnover amounts to € 250,000.

Methods:

Continuous developments of shockwave devices, regular trainings, location extensions, employee trainings, lecture activities, maximal transparency and proper utilization of the potential in Germany Professional Fees establish prosperous shockwave activities in a private practice.

Results:

Widespread acceptance among referring physicians from hospitals and clinics throughout Germany, an integral part of the secondary trauma surgical care after accidents, uninterrupted supply at several locations, established supply structures, academic support.

Discussion:

The relatively large investments in shock wave devices and labor-intensive treatments require an appropriate salary to always use all indications with individual device technique. It is useful for physicians to be a member of the relevant professional shockwave societies. This enables you to work both in accordance with the guidelines and in line with approved standard indications to dispel doubts about the evidence.

Conclusion:

We perform orthopedic, post-traumatic and urologic shockwave treatments for several hundred patients every year. We enjoy a performance-based pay and enhance our reputation through lecture activities, discussions and publications. We strictly adhere to the principle that this should be a purely medical treatment. For each indication and for each device apply established principles of treatment. The high degree of organization of the practice and the care of the network guarantees growing number of cases, fees and - treatment success.

P25

Porphyrin Loaded Nanoparticles Improve in Vitro Anticancer Sonodynamic Treatment

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Institution: (1) Department of Medical Sciences, University of Turin; (2) Istituto per la Sintesi Organica e la Fotoreattività, CNR, Bologna; Italy

Device and producing company: Piezason 100 – Wolf

Introduction:

Ultrasounds are used in sonodynamic therapy (SDT) to enhance the cytotoxic effects on cancer cells of chemical compounds known as sonosensitizers. Although there are several physical and chemical mechanisms underlying SDT, the most prominent and, non-thermal promising effect of continuous or pulsed ultrasounds on tissue, is acoustic cavitation.

Methods:

We have investigated the effect of high energy Shock Waves (SW), generated by a piezoelectric device, at the Energy Flux Density (EFD) of 0,43 mJ/mm² for 500 shots (4 shots/sec), on a human neuroblastoma cell line (SH-SY5Y) exposed to two different formulations of meso-tetrakis (4-sulfonatophenyl) porphyrin (TPPS), e.g. free drug and TPPS loaded nanoparticles (NP), respectively.

Results:

The TPPS-NP were able to significantly increase the porphyrin incorporation into living cells. A significant decrease in cell growth was observed in two and three dimensional cell culture after sonodynamic treatment with SW and TPPS-NP. The cell growth inhibition was up to 50% for the porphyrin loaded NP compared to untreated cells, cells exposed only to unloaded NP and cells exposed only to free TPPS. The sonodynamic treatment with SW and TPPS-NP determined a significant increase in the SH-SY5Y cell generation of Reactive Oxygen Species (ROS).

Discussion:

The uncontrolled increase in the generation of ROS after the sonodynamic treatment with SW and TPPS-NP resulted in cell damage. In particular, the sonodynamic treatment with SW and TPPS-NP was able to significantly increase apoptotic cell death.

Conclusion:

Porphyrin properties are significantly enhanced once loaded on NP, thus increasing the in vitro anticancer efficacy of the sonodynamic treatment.

P26

Extracorporeal Shock Waves (ESW) Trigger Drug Release and Enhance Cytotoxic Effects of Doxorubicin-Loaded Nano-bubbles in Anaplastic Thyroid Cancer

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Institution: (1) Department of Medical Sciences, University of Turin, (2) Oncological Endocrinology, AO Città della Salute e della Scienza di Torino, (3) Med & Sport 2000 S.r.l., Torino, Italy

Device and producing company: Piezason 100 (Richard Wolf, Germany)

Introduction:

No standard therapy is available for advanced thyroid cancers, metastatic or recurrent, differentiated, poorly differentiated or anaplastic tumors (ATC). Therefore, the searches for new therapeutic approaches or methods that can potentiate the effects of traditional chemotherapeutic agents are needed. Nanobubbles loaded with anticancer agents have been studied as promising innovative drugs in oncology, since they act at a cellular level enhancing antitumor efficacy. Moreover, Extracorporeal Shock Waves (ESW) can be used as a new tool to enhance drug release from anticancer drug-loaded nanoparticles. Based on this background, the aims of the present study are to combine ESW and nanobubbles, in order to: a) target doxorubicin in thyroid cancer tissue; b) release targeted drug by popping these bubbles.

Methods:

Human anaplastic thyroid cancer cells lines were treated with doxorubicin or doxorubicin-loaded nanobubbles and exposed to ESW (0.59mJ/mm², 500 shots). After treatment, drug uptake by cells was determined by cytofluorimetry and cell viability was assessed by WST-1.

Results:

Combined exposure to doxorubicin-loaded nanoparticles and to Extracorporeal Shock Waves resulted in a significant enhancement of drug uptake and cytotoxicity in thyroid cancer cells with respect both to cells subjected to ESW treatment and to cells treated with doxorubicin alone.

Discussion:

ESW enhance drug uptake and cytotoxicity of doxorubicin-loaded nanoparticles in anaplastic thyroid cancer cells.

Conclusion:

These data suggest the possibility to use doxorubicin-loaded nanobubbles in combination with Extracorporeal Shock Waves as a new promising therapy in the treatment of anaplastic thyroid cancer.

P27

Selective Destruction of Vemurafenib Resistant Melanoma Cells in Ballistic Pressure Fields

Thomas Dietrich

Institution: NA

Device and producing company: NA

Introduction:

The most notable structural characteristics of melanoma cells are an altered organization of the cytoskeleton. As a result, diffuse and unbundled arrangements of cellular filaments occur. Second, the nucleus/cytoplasm ratio is often shifted in favor of the nucleus. Experimental results and accompanying simulation analysis confirm that specific ballistic pressure fields are suitable for selective destruction of Vemurafenib resistant melanoma cells and concomitant protection of healthy cells.

Methods:

The finite element method (FEM) is used in order to simulate the dynamic behavior of melanoma and healthy cells in ballistic fields, to develop an experimental design and a therapeutic option to determine the best cell type-specific treatment parameters for the selective destruction of melanoma cells. Cell cultures of Mel1617 (Mel-R), MV3, human HF were used. Dead cells numbering was evaluated by means of Trypan blue staining, LDH assay and FACS

Results:

After specific shock wave treatment all Mel-R cells were destroyed (100%). At the same treatment parameters only 11.7% healthy cells (HS) were destroyed. After shock waves at 60 % Mel-R cells were destroyed. At the same treatment parameters only 4.3 % HF were destroyed.

Discussion:

The theoretical and experimental results data open the opportunity for a new tumor treatment applying specific shock fields at relatively low repetition frequencies.

Conclusions:

Experimental results and accompanying simulation analysis confirm that specific ballistic pressure fields are suitable for selective destruction of Vemurafenib resistant melanoma cells and concomitant protection of healthy cells.

P28

Why the Mechanisms of Shockwave Therapy are Still Not Understood

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Institution: (1) Chair of Medical Engineering, Helmholtz-Institute for Biomedical Engineering RWTH Aachen University, (2) Institute for anatomy and cell biology, RWTH Aachen University, (3) Department of Cardiothoracic and Vascular Surgery, University Hospital RWTH Aachen, (4) Department of Oral and Maxillofacial Surgery, University Hospital RWTH Aachen Germany

Device and producing company: Piezason 100 plus, F10G4, Richard Wolf

Introduction:

In recent years shockwave induced therapeutical effects could be demonstrated both in empirical in-vivo studies as well as in experimental in-vitro setups for different cell types. However, the mechanisms of shockwave therapy are still not understood. To compare different studies, usually the energy flux density (EFD) of the SW device, the frequency of repetition and the number of pulses is used. These parameters are usually not measured for the experimental setups, but theoretical values are given from the manufacturers. We hypothesize firstly that different studies are not comparable because the stated physical parameters of the shockwave are wrong due to the experimental setup. Secondly, we put forward the hypothesis that the EFD is not the only effective parameter of the shockwave.

Methods:

The physical parameters of shockwaves were measured according to standard EN61846 (Ultrasonics – Pressure pulse Lithotripters – characteristics of fields, 1998). These parameters were evaluated in different settings, e.g. in a water tank, inside a cell tube or behind a few centimeters of tissue to model in-vitro as well as in-vivo situations. The measurements of the pressure time history with a fiber optic probe hydrophone was also used to validate an FEM simulation model which offers the possibility to calculate the pressure field and tissue deformation during the therapy.

