The ISMST and the ISMST-Newsletter (International Society for Shockwave Therapy) - An international platform for communication and knowledge transfer

Since the end of the 80’s, musculoskeletal shockwave therapy has been researched in the field of orthopaedic traumatology, and administered to patients suffering from various sorts of ailments. So it was simply a matter of time before working groups and practitioners’ meetings became registered associations and societies. By 1994, national organizations like the German Association for Musculoskeletal Shockwave Therapy (DGST), the Swiss Association for Orthopaedic Shockwave Therapy (AMST) and working groups within the German and Austrian Associations for Orthopaedic and Traumatology (AK 10 of the DGU and AK-EKVT of the OGO) had been established. Non-German-speaking organizations such as the National Association for ESWT in Italy (SITOD) likewise followed suit. This new technology spread with such explosive force and demonstrating such immense success that an international coordination and communication platform for these organizations soon proved necessary. To this end, the European Society for Shockwave Therapy (ESMST) was founded on 14 June 1997, during the German Orthopaedic Association (DGU), today the DGUOC) Congress in Vienna, for the purpose of bringing together European researchers and practitioners. Representatives of the management and advisory boards were drawn from all the then existing national organizations.

Immense interest in the technology and the first of many promising publicized results gave impetus for the association to convene on a regular basis. A decision was made for an annual conference, to be held each time in a different country. To ISMST’s delight, the personal efforts of its members from the various states helped make these meetings a reality and a success. The list of locations (table) where the association has since met reflects this worldwide resonance. With the ISWST expanding beyond the European border - and Japan, Taiwan and the US on the threshold of becoming active members, the association was renamed the International Society for Shockwave Therapy (ISMST) in London, 1999.

From the inception, the expressive aim was to gather in one place, if possible, all those who are interested in shockwave therapy, in order that the transfer of knowledge not be restricted to national societies and associations or practitioners’ groups that specialized in individual devices. With additional applications of this highly successful therapy, the range of healthcare professionals and scientists broaden from accident surgery and orthopaedic to include those in veterinarian medicine, cardiology, sports medicine, dermatology and plastic surgery. The ISMST today has grown to 45% full members, and an additional 81 awaiting membership, from 55 countries (see list, as of 31.12.05).

Well attended from the start, the conferences are marked by lively discourses on the developments of shockwave therapy. While the initial focus of the conferences was on case reports and small serial presentations, the last years have been marked by the rise in scientific standard, exciting clinical trials and spectacular works in fundamental research. This has imbued the conferences with vital impetus and, in turn, greatly influenced research in ESWT clinically as well as animal models. The talks and debates within the congresses and outside the conference halls have powerfully driven developments.

Right from the get-go, the ISMST has sought contact with the industrial sector in order to set itself up as an information clearinghouse and intermediary between research and business. In particular, the continued presence of a platform for manufacturers of devices provides the opportunity for discussion and collaborative development of new technology. The agreement to standardize technical specifications regarding shockwave strengths, frequencies and forms allows for the scientific comparability of studies of various sorts. As all clinical studies must employ unified rules of bismetrics, works on shockwave have likewise been standardized by the use of a uniform set of physical parameters.

The ISMST has been able to set up excellent contact to all the national associations - some of which were organized within the ISMST,
The presence of bone marrow edema may be associated with a wide range of focal bony lesions, including malignant, benign, non- malignant, or inflammatory conditions which may be occurring simultaneously. There is no clear evidence that non-invasive imaging modalities (US, MRI) are capable of assessing isolated bony lesions or bone marrow oedema. The only way to assess bone marrow oedema is to surgically biopsy it. For the clinical management of bone marrow oedema, the effective treatment options are still very limited. However, the understanding of the pathophysiology of bone marrow oedema and the development of new diagnostic tools are advancing rapidly. There is a need for improved imaging techniques to better visualize and characterize bone marrow lesions.
osteoarthrosis), most clinically changes were found at the narrow; level (with accumulation of fluids, fat cell fragmentation and fibrovascular tissue); these changes are obvious due to osteoblasts and, with irregular; bone formation and mild inflammatory changes. All these features (BME, bone marrow oedema or necrotic repair) may be considered as expression of increased bone turnover, in an attempt to react to a pathological stimulus (perhaps hypoxia) (10, 11, 14). Moreover, an increase in interstitial fluid is an expression of bone marrow oedema, if, uncorrected, may lead to necrosis with local collapse of bone (11).