Results:

The EFD declared by the manufacturer is only valid inside a water bath and changes substantially due to the additional materials used during the in-vivo and in-vitro experiments. During the in-vitro and in-vivo experiments the pressure wave is reflected and dispersed by the material surrounding the target tissue (water/cell flask or bone/tissue interfaces), thereby affecting the energy flux density and the other physical parameters at the focal point.

Discussion:

The comparability of experimental results of different researchers is the main requirement to be able to confirm the results and find correlations between physics and biology. But the assumption that the theoretical energy flux density of the device measured by the manufacturer is also the shockwave parameter acting really on the cells is incorrect. Therefore the comparison of the results of different studies is impossible and the mechanism of shockwave therapy has not yet been understood.

Conclusion:

Once the effective parameters of shockwaves are found, a personalized model-based therapy could be achieved by simulations of the shockwave inside the body.

P29

ESWT: An Extraordinary Tool for Tissue Regeneration and Remodeling

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Device and Producing Company: Modulith SLK and Duolith, Storz Medical; Orthogold, MTS; Dermapace, Sanuwave

Introduction:

Regenerative Medicine nowadays represents the new frontiers of ESWT. The authors propose some interesting case reports supporting this argument, by showing some unexpected therapeutical results that suggest new perspectives and insights about this topic.

Methods:

Case A and B: two patients, with tibial fracture delayed healing, both presenting also skin ulcers, distally to the fracture site.

Case C: a sportsman, with painful swelling of the distal calf (muscular and cutaneous fibrosis, due to a deep wound).

Case D: A young woman with hip osteonecrosis.

Case E: A woman with delay of femoral fracture healing and extensive skin fibrosis of the lower limb (crash trauma --> skin graft).

All patients were treated with different ESWT protocols, according to each disease.

Results:

The use of ESWT resulted in these outcomes:

Case A and B: bone healing, and surprisingly, a faster repair of the ulcers, away from the fracture site and therefore not directly treated;

Case C: resolution of pain and swelling, as well as reduction of muscular fibrosis.

Case D: arrest of necrotic evolution and bone remodeling appearance (with a trophic effect) at medium-long term follow up (> 5 y).

Case E: besides bone healing, unexpected hair regrowth and reactivation of sweating, reduction of skin fibrosis and tactile hypersensitivity.

All results were documented by clinical and instrumental data (including photos).

Discussion:

These case reports would suggest some positive changes after ESWT:

Real stem cell mobilization "in vivo", with effects at a distance.

A regenerative effect also on intact tissues (remodeling action).

The authors will discuss in detail the regenerative potential of ESWT that seems to be even more extraordinary than believed and proven. It is effective also on already healed or "intact" tissues (remodeling effect).

Conclusion:

We expect that the use of ESWT will be further encouraged as a safe and versatile therapy, both alone and associated to other treatment tools in the field of Regenerative Medicine. New studies will be able to widen the list of therapeutical indications, especially in the field of post - traumatic and complicated clinical cases.

P30

The Influence of SW on the Morpho-Functional State of Kidneys with Chronic Pyelonephritis

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Institution: (1) Filial (branch to) 3-rd Central military clinical hospital, (2) The 1st Moscow Medical University & Filial (branch to) 3-rd Central military clinical hospital, (3) Scientific Research Institute of Urology Moscow, Russia

Device and Producing Company:
AUVT Rumelit, electromagnetic source, Russia

Introduction:

One of the factors leading to the progression of inflammatory changes in the kidney is the microcirculation failure caused by interstitial tissue edema, microcirculatory stream vessels thrombosis, and the decreased vessel elasticity. The Shockwave Therapy (SWT) improving microcirculation should be useful in pyelonephritis patients.

Methods:

A clinical and experimental study was performed in order to prove the efficacy of SWT in chronic Pyelonephritis. We performed urethral ligation in rats and evaluated an e-coli culture into the ureter three times every 2 weeks. Shockwaves were applied every two-weeks over the infected rats' kidneys (Parameters: frequency 2 Hz, amplitude of pressure from 5 to 9 MPa, total number of pulse 500-1000-1500). The kidneys microcirculation in 35 patients with pyelonephritis was studied after the use of SWT.

Results:

We observed a decrease in the inflammatory infiltration in the form the prevalence of macrophages, and activation of the fibroblasts with reduction of the quantity in the control group after SWT. When we looked at the kidney bloodstream we found an increase in speed of the segmental arteries of 20% as well as a 10% in the arcuat arteries. The excretory functions also improved according the radioisotope survey after 5 to 7 sessions SWT.

Discussion:

The results indicate an improvement of blood flow in the kidney after SWT perhaps due to the activation of synthesis of prostaglandins leading to a decrease of intensity of the inflammatory reaction.

Conclusion:

Our results provide a basis for the expansion of another possible use of SWT in the complex treatment and rehabilitation of patients with infectious-inflammatory diseases of the kidneys.

P31

Improved Axonal Regeneration and Improved Functional Results by Extracorporeal Shock Wave Treatment After Peripheral Nerve Injury in the Rat

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Device and producing company: NA

Introduction:

Although de-focused low energy extracorporeal shock wave therapy (ESWT) is routinely used to treat chronic inflammatory processes, very little is known about the effects of ESWT on injured peripheral nerves and these results concern reduction of pain and induction of unmyelinated nerve fibers degeneration. We aimed to investigate whether ESWT is able to improve the regeneration of injured nerves in an experimental rat model.

Methods:

Sprague-Dawley rats received an 8 mm long homotopic nerve autograft into the right sciatic nerve. All animals were randomly assigned to two experimental groups:
Group1: ESWT (300 impulses, 0.1 mJ, 3 Hz)
Group 2 (control): Nerve graft without ESWT. The specimens were evaluated with serial CatWalk automated gait analysis, electrophysiological studies and morphological investigations. The survival time was either 3 weeks or 3 months.

Results:

At 6 to 8 weeks of survival the ESWT group of animals exhibited a significantly improved functional recovery relative to the controls. Electrophysiological observations at 3 weeks after surgery revealed marked values of amplitude and compound nerve action potentials in the ESWT group, whereas there were no detectable amplitudes in the control group.

Discussion:

These findings were accompanied by significantly greater numbers of myelinated nerve fibers in the middle of the graft and in the distal stump of ESWT animals relative to the controls 3 weeks after surgery. There was no significant difference between the number of endoneural vessels in the ESWT and the control nerves.

Conclusion:

These results suggest that ESWT induces an improved rate of axonal regeneration. This phenomenon probably involves faster Wallerian degeneration, the improved removal of degenerated axons and a greater capacity of the injured axons to regenerate.

P32

Focal ESWT in Greater Trochanteric Pain Syndrome

Osvaldo Patiño, Daniel Moya,

Institution: Centro Argentino De Ondas De Choque, Buenos Aires, Argentina

Device and producing company: Orthima-Direx

Introduction:

Trochanteric pain syndrome (TPS) is a common and frustrating condition encountered by orthopedic surgeons and rheumatologists in patients older than 50 years. Patients feel pain on the greater trochanter during activities and at rest, with functional impairment. Many conventional treatments have been used to treat these patients with controversial results. Focal Extracorporeal Shock Wave Therapy (FESWT) has been successfully used since 1980 to treat different tendon pathologies. Our objective with this presentation is to describe the results using FESWT in patients with greater TPS who did not response to conventional therapy.

Methods:

We studied 37 patients, 7 males and 30 females (average age 65.4 years), with a history of lateral hip pain over the greater trochanter for more than 14 months with unsuccessful conventional treatment. We used an Orthima FESWT device (Direx inc.), with a 2000 shockwaves, 0,20mJ/cm² protocol, in 3 sessions once every 15 days. Evaluation was performed using Visual Analogue Scale (VAS) for pain, and Lower Extremity Functional Scale (LEFS), being 80 points the best, and 0 points the worse. For statistical analysis we used a T-test for paired data and a Wilcoxon Sign-Rank.

Results:

After treatment and from baseline values, VAS score significantly decreased 2.99 points (2.74-3.25; p<0.001) and LEFS score improved 30.24 points (27.47-33.02; p<0.001).

Discussion:

We found statistical and clinical significant improvement in pain and function in patients with greater TPS treated with a short protocol of FESWT.

Conclusion:

We suggest the use of FESWT in patients with greater TPS that show poor improvements with conventional treatments. Our results are promising and this therapy should be evaluated in the future through randomized trials.