We agree with some of the authors in the literature, that BMESH and related syndromes have been described as a distinct but eventually an early reversible subtype of non-traumatic osteonecrosis (ON) (15, 16). BME can also accompany true ON, generally in the painful phases of the disease (at different joint districts) (2). Osteonecrosis of the femoral head, an example of premonitory lesions of osteonecrosis in subchondral areas as well (FIGURE 1) (17, 18).

BME has been recently recognized in fact to be an important pathogenetic and prognostic factor in degenerative osteoarthritis diseases. It has been described that a spectrum of changes occurs in the subchondral bone, seen with MR scans in patients with osteoarthritis (OA), as “bone marrow edema pattern” (19, 20, 21); and that the first structural finding identified to have a causal relationship to BME is to be right bone marrow oedema (18, 22).

From the histological point of view, in degenerative joint diseases the subchondral bone shows reactive enhanced vascularization and heightened local bone metabolism (23). In particular, angiogenesis and inflammation are closely integrated processes in OA and may affect disease progression and pain (24). Vascularization is accompanied by nerves, Substance P mediated, as identified in erosion channels and osteocytes this offers evidence why articular remodeling is perceived painful; in particular, compressive forces and hypoxia have been postulated to stimulate these new nerves (24).

It is recognized, nowadays, the importance of hemodynamic factors in the development of OA: thus, its hemodynamics (in combination or due to overload) lead to changes in the physicochemical environment of the cells by which subchondral bone formation and bone removal are controlled (21). BME in degenerative osteoarthritis diseases have been described to a spontaneous complete resolution in 0.5% of the cases, while a percentage of 5-9.8% decreasing and 18.8-40% increasing exstension with time (25, 26). Resolution of pain generally coincides with the disappearance of bone marrow oedema (27) and subchondral bone marrow abnormalities have been shown to be predictors of radiographic progression in OA, while reductions in the extent of bone marrow abnormalities is associated with a decrease in cartilage degradation (26), thus confirming that MR alterations may reflect early changes of degenerative disease (2). Considering that OA, osteochondritis dissecans and avascular osteonecrosis may have the same basic etiology, but with different disease severity (27, 28), osteoclasts (OC) and reparative processes (repair) take local, metabolic, or biomechanical altered microenvironment (as it is postulated to be in avascular osteonecrosis and osteochondritis dissecans), may lead also to irreversible tissue damage (osteochondral degeneration).

It is well known as long time that OA primary osteoclast activation and prom treatment could have a key role in preventing worsening and irreversible tissue degeneration.

FIGURE 2.

It has been described that OA subchondral lesions has been reported as a site of localized reactions between antiresorptive treatments (estrogen and bisphosphonates) and improved symptoms and/or decreased bone marrow oedema abnormalities to have been described (35, 36).

A decreased prevalence of OA subchondral lesions has been reported in patients treated with alendronate and/or estrogen and a reduction of symptoms in those treated with risedronate (29), in particular, in osteoarthritis containing bisphosphonates demonstrated more significant therapeutic effects (30). For example, a potent nitrogen-containing bisphosphonate, whose efficacy in the management of postmenopausal and corticosteroid-induced induced osteonecrosis has been proven, has also been employed for bone marrow oedema syndrome relief (31).

In recent years, a number of important mediators of disease progression have been identified and these represent potential therapeutic targets for the prevention or reversing, the pathogenesis of OA (38); in particular, it has been postulated that drugs affecting bone metabolism, such as the antiresorptive treatment of OA, might be a potent therapeutic tool in OA, thus revealing a significant level of interest in subchondral bone as a therapeutic target (37).

Intravenous IP has been proposed also as a novel therapy for the treatment of OA, as “bone core decompression” (31) and subchondral cysts develop in pre-existing regions of subchondral bone edema (subchondral bone marrow edema) (32). According to all above considerations, as for bone marrow in sports medicine and arthritic pathologies in “iatrogenic vascular diseases”, the target of therapy seems to be bone marrow edema.

From the point of view of therapeutic potentialities, since BME and related syndromes can have a self-relying course, in the literature, there are not yet general guidelines and the argument is still under debate, although new strategies seem to have been announced. Against BMSH, for example, other than simply unload and physical therapy, or symptomatic drugs, until further treatment strategies have been developed to actually improve the quality of life (strickly correlated also from the physical point of view). Older pathological conditions, for a long time the BME has been considered as expression of bone marrow necrosis and active repair may be effective in relieving bone marrow oedema (14).

Duch, for example, described the possibility to arrest the spread of necrosis, by reducing the edema. BME may lead to osteoclast equilibrium towards absorption, and regulation of endothelial function mediated by inhibition of proinflammatory cytokines production, partial inhibition of phosphonuciates and lipoyphocytes adhesion to endothelial cells, attenuation of the inflammatory response, through modulation of cellular interactions, example, by suppression of potential mechanism on action of IP, when used for the treatment of pathological conditions, could inhiber endothelial activity (33).

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Fig. 7

The painful bone marrow

The edema of the bone marrow can be related to the anti-inflammatory properties of NO, normally produced in physiological conditions. However, NO can also be produced in pathological conditions, such as in osteoporosis (50). Although their antiresorptive drugs used in the treatment of osteoporosis, some limitations have been reported (48). NO is a powerful inhibitor of bone resorption and has a potential osteoprotective factor; it has been suggested that NO donors can be an alternative therapeutic intervention before surgical treatment. Moreover, NO has emerged also as a strong protective agent in the treatment of osteoporosis and other bone diseases, such as in rheumatoid arthritis (57).

References


The treatment for Extracorporeal Shock Wave Therapy (ESWT) is associated with the induction of nitric oxide-dependent mechanisms that have been identified in several studies. This interaction with nitric oxide has been proposed as a potential therapeutic target for the treatment of musculoskeletal disorders.

**Introduction**

The use of shock waves in different medical entities has been steadily increasing over the past few years. This is due to the fact that, to date, the mechanism of action of shock waves in musculoskeletal disorders remains largely unknown. The main reason for this is due to the fact that, to date, we do not know all the possible mechanisms of action of shock waves in musculoskeletal disorders.

**Results**

Among 114 patients treated with shock waves, 90 patients showed improvement in their shoulder symptoms. The most common symptoms were pain and stiffness. The most common indications for shock wave treatment were rotator cuff tears and bicipital tendinopathy.

**Discussion**

The treatment of shoulder pain using shock waves has been shown to be effective in improving pain and function in patients with rotator cuff tears and bicipital tendinopathy. The results of this study suggest that shock wave therapy may be a viable treatment option for these musculoskeletal conditions.
Shock waves hit cardiac muscle: extracorporeal cardiac shock wave therapy proves safe and beneficial in patients with chronic ischemic heart disease

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The Society of Shock Wave Treatment in Cardiology has not been formed yet, but the growing number of original papers published in cardiology journals on extracorporeal shock wave (ESW) therapy of ischemic heart disease indicates that cardiologists recognize well their main problem. Indeed, epidemiological studies show increasing incidence of post-ischemic heart failure in the general population followed by growing number of hospital admission related to the exacerbation of its symptoms. New treatment options, that could inhibit or retard the progression of the disease and heart remodeling, would save numerous patients and reduce the need for heart transplantation. Shock waves seem to offer great hope with their extracorporeal use in patients with ischemic heart disease.

Two recent clinical studies reveal the positive effects and clinical safety of ESW therapy in patients with severe coronary artery disease. In the study by Fukumoto et al.1 nine patients with over 30 months of history of stable angina pectoris, with no indications for percutaneous coronary intervention or coronary artery bypass grafting, have been treated by ESW applied under echocardiographic guidance to the ischemic regions of the heart 3 times during one week, 200 shots/s, 0.09 mJ/mm² at 20-40 spots each time (Modulith SLT, Storz Medical, Krefeldingen, Switzerland), repeating the procedure after 1, 3 and 6 months. The therapy improved perfusion, evaluated by dipiridamole stress thallium scintigraphy, specifically in the ischemic areas of myocardium. This effect was associated with the reduction of symptoms from III to II CCS class in 55.5% of the patients (III to I in one case) and the reduction in the use of nitroglycerine that persisted over 12 months of follow-up. The group of Khatib et al.2 enrolled at their institution ten patients with similar characteristics (CCS class III or IV despite the maximum tolerable pharmacological therapy) and subjected them to 9 sessions of ESW (3 cycles) over 3 months at the same energy (0.1 mJ/mm²). The overall results raise even more enthusiasm, with 79% success defined as an improvement of angina symptoms to CCS class II or less and a substantial reduction of ischemia in the treated myocardium at follow-up tomograms.