P33

Radial Extracorporeal Pressure Pulse Therapy for the Primary Long Bicipital Tenosynovitis: A Prospective Randomized Controlled Study

Gen Yan Xing

Institution: General Hospital of Chinese Peoples' Armed Police Force, Beijing, China

Device and producing company: Swiss DolorClast, EMS

Introduction:

Long bicipital tenosynovitis is regarded as one of the common causes of shoulder pain and dysfunction. The traditional therapeutic approach includes a variety of conservative treatments, but they are not substantiated, owing to the lack of proven clinical efficacy. Radial extracorporeal shock wave therapy (RESWT) uses a pneumatically generated and radially propagating low-energy pressure pulse and has been clinically shown to be a new alternative form of treating refractory soft tissue inflammation.

Methods:

Seventy-nine adults with long bicipital tenosynovitis were randomized to receive either active (1500 pulses, 8 Hz, 3 bars) or sham treatment through four sessions that were held once a week. All of these adults were assessed before treatment and at time intervals of 1, 3 and 12 months since the completion of the treatment. The outcomes were measured through the visual analogue scale (VAS) and L'Insalata shoulder questionnaire.

Results:

Mean VAS in the RESWT group showed significant and sustained reduction from 5.67 ± 1.32 at baseline to 2.58 ± 1.49 at one month, 1.83 ± 1.25 at three months and 1.43 ± 0.94 at 12 months. The sham group's mean VAS was 6.04 ± 0.97 before treatment and stabilized at 5.57 ± 0.84 at 12 months. Similar trends were found for the function scores. Mean scores were increased after RESWT from 60.57 ± 6.91 at baseline to 79.85 ± 6.59 at 1 month and 83.44 ± 5.21 at 12 months from baseline. Both pain and function scores showed significant differences between the two groups ($p < 0.001$).

Discussion:

When primary pathogenesis like impingement syndrome was excluded, radial shock wave therapy for the primary long bicipital tenosynovitis of the shoulder produced a high rate of success in achieving the relief from pain and functional restoration. Negligible complications were associated, regardless of whether the patients received conservative treatment previously or not.

Conclusion:

RESWT should be considered as the preferred method for treating long bicipital tenosynovitis.

P34

Extracorporeal Shockwave Therapy (ESWT) in Impingement Syndrome of the Shoulder

Ayman Elwely Balabel, Faisal Ramadan Al-Kandary, Amani Ahmed Yacoub, Sahar Sobhi Othman

Institution: Ahmadi Hospital, Kuwait Oil Company, Kuwait

Device and producing company: Piezason 300, Richard Wolf

Introduction:

The rotator cuff muscle tendons pass through a narrow space between the acromion process of the scapula and the head of the humerus. Narrowing of this space can result in impingement syndrome. Thickening or calcification of the coracoacromial ligament and inflammation of the subacromial bursa can also cause impingement that will reduce the space between rotator cuff and the acromion (subacromial impingement). The cause of the formation of calcium in the rotator cuff is idiopathic. It is common in people between the ages of 30-60 years of age.

Methods:

We performed a retrospective study including 20 patients with impingement syndrome, ages 35-57 years old, with a pain VAS rating of 7-9, with pain in all overhead activities and at rest, as well as a marked limitation of shoulder ROM. X-rays were done in all cases in order to exclude other pathology. Inclusion criteria were: shoulder pain present for a minimum of 5 months, rotator cuff calcification on the plain x-rays, or unsuccessful conservative treatment for at least six months. The exclusion criteria were: generalized osteoarthritis, pregnancy, infectious or tumorous diseases, and any neurological abnormalities. We performed the treatment as an outpatient procedure without anesthesia in 3 Focused ESWT sessions every two weeks, with a 3000 pulses, energy level of 0,11 – 0,14 mJ/mm² protocol. All patients had been advised to start ROM and strengthening (RTC) exercises within 4-6 weeks after treatment. Eccentric exercises were encouraged to be started gradually and progressively to core muscle stability for 3 months, seeking cuff recovery. Patients were advised to continue exercises for 12 weeks.

Results:

We followed out patients for six months, and found that 85% of the cases showed significant clinical improvement. Pain had been reduced to VAS 2-3 and range of motion had significantly improved. 10 % of our patients were slightly better for pain and ROM. 5 % had poor results. Mean pain score before treatment was 8.95 ± 0.76 and after we recorded 4.20 ± 1.40 . ROM changed from 29.50 ± 8.26 to 76.25 ± 10.11 with a highly significant P-value > 0.001 .

Discussion:

Focused Shock wave therapy produces significant relief of pain, improves ROM in Impingement Syndrome of the Shoulder, and has effects in changing the absorptions of calcium deposits at RCT calcified tendon.

Conclusion:

FESWT in calcific tendinitis of the shoulder is a very effective, noninvasive, and safe procedure with no complications or any side effects, especially as compared to arthroscopic surgery. Shock Waves treatments can be recommended as a valuable treatment for impingement shoulder syndrome, in addition to core muscle stability exercises program.

P36

Extracorporeal Radial Shockwave Therapy for Lateral Epicondylitis

Edson Antonio Serrano

Institution: Neomedica, Lima, Peru

Device and Producing Company: BTL 5000, BTL 6000

Introduction:

Extracorporeal radial shockwave therapy has shown to be effective in the treatment of chronic tendinopathies of the elbow, shoulder and plantar fascia. This prospective case series study evaluates the efficacy of extracorporeal radial shockwave therapy in the treatment of chronic lateral epicondylitis.

Methods:

We conducted a prospective study in forty-two patients with lateral epicondylitis. Our patients were treated with three to five weekly applications of 6000 impulses of radial shock waves with a progressive protocol. This protocol includes 2000 initial analgesic shockwaves followed by 2000 therapeutic shockwaves, and ending with 2000 of neurostimulation impulses. Analgesic or neurostimulation impulses are done with high frequencies of 12 – 18 pressure waves per second at a very low constant energy of 1.5 Bar. Therapeutic levels are considered above 2 Bar, and the frequency is managed from 12 to 6 impulses per second in a decreasing manner. Follow-up examinations were performed after one month, then every month up to 6 months using a pain visual analog scale from 0 to 10.

Results:

After 6 months of follow up, twenty-seven elbows (64.2%) were free of complaints, 10 (23.8%) were significantly better, 2 (4.7%) were slightly better, and 2 (4.7%) were unchanged. The only minor complication observed in the series was petechiae in 5 (11.9%) patients.

Discussion:

This case series showed the benefits of radial shock waves using a progressive protocol that includes analgesic shockwaves before and after the therapeutic session, in the treatment of lateral epicondylitis.

Conclusion:

Our protocols showed to be effective and safe in the treatment of lateral epicondylitis of the elbow with radial extracorporeal shockwaves. Case control studies are required to follow our results.

P37

Piezoelectric Shockwave Therapy in the Treatment of Chronic Lateral Epicondylitis

Paulo Roberto Rockett

Institution: Ortosom, Brazil

Device and Producing Company: Piezason 100 plus

Introduction:

The aim of the study is to evaluate the efficiency of piezoelectric shockwave therapy in the treatment of chronic lateral epicondylitis.

Methods:

Sixty nine patients (73 elbows), with ages ranging from 32 to 70 years old (average 52 y/o) were included in this retrospective study. Treatment was delivered with a piezoelectric shockwave generator (Piezason 100 plus). The protocol consisted of at least three and a maximum of nine sessions at weekly intervals. Two thousand impulses with energy between 0,22 and 0,32 mJ/mm² were administered in each session. The symptoms were classified using the Visual Analogue Scale, and the clinical evaluation followed the Roles and Maudsley score, at intervals of 45, 90 and 180 days after the treatment was considered finished.

Results:

One hundred and eighty days after treatment the results were classified as excellent in 39,7%; good in 23,3% fair in 13,7% and poor in 23,3% of the patients. Side effects were rare and were associated with pain during or immediately after the applications, but no cases of worsening of the previously reported complaints were observed during follow-up.

Discussion:

The results were evaluated in a consecutive series of patients who did not achieve satisfactory results after the three months of conservative treatment, or in patients symptomatic for more than six months. Procedures were performed in the doctor's office, without anesthesia.

Conclusion:

Shockwave Therapy should be considered as an optional treatment for Chronic Lateral Epicondylitis in cases the conservative treatment failed. It is a non-invasive safe method without significant complications, thus reducing risks and costs of surgical procedures.

P38

Epicondylitis: A Problem with a Difficult Solution

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Institution: (1) ASL AL, Tortona, (2) LIST SpA, Milano, (3) no inst., Italy

Device and producing company: Piezason 300 – Wolf

Introduction:

Chronic epicondylitis is a problem without an easy solution. It may frequently appear in a symptomatic acute mode. The purpose of this study is to verify our results of ESWT in this medical condition with the passing of time.

Methods:

In this retrospective study we checked a homogeneous group of patients including ordinary workers, as well as in amateur sports men and women. We treated 120 patients from January 2010 to September 2011. There was no predominance of the dominant side. The treatment was carried out using a Wolf Piezason 300 device. The protocol of treatment included 4 sessions of 2000 pulses at 0,08mJ/mm².

Results:

The follow-up was after a short period of three months, but for this paper we wanted to verify the results at longer time: 18-24 months. We had excellent or good results in 85% of patients; only in 10 patients (8,5%) we had poor results.

Discussion:

In our series of patients were symptomatic for 6 to 12 months, and the patients had poor or no results with other conservative treatments. We didn't use anesthesiology and there were no complications.

Conclusion:

ESWT is not the answer to all problems of orthopedic pathology, but it is a very good solution for elbow epicondylitis according to the good results and the absence of associated problems reported in the literature and our own series.

P39

Shockwave Treatment for Musculoskeletal Infection

Richard Coombs, Moustafa Hafez, Milad Hanna

Institution: Orthopaedic Clinic, London, UK

Device and producing company: Storz

Introduction:

Musculoskeletal Infections can have serious systemic consequences and be challenging to eradicate. Shockwave treatment is helpful adjunct to the management of difficult cases.

Methods:

A series of patients have been treated with four to ten sessions of shockwave treatment.

Results:

All patients have experienced significant improvement in their symptoms.
No complications have been observed.

Discussion:

Clinical experience of shockwave treatment for infected patients has confirmed the helpful results observed in our experimental studies.

Conclusion:

Shockwave treatment is a useful addition to the management of challenging orthopaedic infections.

P40

Extracorporeal Shockwave Therapy in Spastic Children with Cerebral Palsy

Andrada Mirea (1+2), Gelu Onose (1), Liliana Padure (1)

Institution: (1) University of Medicine and Pharmacy CAROL DAVILA; (2) Emergency Hospital "Elena Beldiman", Romania

Device and producing company: BTL-5000 SWT

Introduction:

As there are already some reports of the use of Extracorporeal Shockwave Therapy (ESWT) for the management of spasticity of children with Cerebral Palsy (CP) the purpose of our trial was to achieve improvement of our patients.

Methods:

We included 56 spastic children (29 males, 27 females) in our study with CP, aged between 5 and 16 years. We used radial focused ESWT for 4 sessions during the admission of each child on the mainly affected muscles using for all children the same treatment parameters (500 shocks, frequency: 10 Hz).

All patients were assessed twice: for the first time during admission (before 1st ESWT application) and the second time at discharge (after the 4th ESWT session). The following examinations have been performed: active range of motion, modified Ashworth scale scores and patient's Quality of Life (QoL).

Results:

We found a significant decrease of modified Ashworth scale level. ESWT also proved to be efficient for the improvement of global functioning of the upper and lower limbs.

Discussion:

For more reliable statistical assessment and improvement of the methodology further studies are necessary.

Conclusion:

ESWT applied 4 times in 2 weeks decreased spasticity level in children without affecting the Quality of Life as other anti-spastic procedures might do.

P41

Combined Non-Invasive Treatment for Plantar Fibromatosis (Ledderhose's Disease) – High-Energetic Focused ESWT and Antifibrotic Therapy Using JetPeel

Karsten Knobloch

Institution: SportPraxis, Hannover, Germany

Device and producing company: Storz Ultra, Storz Medical & JetPeel from TavTecq, Israel

Introduction:

Plantar fibromatosis as Ledderhose's disease is a benign disease creating nodules on the medial plantar side of affected patients. TGF- β is up-regulated as a profibrotic factor. While surgical removal is regarded as the therapeutic mainstay, recurrence rates, scars and impairment of daily activities remain substantial. We sought to combine topical jet-beam antifibrotic therapy with high-energy focused extracorporeal shockwave therapy in plantar fibromatosis.

Methods:

A total number of 11 patients (9 males, 54 \pm 6 years) were included with plantar fibromatosis (Ledderhose's disease) associated with pain. High-energy focused ESWT was applied using a Storz Duolith SD1 (2000 impulses, 3 Hz, 1.24mJ/mm²) in three sessions. This was combined with topical acetyl-cystein instillation as antifibrotic agents (TGF- β -blocker) using the JetPeel jetbeam technology non-invasively.

Results:

Pain at baseline (6.1 \pm 2.0) was significantly reduced to 1.5 \pm 0.9 after 3 months. Softening and flattening of the nodules was noted by all patients in line with a subjective increase of the skin elasticity. No adverse effects were noted.

Discussion:

It appears that high-energetic focused ESWT is able to structurally alter the plantar nodules in combination with antifibrotic non-invasive therapy using the JetPeel system.

Conclusion:

High-energy focused extracorporeal shockwave treatment in combination with topical antifibrotic therapy reduces pain and improves skin texture in plantar fibromatosis (Morbus Ledderhose) in this pilot cohort study.

P42

High-Energetic Focused Extracorporeal Shockwave (ESWT) Reduces Pain Levels in the Nodular State of Dupuytren's Disease (DupuyShock) – A Randomized Study

Marie Kühn (1), Heiko Sorg (1), Peter M. Vogt (1), Karsten Knobloch (2)

Institution: (1) Hannover Medical School; (2) SportPraxis, Hannover, Germany

Device and producing company: Storz Duolith SD1

Introduction:

Given the effect of high-energetic focused shockwave therapy (ESWT) in the resolution of kidney stones we hypothesized whether high-energetic focused ESWT is able to improve quality of life and reduce pain in the nodular state of Dupuytren's disease.

Methods:

In this prospective, randomized, blinded, placebo-controlled single center trial we included 58 patients (mean age: 58.2±9.2, 35 males, 23 females) with nodular Dupuytren's disease Tubiana N. They were randomly assigned to receive either

- 3 treatments with high-energetic focused ESWT (2000 shots, 3Hz, mean: 49mJ/mm²/hand, Storz Duolith SD1, n=27, 15 males, mean age 57.6±8.1)
- or placebo (2000 shots, 3 Hz, 0.01mJ/mm²/hand, n=25, 17 male, mean age 58.9±10.9) in a weekly interval

Outcome was assessed by three validated quality of life instruments

- DASH score (0=perfect, 100= maximal impairment)
- MHQ score (0=maximal impairment, =perfect)
- URAM scale (0=perfect, 45=maximal impairment)

In addition, pain on a visual analogue scale and grip strength (JAMAR) were assessed before and after three months.

Results:

Treatment with ESWT reduced pain from 3.6±1.8 to 1.90±1.2 (53% reduction, p=0.0096) in intervention group, whereas in placebo group pain even increased from 2,24±1,36 to 3,53±1,70 (58% increase) (p=0.0096). Quality of life score tended to improve in the intervention group (MHQ: 77±19 to 83±15, DASH: 12±18 to 9±12, URAM: 3±4 to 2±4) while it deteriorated in the placebo group as Dupuytren's disease was progressing (MHQ: 80±15 to 77±16, DASH: 6±10 to 8±10, URAM: 1±2 to 2±3). The strength of the affected hand and fingers did not change significantly in either of the groups (JAMAR Intervention: 37±12kg to 37±13kg, Placebo: 39±14kg to 40±14kg). No adverse events were reported beside a moderate pain during treatment.

Discussion:

It appears that high-energetic focused ESWT is able to reduce pain and improve quality of pain in nodular Dupuytren's disease.

Conclusion:

Treatment with extracorporeal focused shockwaves reduces pain in patients with nodules in Dupuytren's disease.

P43

Unusual Skin Reaction Following Repetitive Focused ESWT for Chest Wall Pain in Serial Rib Fracture in a Triathlon Athlete – A Case Report

Karsten Knobloch

Institution: SportPraxis, Hannover, Germany

Device and producing company: Storz Ultra

Introduction:

Focused extracorporeal shockwave therapy has been shown to accelerate bony union in fractures with delayed healing or in pseudarthrosis. On the other hand, acceleration of bony healing might be achieved by focused ESWT treatment earlier after the injury in order to reduce pain and improve quality of life. Serial rib fractures are shown to be associated with prolonged pain and disability lasting for more than eight weeks after the injury (Fabricant L et al. Am J Surg 2013).