The enthusiasm generated by the results of the first clinical studies may be dampened by the low number of patients, lack of randomization and placebo group. The first problem should be overcome with time, but the solution of the latter may be hampered by the ethical problems and technical obstacles of the therapy, although not described by the patients as painful, is associated with the feeling of coldness in the chest that may be difficult to mimic without the application of shock waves in order to eliminate the placebo effect. As is often the case with the new life saving therapies that enter the clinic long before their action is fully understood, also the mechanisms of the cardiac ESW treatment remain merely a hypothesis. Recent findings, however, shed light on the possible effects of shock waves on cardiac tissue. In a rat model of chronic hind limb ischemia, which mimics the clinical setting of patients with chronic ischemic heart disease, the treatment pre-conditioning with low energy SW improved recruitment of circulating endothelial progenitor cells following enhanced local expression of chemotactic factors, such as vascular endothelial growth factor (VEGF) and stromal-cell derived factor-1. Other convincing results from in vitro studies indicate that the vascular effects of SW application are mediated through enhanced expression of VEGF receptors and their internalization. But the presence of the cardiac resident stem cells that can give rise to new cardiomyocytes, endothelial cells and smooth muscle cells in the adult heart, suggests that more than just a neovascularization is involved in the restoration of heart function after chronic ischemia. In fact, the application of SW on cultured cardiac primitive cells, isolated from human hearts with post-ischemic cardiopathy, enhanced their differentiation and maturation, without causing their apoptosis (authors’ observations, manuscript under revision). Again, the acute and paracrine action of induced by SW expression and release of growth factors seem to be responsible for the observed results. The effects of cardiac ESW therapy emerging from basic science research and from first clinical experience are summarized in the table below.

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One aspect that we observed during the analysis of the material is the appearance of “round cells”, quite similar to mast cells and plasma cells. They are indicative of “acute flogosis” following the axis of the collagens and fibroblasts rows is indicative of a “cellular aspect”. Neo-blood vessels surrounded by fibroblasts rows is indicative of “acute flogosis” and from which similar responses arise. To resolve the anomalous conditions using the normal ontological repair mechanisms.

Discussion

It is significant to note the same reaction in tissue with quite different acoustic impedance. Possibly it is indicative that SW have “target areas” from which similar responses arise. To find neo-blood vessels crossing the area in different directions along resident undisturbed blood vessels following the axis of the collagens and fibroblasts rows is indicative of a “cellular aspect”. Creating a new opportunity to SW and probably inducing a coherent tissue reaction (fig.4).

Bibliography


Fig. 3 - Biopsy taken at 16 weeks after SW treatment. On the left: red arrow indicates neo-vascularization and on the right shows the presence of “round cells” indistinguishable from plasma cells or mast cells.

Table 1. The effects of cardiac ESW treatment emerging from basic research studies and clinical experience.

<table>
<thead>
<tr>
<th>Clinical effects</th>
<th>Biomorphological and functional effects</th>
<th>Cellular effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>• better physical activity tolerance (lower CCS score)</td>
<td>• improved myocardial perfusion</td>
<td>• increased number of endothelial cells per myocyte</td>
</tr>
<tr>
<td>• reduced use of nitroglycerin</td>
<td>• improved contractility and ejection fraction</td>
<td>• upregulation of growth factors and cytokines expression</td>
</tr>
<tr>
<td>• possible reduction of pathological heart remodelling</td>
<td></td>
<td>• activation of progenitors and precursors of cardiac cell lineages</td>
</tr>
</tbody>
</table>

References

4. Nishida T, Shimokawa H, Os K et al. Extracorporeal cardiac shock wave therapy markedly ameliorates ischemia-induced myocardial dysfunction in pigs using cardiac output, 5:220-220. But the presence of the cardiac resident stem cells that can give rise to new cardiomyocytes, endothelial cells and smooth muscle cells in the adult heart, suggests that more than just a neovascularization is involved in the restoration of heart function after chronic ischemia. In fact, the application of SW on cultured cardiac primitive cells, isolated from human hearts with post-ischemic cardiopathy, enhanced their differentiation and maturation, without causing their apoptosis (authors’ observations, manuscript under revision). Again, the acute and paracrine action of induced by SW expression and release of growth factors seem to be responsible for the observed results. The effects of cardiac ESW therapy emerging from basic science research and from first clinical experience are summarized in the table below.

At this stage of the investigations drawing conclusions must be done carefully, nevertheless the cardiac SW therapy seems effective in ameliorating symptoms and reducing ischemia in the treated myocardium. Moreover, tissue preconditioning by shock waves followed by cellular therapy (injection of autologous stem or progenitor cells into coronary vessels or damaged myocardium) may improve healing, survival and differentiation of the damaged tissue, avoiding the stimulation of synthesis and release of growth factors in the chronically ischemic tissue. Further studies are needed to identify the patients and protocols most appropriate for the cardiac SW therapy, nonetheless it is reasonable to state that the new chapter of regenerative medicine will definitely have shock waves as one of its protagonists.
Abstract

Extracorporeal shockwave therapy (ESWT) has become increasingly popular in orthopedics for the treatment of bone and soft tissue pathologies. In spite of the existing data set-up, and studies did not allow comparison due to different test set-ups, media and energy levels (given in “kJ”), we developed a standardized experimental model (Fig. 1) and systematically investigated the influence of energy flux density (ED), impulse rate and growth medium on bacterial survival in vitro. Antibacterial efficacy of ESWT was demonstrated for all tested bacterial strains [24]. Our results with Staphylococcus aureus in suspension (NaCl or CAMHB growth bouillon) further demonstrated that bacterial killing by ESWT was clearly energy-dependent and both the applied impulse rate as well as the administered ED of the single shocks influenced bacterial survival [25]. An increase in impulse counts continuously decreased bacterial growth, and a reduction of bacterial growth by more than 3 logarithmic levels with 350 impulses was observed with fewer impulses. Complete disinfection was achieved with up to 4000 impulses [21]. In contrast, Reid and coworkers pointed to a significant antibacterial effect of extracorporeal shockwaves on infected tissue in vivo [22]. The antibacterial effect of ESWT was neutralized by embedding bacteria in agar and carbonaceous crystals for the simulation of struvite stones. Finally, Von Eiff et al. were able to demonstrate that a certain impulse count was necessary as a minimum threshold value in order for extracorporeal shockwaves to have an antibacterial effect [23]. In suspension, the growth of Staphylococcus aureus was reduced by more than 3 logarithmic levels with 350 impulses or more. However, no antibacterial effect was observed with fewer impulses. Complete disinfection was even achieved in the majority of sufficiently treated wounds.

Since results significantly depended on experimental set-up, and studies did not allow comparison due to different test set-ups, media and energy levels (given in “kJ”), we developed a standardized experimental model (Fig. 1) and systematically investigated the influence of energy flux density (ED), impulse rate and growth medium on bacterial survival in vitro. Antibacterial efficacy of ESWT was demonstrated for all tested bacterial strains [24]. Our results with Staphylococcus aureus in suspension (NaCl or CAMHB growth bouillon) further demonstrated that bacterial killing by ESWT was clearly energy-dependent and both the applied impulse rate as well as the administered ED of the single shocks influenced bacterial survival [25]. An increase in impulse counts continuously decreased bacterial growth, and a reduction of bacterial growth by more than 99.5 % was achieved after the application of 5000 shocks (0.96 mJ/mm² in NaCl, Fig. 2). Bacterial killing was significantly reduced if the tests were carried out in bacterial growth medium (CAMHB) [26]. Similarly, bacterial killing was also enhanced with an increase in ED (Fig. 2). The antibacterial effect of ESWT was again stronger in NaCl at 21°C compared to growth medium (CAMHB) and 37°C. However, impulses of lower ED in the range of 0.38 mJ/mm² were not followed by bacterial killing, but by a promotion of bacterial growth up to 120% (NaCl, 21°C) or even up to 219% under growth promoting conditions (CAMHB, 37°C). Shockwaves of higher ED again demonstrated significant antibacterial potency [25, 26].

We summarize that available data from in vitro studies clearly demonstrated energy-dependent antibacterial effectiveness of shockwaves. Furthermore it has to be recognized that shockwaves might also stimulate bacterial growth under certain conditions that allow optimized bacterial multiplication. Taken the complexity of chronic infections with reduced microcirculation, tissue edema, local necrosis, abscess formation, inflammatory processes, and impaired local immune response into account, in vitro models only provide limited information and in vivo studies are necessary to adequately assess effects of ESWT on an infected tissue.