Methods:

As such, I hypothesized that focused ESWT early after the chest wall injury (after one week) might accelerate rehabilitation time substantially with earlier return to sport.

Results:

A 55-year-old triathlon athlete sustained a blunt bicycle crash while on a training camp on a Spanish island. He did not seek medical attention and continued his planned training routine for another 5 days with substantial chest pain. Following his return to Germany I could demonstrate a serial rib fracture on his left chest wall (costae 5-7) with pain level 7 out of 10, which was treated with focused ESWT (Storz Ultra, 1000 impulses, 0.8-1.24mJ/mm²) in three sessions. Following the first focused ESWT treatment kinesiology tape was used on his left chest wall. Two days later he experienced itchiness and removed the tape. Pain in his daily activities was markedly reduced. Two weeks later on the scheduled third focused ESWT session (3 weeks after the injury) a callus formation could already be demonstrated in chest wall ultrasound with markedly diminished pain (VAS 1-2/10). The day after the third focused ESWT session he already could swim in freestyle fashion, the day after he worked in his garden with the first sunlight exposure in spring time in Hannover, Germany.

Discussion:

One day later, three days after the last focused ESWT treatment, he developed a substantial erythema on his left chest wall of 10x10cm dimension with substantial itchiness. Two days later he presented himself again in my practice while the erythema was reduced. Ultrasound was performed now using alcohol only without ultrasound contact gel which was suspected to be involved in the skin reaction. Low dose focused ESWT (0.13mJ/mm², 1000 impulses) was used for a local immunosuppressant effect which relived the itchiness immediately from 6/10 to 2/10.

Conclusion:

It appeared that the hypo-allergic ultrasound contact gel used for both, serial ultrasound as well as serial focused ESWT has triggered a skin reaction in this triathlon athlete. Conserving agents such as MIT (methylisothiazolinone) and BIT (benzisothiazolinone) might be the triggering substances in the contact gel, which was facilitated by the prior minor skin reaction towards to chest wall from the kinesiotape. Typically a repetitive exposure (three ultrasound examinations and three focused ESWT sessions) combined with an external trigger (such as UV light as a

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phototoxic trigger) might have provoked the erythematous skin reaction with the itchiness in the patient. Alternative contact measures such as alcohol spray for both, ultrasound and focused ESWT, are recommended in this rare circumstances as presented in this case. On the other hand this illustrative case presents the rapid return to sport and immediate relief of pain in serial rib fractures in a triathlon athlete.

P44

Extracorporeal Shockwave Therapy for Chronic Foot Ulcers at One and Five Years

Ching-Jen Wang

Institution: Chang Gung University College of Medicine, Kaohsiung Chang Gung Memorial Hospital, Taiwan

Device and producing company: DermaPACE; Sanuwave, USA

Introduction:

Recent studies showed that extracorporeal shockwave therapy (ESWT) is effective in the treatment of chronic foot ulcers in short-term. However, the long-term effect of ESWT is unknown. The purpose of this study was to evaluate the long-term results of ESWT in chronic foot ulcers with one- and five-year follow-up studies.

Methods:

The study included patients with non-healing diabetic and non-diabetic foot ulcers for longer than 3 months. Patients with cardiac arrhythmia or pacemaker, pregnancy, malignancy, joint sepsis, skeletal immaturity and poor compliance were excluded. Seventy-four patients with 80 ulcers were screened and 67 patients with 72 ulcers were assessed for eligibility including 38 patients with 40 ulcers in the diabetic group (DM) and 29 patients with 32 ulcers in the non-diabetic group (non-DM). All patients received ESWT using Derma-PACE shockwave device (SANUWAVE, Alpharetta, GA) twice/week for 6 treatments. The follow-up examinations were scheduled at 1, 3, 6 and 12 months, and then once a year. The evaluations included clinical assessments of the ulcer status, mortality and morbidity including amputation and local blood flow perfusion scan at one and five years after ESWT.

Results:

Sixty-seven patients with 72 ulcers were examined at one year. Completely healed and $\geq 50\%$ improved ulcers were 83.4% in total series, 73% in the DM group and 97% in the non-DM group. Excluding 10 deaths, 57 patients with 61 ulcers were evaluated at five years. Completely healed and $\geq 50\%$ were 62.1% in total series, 46% in the DM group and 77% in the non-DM group. Twelve cases (8 in the DM group and 4 in the non-DM group) underwent debridement and skin graft for un-healed ulcers after ESWT. Ten patients (9 in the DM group and 1 in the non-DM group) died with the mortality of 15% in total series, 24% in the DM group and 3% in the non-DM group. Six patients (5 in the DM group and 1 in the non-DM group) required amputation because of osteomyelitis and vascular occlusion. The rates of amputation were 11% in total series, 17% in the DM group and 4% in the non-DM group. The blood flow perfusion scans showed significant increases in blood flow perfusion rate at 1 year, but decreased at 5 years after ESWT with better data in non-DM group.

Discussion:

ESWT was shown effective in acute and chronic wounds, improvement in blood flow perfusion, burn healing as well as skin flap survival. This study showed that ESWT is effective in chronic diabetic and non-diabetic foot ulcers in short- and long-term follow-up. However, the natural cause of the disease may predispose the disease progression that leads to mortality and morbidity including amputation. The amputation rate is much lower after ESWT as compared to

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other methods of treatment. One speculates that intermittent booster ESWT may be beneficial to reduce the morbidity of amputation in chronic foot ulcers.

Conclusion:

ESWT appears to be effective in chronic diabetic and non-diabetic foot ulcers in the early stage of treatment. The clinical outcomes of the ulcers correlated well with the improvement of local blood flow perfusion. However, the overall clinical results and the blood flow perfusion deteriorated with time from one to five years after ESWT. It appears that the nature course of the disease may have predisposed to the disease progression with time leading to mortality and morbidity including amputation. Therefore, a total care with multi-disciplinary approach is necessary to provide the optimal treatment for patients with chronic foot ulcers. ESWT is an innovative and effective adjunctive therapy in patients with chronic foot ulcers. It is speculated that intermittent booster ESWT may prolong the effect to sustain tissue viability in chronic foot ulcers.

P45

Extracorporeal Shockwave Therapy Reduces Progression of Knee Osteoarthritis in Rabbits by Reducing Nitric Oxide Level and Chondrocyte Apoptosis

Gen Yan Xing, Zhao Zhe

Institution: General Hospital of Chinese Peoples' Armed Police Forces, Beijing, China

Device and producing company: EMS

Introduction:

The goal of treating osteoarthritis (OA) is finding ways to decrease joint pain and dysfunction and prevent and slow the cartilage degeneration. Extracorporeal shockwave therapy (ESWT) has been found to improve motor dysfunction and ameliorate pain with OA in animals. However, few studies have found that it can prevent and slow joint degeneration in vivo. The aim of study was to investigate the effect of ESWT on OA in rabbit.

Methods:

A total of 30 male New Zealand white rabbits were divided into 3 groups: control, OA induced by anterior cruciate ligament transaction (ACLT) and ACLT plus ESWT. The animals were killed at 4 and 8 weeks. Nitric oxide (NO) level was measured in the synovial cavity of knee joints and cartilage sections were graded macroscopically by a Mankin scoring system. Chondrocyte apoptosis was investigated by flow cytometry and the expression of active caspase 3 by indirect immunohistochemistry.

Results:

ESWT significantly reduced the NO level in the synovial cavity of knee joints ($P < 0.05$) and chondrocyte apoptosis ($P < 0.05$) of rabbits with OA. ESWT treatment significantly decreased the severity of cartilage lesions at both times as compared to rabbits with OA alone ($P < 0.05$).

Discussion:

Although ESWT can relieve OA symptoms and improve function, the mechanism of action was not well demonstrated. We showed that ESWT reduced the histologic grading of cartilage lesions in rabbits with OA. Although the macroscopic grading of cartilage lesions was not significantly improved with ESWT, the reduced histology grading represents a structure modifying effect. This finding confirms Wang et al., who found that application of ESWT to the subchondral bone of the medial tibia condyle resulted in regressed OA of rat knees with changes in bone density, bone strength, biomarkers of the bone, and cartilage remodeling.

Conclusion:

ESWT reduced the progression of OA in rabbits. This effect may be related to decreased level of NO and is likely mediated by reduced chondrocyte apoptosis. ESWT may be a useful treatment for knee OA.

P46

Molecular Changes after Extracorporeal Shockwave Therapy in Osteoarthritic Knee in Rats

Ching-Jen Wang

Institution: Kaohsiung Chang Gung Memorial Hospital, Taiwan

Device and producing company: DermaPACE; Sanuwave, USA

Introduction:

Extracorporeal shockwave therapy (ESWT) was shown to have chondroprotective effects in the initiation and progression of osteoarthritis (OA) of the knee in rats. However, the mechanism of ESWT in OA knee is unknown. This study investigated the molecular changes of DKK-1, MMP13, Wnt-5a and β -catenin after ESWT in anterior cruciate ligament transected (ACLT) osteoarthritic knee in rats.

Methods:

Twenty-seven male Sprague-Dawley rats were divided into 3 groups. Group I was the control and received sham knee arthrotomy but no ACLT or ESWT. Group II underwent ACLT but received no ESWT. Group III underwent ACLT and received ESWT one week after surgery. Radiographs of the knee were obtained at 0 and 12 weeks. The animals were sacrificed at 12 weeks, and the articular cartilage and subchondral bone of the knee were subjected to histopathological examination and immunohistochemical analysis.

Results:

Radiographs of the knee showed no discernible difference among 3 groups at 0 week. At 12 weeks, group II showed more arthritic changes including the formation of osteochondral fragments, whereas very subtle arthritis was noted in groups I and III. In histopathological examination group II showed significant increases of Mankin score and decreases of subchondral trabecular bone as compared to groups I and III. Group III showed significant decreases of Mankin score and increases of subchondral trabecular bone with the data comparable to group I. In immunohistochemical analysis group II showed significant increases of DKK-1 and MMP13 and decreases of Wnt-5a and β -catenin in articular cartilage and subchondral bone as compared to groups I and III. Group III showed significant decreases of DKK-1 and MMP13 and increases of Wnt-5a and β -catenin with the comparable data as compared to group I.

Discussion:

Prior studies showed ESWT has chondroprotective effect in OA knees of the rats. The results of this study supported the hypothesis that ESWT improves the subchondral bone remodeling that result in chondroprotective effects in OA knee. In clinical practice, the concept for the management of OA knee may change with the initial focus from articular cartilage to subchondral bone.

Conclusion:

ESWT produces molecular changes associated with improvement in subchondral bone remodeling and chondroprotective effect in ACLT OA knees in rats.

P47

Extracorporeal Shock Wave Treatment for Osteonecrosis of the Femoral Head - Case Report

Ana Claudia Souza

Institution: ORTHOTRAUMA, Rio de Janeiro, Brazil

Device and producing company: Orthogold 120 - SwiTech Medical AG

Introduction:

The objective of this study is to demonstrate the result obtained using ESWT for bilateral Osteonecrosis of the femoral head.

Methods:

A 49 years old male patient presenting bilateral Osteonecrosis of the femoral head stage II FICAT was treated with one single application by an electro-hydraulic device and under sedation. After treatment the patient was instructed to walk on crutches with partial weight bearing for four weeks. Follow up examinations were at one, two, three, six and twelve months. Clinical assessments included to determine pain scores and Harris Hip Score (HHS). Radiographs were performed before and after treatment (0, 1, 2, 3 and 6 months) and Magnetic Resonance Image (MRI) with three and six months after the treatment.

Results:

After three months the patient had recovered clinically, improved in HHS with remission of painful symptoms and also a total remission of the lesion in the MRI.

Discussion:

The principle of treatment of Osteonecrosis is to preserve the femoral head in the early stages. Decompression with or without bone graft is considered the gold standard. However the results of decompression are irregular and inconsistent evolving for total hip arthroplasty (THA). Recently the use of ESWT has been shown to be effective at the beginning of osteonecrosis. Studies have shown that treatment by SW induces neovascularization and osteogenesis. It is reasonable to believe that neovascularization may play a role in improving the blood supply to the femoral head which in turn promotes bone remodeling and regeneration.

Conclusion:

The result found in this case is encouraging, based on clinical and MRI examination. However it is necessary to confirm the efficacy of this new treatment for osteonecrosis through randomized clinical trials and long-term results for a best scientific evidence of the method.

P48

Early Outcome of High Energy Shock Wave in Osteonecrosis of the Femoral Head

Wie Sun

Institution: China-Japan Friendship Hospital, Beijing, China

Device and producing company: Dornier compact Delta II

Introduction:

There is currently no standardized protocol for evaluating and treating osteonecrosis of the femoral head (ONFH). High energy shock wave provides an additional option in the treatment ONFH. The purpose of this study was to evaluate the clinical results and radiographic outcomes of high energy shock wave in the treatment of ONFH.

Methods:

From Jan. 2012 to Dec. 2012 we evaluated 78 ONFH patients (108 consecutive hips) were treated with high energy shock wave. Patients were aged from 21 to 51 (mean age, 35.2 years). According to the classification system of Association Research Circulation Osseous (ARCO), 4 hips had stage I disease, 89 hips had stage II disease and 15 hips had stage III disease and as to China-Japan friendship hospital (CJFH) Classification, L1: 10hips; L2: 46 hips; L3: 33hips; M: 6 hips; C: 13hips. All patients were treated with Dornier compact Delta II (ED was $>0.44\text{mJ/mm}^2$; 3000 pulses per patients. Outcome measures were Harris hip score, radiographic outcome measures and survivorship analysis with revision to total hip arthroplasty as the end point.

Results:

9 patients (16 hips) were lost follow-up. 69 patients (92hips) were available for follow-up at a mean of 8.7 months (ranged from 6-12months). Overall 8 hips were converted to total hip arthroplasty (or should be THA) including 1 hip with stage II and 7 hips with stage III. As to China-Japan friendship hospital (CJFH) Classification, L1:0/10hips; L2: 2/46hips;L3: 5/33hips; M: 0/6 hips; C:0/13hips. According to analysis of COX risky model, CJFH type ($P=0.01$, risk degree 2.552, 95% CI 1.31~4.43) and pain score postoperatively ($P=0.001$; risk degree 0.539, 95% CI 0.323~0.535) were independent risk factors for failure of radiography. Sizes of lesion, location of lesion and pain score before treatment were independent risk factors for revision. According to Logistic regress analysis, successes of clinic were associated with CJFH type and ARCO classification.

Discussion:

The results of the current study showed regression of the lesion in and progression with stage I and II lesions after shockwave treatment. It appeared that extracorporeal shockwave treatment significantly altered the natural history of the hips affected by early ONFH.

Conclusion:

The survival rate after high energy shock wave treatment of osteonecrosis of the femoral head was affected by ARCO stage and CJFH classification. In total 91.31% hips got acceptable result which is a viable option for the treatment of ONFH.

P49

**Extracorporeal Shockwave Therapy (ESWT) in Osseous Non-Unions:
A German Cohort Study**

Frank Bätje

Institution: Private General Medicine Office, Hannover, Germany

Device and producing company: Duolith Ultra, STORZMEDICAL, Switzerland

Introduction:

Shockwave therapy is more or less established as an alternative treatment to surgical interventions for impaired osseous healing like delayed or non-unions after fractures or arthrodesis. This cohort study looked for own results and best practice of focused shockwaves in adequate cases.

Methods:

Between 2001 and 2010, 381 unselected bone fractures or arthrodesis with persistent impaired healing were included in this pilot study. Details about outcomes were received by questionnaires, X-ray-evaluations and transmitted information from doctors or the patients themselves.

Only hard facts concerning bony consolidation of the fracture gap has been of interest to assess bony healing.

Results:

Overall 239/381 cases (63%) showed sufficient bony consolidation after ESWT. Cases of impaired fracture healing showed better (66%) success rates than those of impaired arthrodesis healing (47%). Healing rates in impaired unions ranged from 93% after scaphoid fractures to only 23% after talo-calcaneonavicular arthrodesis.

Discussion:

As long as there are no consistent definitions of pseudarthrosis and non-comparable results of surgical outcomes in cases of impaired osseous healing ESWT is an alternative to surgery in selected subgroups because of the satisfying success rates in selected groups of impaired bone healing.

Conclusion:

As ESWT is a serious alternative to surgery in cases of impaired bone healing all physicians who use this option must be certificated and have to use comparable shockwave devices in the interest of improvement of successful therapy protocols for different bone healing complications.

P50

Combined Treatment of Scaphoid Non-Union by Surgery and Additional Extracorporeal Shockwave Therapy (ESWT)

Stefan Quadlbauer (1), Christoph Pezzeri (1), Josef Jurkovitsch (1), Thomas Beer (1), Wolfgang Schaden (2), Heinz Redl (3), Martin Leixnering (1)

Institution: (1) AUVA Trauma Hospital Lorenz Böhler - European Hand Trauma Center; (2) AUVA Trauma Hospital Meidling; (3) Ludwig Boltzmann Institut for experimental und clinical traumatology, Vienna; Austria

Device and producing company: OrthoWave 280, MTS, Konstanz, Germany

Introduction:

Non-union of the scaphoid is even today a challenge for the treating hand surgeon. Main cause of a scaphoid non – union is the overlooked fracture with an inadequate immobilization or a fracture in the proximal third of the scaphoid. Through its specific retrograde blood supply, with entrance of nutritive blood vessels in the distal pole the proximal pole is only supplied by terminal blood vessels. However as a consequence scaphoid non-union lead to an osteosclerosis at the fracture surfaces and tilting of the fracture (“humpback – deformity”). Tilting of the fracture and instability of the wrist causes a change in wrist biomechanics and leads to wrist arthritis. These changes consequently result at the end in a carpal collapse the so-called SNAC – wrist. Several methods for treating scaphoid non-union are available, like sole bone graft in the technique according to Matti–Russe additional stabilization through a headless bone screw or angle stable plate. In the last decades extracorporeal shockwave (ESWT) established in the treatment of non-union. Schaden et. al reported a healing rate of delayed union or non-union treated by ESWT of 81 %. However the mechanism of shockwave therapy is not fully understood, there is good evidence that it leads to an angio- and vasculogenesis in the treated tissue which causes a persisting increase of blood supply. It was also shown in recent publications that shockwaves have a positive influence on the migration and even differentiation of stem cells. To our knowledge there is no publication that proves the effects of combined therapy of scaphoid non-union by surgery with headless bone screw or plate and additional extracorporeal shockwave therapy.

Methods:

All scaphoid non-unions, treated by operation and additional ESWT had been read out of the archive of the AUVA (Allgemeine Unfallversicherungsanstalt - the Austrian Workers' Compensation Board), anonymized by the patient´s number and had been analyzed retrospectively. For statistical analysis age, gender, range of motion (ROM), date of accident, date of surgery, last follow up, surgical technique were investigated. All fractures had been classified by the Herbert classification. The last CT was analyzed to judge bony bridging and signs of arthritis. An existing DISI – deformity, SNAC – wrist or humpback deformity had been documented.

Results:

With a combined therapy of surgery and additional ESWT in all cases fracture union was achieved. DISI – deformity, SNAC – wrist or humpback deformity wasn´t found in any case.

Discussion:

In a high percentage ESWT leads to union of delayed or non - union fractures and increases the union rates in combination with surgery in scaphoid non-unions.

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Conclusion:

Combined therapy of scaphoid non-union by surgery and additional ESWT should be considered as standard therapy in scaphoid non-unions.

P51

The Effectiveness of Extracorporeal Shockwave Therapy in the Treatment of Surgical Hand Scars

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(5) Department of Molecular Medicine, 'Sapienza' University, Viale del Policlinico, 155, 00161 Rome, Italy.

Device and producing company: DermaGold, MTS, Konstanz, Germany

Introduction:

Cutaneous scarring can cause patients symptoms ranging from psychological to physical pain. Although the process of normal scarring is well described the ultimate cause of pathological scarring remains unknown. The retracting scars on the hands may cause significant functional deficits. For this reason clinical studies for preventative or curative scarring treatments are crucial.

Previous studies showed that shockwaves are effective in stimulating several endogenous growth factors such as EGF, IGF1, VEGF and nitric oxide production inducing angiogenesis and promoting the healing of fractures, ulcers and complex lesions. In 2009 Kuo et al. also showed that ESWT is able to: 1) reduce the inflammatory response with subsequent reduction in the number of circulating leukocytes and of oxygen free radicals; 2) promote the production of fibroblasts and the vascularization of the compromised skin, thus reducing the number of apoptotic cells. The aim of our study was to evaluate the efficacy of the treatment of hand scars with unfocused shockwaves and to judge the improvement of the function of the hand.

Methods:

We studied a group of 60 patients, aged between 20 and 65 years, with painful scars over one month after surgery. The patients were randomly divided in 5 groups: group A with surgical scars did not receive treatment with ESWT (control group), group B with surgical scars received treatment only with unfocused ESWT, group C with surgical scars with regional pain complex syndrome received treatment only with unfocused ESWT, group D with surgical scars received treatment with unfocused ESWT associated with manual rehabilitation, group E with surgical scars received treatment with unfocused ESWT associated with manual rehabilitation and local treatment with I-COONE system.

The patients were treated with a frequency of 2 sessions every 7 days for 5 weeks with Dermagold system using 500 impulses at 0,11 mJ/mm².

Their evolution was monitored by histological and clinical examination, scar scales and photography.

For histological examination, biopsy specimens were performed on patient's scars before and 5 weeks after shockwave therapy and subsequently stained with hematoxylin-eosin, picosirius red and immunohistochemical stains for FXIII, CD34 to evaluate collagen and stain for CD34 to assess vascular response to therapy. Biopsies were also taken from patients who did not undergo shockwave therapy.

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Scar scales have been devised to quantify scar appearance in response to treatment. We used 3 scar scales for the evaluation that were originally designed to assess subjective parameters in an objective way. The Vancouver Scar Scale (VSS), Patient and Observer Scar Assessment Scale (POSAS), Visual Analogic Scale (VAS). These observer-dependent scales consider factors such as scar height or thickness, surface area, texture, pigmentation and vascularity.

Results:

In the groups B, C, D, E a significant improvement of vascularity, color, height, thickness, pigmentation, and a significant reduction of scars hypersensibility and a remission of pain has been observed evaluated with Visual Analogic Scale. Reduction of hand disability and return to the daily activity was very important for shock wave treated patients. Conversely the control group not receiving shockwave therapy did benefit on the reduction of hand disability and pain and did not show a significant improvement of vascularity, color, height, thickness, and pigmentation.

We observed in all patients of B, C, D and E group a more ordered disposition of collagen bundles, increased amount of fibroblasts and vascular proliferation in histological examination compared to the control group A.

Conclusion:

Unfocused shockwave therapy seems to have a positive influence on scar formation on scars of the hand after surgery.

Poster 1

ESWT for Patellar Spur (Case Study)

Ayman Elwely Balabel, Faisal Ramadan Al-Kandary, Shafeek Abubacker

Institution: Ahmadi Hospital, Kuwait Oil Company, Kuwait

Device and producing company: EMS Swiss Dolorclast®

Introduction:

Patella bone spurs are abnormal bone growth that develops along the joint margins of the patella, Bone spurs are also known as osteophytes. They can affect any part of the body, including the shoulders, hips, and the spine. They develop in the joint areas where the bones meet other bones, or where the bones connect to the ligaments and tendons. In majority of the cases, there are no significant symptoms and the condition can remain undetected for years. However, in some cases when it causes severe pain and loss of motion of the joints, it needs to be treated immediately. Treatment options vary from non-surgical (conservative treatment) to surgical excision of spur to remove bony projection.

Methods:

A case of a 51 y old very active man is described. He used to play cricket and did gymnastic exercise regularly. He presented himself in our clinic with an anterior knee pain over the patella for the last 5 months, mainly as a suprapatellar pain. He was limping and unable to do squatting, upstairs and downstairs walking. Pain was VAS 8-9 and he was unable to do full flexion of the knee, showed weakness of the knee extensor muscle and had tried multiple conservative treatments for last few months. X-ray had been taken and showed a patellar spur. R-ESWT treatment has been advised for 3 sessions at weekly intervals. Each treatment consisted of 3000 pluses at a frequency of 9-11 Hz and a pressure of 1.9–2.7 bar. The patient was advised to stop any activities or sport during and after treatment program for a minimum of 4-6 weeks. Treatment was performed as an outpatient procedure without anaesthesia.

Results:

Follow up at 3 months showed a significant improvement for pain (VAS 2-3), ROM and a full flexion. Patient was advised to start eccentric exercise program and graduated muscle power exercises close chain exercises as well as home program exercised. Follow up at 6 months showed an excellent improvement for pain & ROM. Muscle power has been improved back to its normal activities with walking and exercising. X-ray showed that the spur was reduced in size.

Discussion:

Radial Shock Wave Therapy showed a significant clinical improvement for both pain and ROM in people with patellar spur.

Conclusion:

The authors considered that SWT is as first line to treat patellar spur, provided no contraindication related for the patient since the treatment is non-invasive, effective and shows absence of side effect.

Poster 2

A Retrospective Comparative Study

Dujo Rodriguez Fernando

Institution: Hospital Madrid Sanchinarro, Madrid, Spain

Device and producing company: Dornier AR-2

Introduction:

We will show documented cases through which we can see that the shockwaves are more effective than other traditional treatments.

Methods:

We have compared similar pathologies that we have been treating this year using different techniques: Surgery/Orthopedics/Rehab and Shockwaves.

Results:

The results have been the improvement and healing that patients experience with a comfort and a relief from their ailments.

Discussion:

Shockwaves are an indispensable ally in any service of orthopedics, plastic surgery, rehabilitation and must be associated with the emergency services.

Conclusion:

The shockwaves, whenever they are indicated, decrease the sick leave period, shorten the healing period and decrease the number of aftermath.

Poster 3

Radial ESWT for Bone Non-Unions - Is it possible?

Paulo Kertzman

Institution: Santa Casa de Sao Paulo, Brazil

Device and producing company: Dolorclast, EMS

Introduction:

Is there any possibility to use R-ESWT for a non-union treatment?

Methods:

We will show some cases of superficial bone non-unions treated with R-ESWT.

Results: We have treated 23 cases in 3 different cities with good results in 16 cases (69%).

Discussion: The traditional treatment option for non-unions is surgery. Focused ESWT is a more recognized option. We want to discuss R-ESWT as a new indication for bone non-unions.

Conclusion: For some very specific cases of superficial bone non-unions R-ESWT could be a new treatment option.

Poster 4

Piezoelectric Shockwave Therapy for the Treatment of Chronic Tendinopathy of the Rotator Cuff

Paulo Roberto Rockett

Institution: Ortosom, Brazil

Device and producing company: Piezason 100 plus

Introduction:

The aim of the study was to evaluate the efficiency of piezoelectric shockwave therapy on the course of a Chronic Tendinopathy of the Rotator Cuff.

Methods:

One hundred and thirty one patients (142 shoulders) were enrolled in this retrospective study, ages ranging from 14 to 79 years old (an average age of 53 years). SWT was delivered with a piezoelectric shockwave generator. The protocol consisted of at least three and a maximum of nine sessions at weekly intervals. In each session 2000 impulses at an EFD of 0,22 mJ/mm² and 0,32 mJ/mm² were delivered. The symptoms were classified using the Visual Analogue Scale (VAS) and the clinical evaluation according to the Roles and Maudsley score at 45, 90 and 180 days after the end of the treatment.

Results:

One hundred and eighty days after the treatment the results were evaluated as excellent in 23,3%, good in 40,2%, acceptable in 12% and poor in 24,6% of the patients. Side effects were rare and associated with pain during, and immediately after, the application, but no cases of worsening of the complaints previously reported were observed during follow-up.

Discussion:

The results were evaluated in a consecutive series of patients who did not achieve satisfactory results after conservative treatment for three months, or with complaints for more than six months. Procedures were performed in the doctor's office without anesthesia.

Conclusion:

Shockwave therapy should be considered as an optional treatment to Chronic Tendinopathy of the Rotator Cuff in cases when the conservative treatment failed. It is a safe, non-invasive alternative without significant complications, thus reducing risks and costs of surgical procedures.

Poster 5

The Effectiveness of ESWT in Patients with Myofascial Pain

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Institution: (1) Pamukkale University School of Physical Therapy and rehabilitation, Denizli Turkey, (2) Servergazi State Hospital, Bereketli Beldesi, Denizli Turkey

Device and producing company: Masterpuls MP 100, Storz Medical

Introduction:

The purpose of the study was to investigate the effectiveness of Extracorporeal Shockwave Therapy combined home stretching exercise in patients with chronic cervical myofascial pain.

Results:

Before treatment pain pressure threshold and cervical range of motion (ROM) scores were $5,81 \pm 2,11$ kg and $293,81 \pm 46,47^\circ$, respectively. After the SW treatment the scores of pain pressure threshold and cervical range of motion were $10,80 \pm 2,80$ kg and $350,57 \pm 56,71^\circ$. After the treatment, differences in pain pressure threshold and cervical range of motion were significant ($p < 0,05$).

Discussion:

Pain pressure threshold, cervical range of motion of the patients improved after the radial extracorporeal shockwave therapy.

Conclusion:

Our results suggest that the use of radial extracorporeal shockwave therapy for the management of chronic cervical myofascial pain is effective, leading to a significant increase in pain pressure threshold and improvement of the cervical range of motion after 6 weeks.

Poster 6

Extracorporeal Shock Wave Therapy combined with Arthroscopy for the Treatment of Osteochondral Lesions of the Talus

Gen Yan Xing

Institution: General Hospital of Chinese Peoples' Armed Polices Forces, Beijing, China

Device and producing company: Swiss Dolorclast, EMS

Introduction:

The present study determined the effect of a new combination treatment, extracorporeal shock wave therapy (ESWT) with ankle arthroscopy on osteochondral lesions of the talus (OLT).

Methods:

From June 2009 to January 2011, the data of 26 patients of OLT (30 taluses, in total) were recruited. The patients were firstly treated with ESWT every other day for 5 times. The energy was 3-3.5 bar and the lesion area was decided as shock point based on the MRI which was impacted for 2000 times with a frequency of 40-50 Hz. After that, all patients performed an arthroscopic debridement, microfracture or perforation. Mazur symptom and functional scoring system was applied to evaluate the differences of ankle's function between before and after treatment for 10 months. The lesion area changes of talus were observed from the MRI results of the treatments for 6, 12, and 18 months.

Results:

After the combination treatment, the ankles function showed a significant improvement ($p < 0.05$) according to the Mazur symptom and functional scoring system evaluation. Meanwhile, analysis of the MRI results obtained in the patients also showed a significant decrease in the proportion of the lesion area ($p < 0.05$).

Discussion:

Interactive and compound effects occur between ESWT and ankle arthroscopy. The ESWT is able to promote osteogenesis and ameliorate topical blood supply, which directly stimulates the recovery of OLT. Moreover, ankle arthroscopy can detach osteochondral fragment or perform perforation to enhance topical and periphery blood supply and accelerate the healing of the injured articular cartilage.

Conclusion:

We can conclude that ESWT combined with ankle arthroscopy is an ideal solution to OLT with the characteristics of a significant effect and a minor invasive and easy acceptance.

Poster 7

Piezoelectric Shockwave Therapy for the Treatment of Calcifying Tendinopathy of the Shoulder

Paulo Roberto Rockett

Institution: Ortosom, Brazil

Device and producing company: Piezason 100 plus

Introduction:

The aim of this study was to evaluate the efficiency of piezoelectric shockwave therapy on the course of a Calcifying Tendinopathy of the Shoulder.

Material and Methods:

Fifty-eight patients (65 shoulders) were enrolled in this retrospective study, ages ranging from 32 to 87 years (average age of 55 years). The treatment was delivered with a piezoelectric SWT generator. The protocol consisted of at least three and a maximum of nine sessions at weekly intervals. In each session 2500 impulses were delivered at an EFD of 0,22-0,32 mJ/mm². The symptoms were classified using the VAS and the clinical evaluation according to the Roles and Maudsley score at 45, 90 and 180 days after the end of the treatment.

Results:

180 days after the treatment, the results were evaluated as excellent in 32,3%; good in 33,9%, acceptable in 15,4% and poor in 18,4% of the patients. Side effects were rare and were associated with pain during or some days after the applications, but no cases of worsening of previously reported complaints have been observed during follow-up.

Discussion:

The results have been evaluated in a consecutive series of patients who did not achieve satisfactory results after conservative treatment for three months, or with complaints for more than six months. Treatment was performed in the doctor's office without anaesthesia.

Conclusion:

Shockwave therapy should be considered as an optional treatment for Calcifying Tendinitis of the Shoulder in cases when the conservative treatment failed. It is a safe alternative, non-invasive, without significant complications, thus reducing risks and costs of a surgical procedure.