ESWT and infections: in vivo data

Since infections have always been considered a contraindication for ESWT, in vivo data on the interaction of shockwaves with infected tissue are very limited. Nevertheless, ESWT is increasingly applied to treat chronic wound problems and difficult-to-heal skin lesions like venous ulcerations. Since chronic wounds are frequently colonized by bacteria, chronic wounds have to be regarded an “infection model” for ESWT. Schaden and coworkers reported the results of treating skin lesions with planar shockwaves in a last year’s issue of the “ISMST Newsletter” and observed an overall complete healing rate of 74%, only 7% of patients responded with a wound closure of less than 50% area to be considered failures [27]. Furthermore, no systemic or local side effects of ESWT were reported. In another clinical study, Schaden investigated ESWT in both aseptic and septic non-unions, and observed a healing rate of 77% for both types of non-unions without any complications due to shockwave treatment [28]. The results are limited since the author did not provide a detailed account of infection (history of infection or ongoing active infection); nevertheless, consolidation rates of 77% in septic non-unions are definitely encouraging.

The first controlled study evaluating local and systemic effects of ESWT applied to infected bone was published by a large group in the rabbit model of chronic osteomyelitis [29]. Chronic bone infections were induced by injecting sodium morrhuate and Staphylococcus aureus into the proximal tibia of New Zealand white rabbits. The avoidance of a foreign body as well as the bone sequestrum induced after the injection of sodium morrhuate helped to optimally mimic bone conditions in chronic osteomyelitis and septic infections.
non-unions. After establishment of chronic osteomyelitis, planar ESWT was applied twice to the infected target area (1500 impulses at each session; energy flu density = 0.3 mJ/mm²). An untreated group of similarly infected animals served as a control. Signs of bacterial spreading were not detected in any animal, neither in blood cultures nor in histological analyses of representative organs. Clinical parameters as well as laboratory values remained unchanged after ESWT. Of particular interest, histological scores of osteomyelitis were significantly decreased in the ESWT group compared to the untreated control, thus demonstrating improvement of chronic bone infections in tissue samples of all animals. Based on the available in vivo data we conclude that ESWT of infected bone did neither induce bacterial spreading nor worsening of infection. The results further suggest ESWT to be beneficial in the treatment of chronic bone and soft tissue infections.

Discussion

Chronic musculoskeletal infections, especially chronic osteomyelitis and septic non-unions represent a group of disorders that are extremely difficult to treat and challenge both patients and physicians. Since most patients have a history of soft tissue trauma and / or repeated operations, new and non-invasive treatment options are badly required. However, until now septic non-unions and chronic osteomyelitis have been considered a contraindication for ESWT. On the other hand, a myriad of publications is available reporting successful treatment of septic non-unions by ESWT, with healing rates up to 90% [6]. Ratioues of treating non-unions by ESWT are documented stimulatory effects on bone growth, neovascularization and hyperemia [30-32]. These effects induce healing processes in sclerotic bone, in which vascularization is decreased. Bone scintigraphy and histological analyses are also the essential pathologic factors in chronic bone and soft tissue infections. Furthermore, neovascularization and hyperemia could improve access of immune defense and systemically administrated antibiotics to the site of infection.

We demonstrated that ESWT did neither worsen active bone infections, nor induce bacterial spreading or sepsis in vivo. The studies demonstrated antibacterial potency in vivo. Furthermore, we were able to exclude negative side effects of treating infected bone. A combined application of ESWT and antibiotics might even be more effective and should be studied in a controlled investigation. Based on the available data presented in this manuscript we hypothesise that ESWT should be made available to subjects with septic non-unions, and might even be a therapeutic option in chronic bone infections. These possible new indications should be investigated in future clearly defined and well-controlled studies.

References


Table 1. Current data on the interaction of ESWT with bacteria

<table>
<thead>
<tr>
<th>Author</th>
<th>Bacterial strain</th>
<th>Medium</th>
<th>Impulses</th>
<th>Energy</th>
<th>Bacterial Growth after ESWT</th>
<th>Significance</th>
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<td>20 kV</td>
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<td>E. coli</td>
<td>S. aureus, S. faecalis, P. aeruginosa</td>
<td>Suspension</td>
<td>20 kV</td>
<td>55%</td>
<td>Antibacterial effect when treated in suspension; embedding of bacteria in agar and calcium carbonate crystals prevented bacterial killing by ESWT</td>
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<td>Gollwitzer, 2004</td>
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<td></td>
<td>S. aureus, S. faecalis, P. aeruginosa, S. epidermidis</td>
<td>NaCl</td>
<td>4000</td>
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<td>Energy-dependent killing of bacteria (ED and impulse counts)</td>
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<td>NaCl</td>
<td>0-4000</td>
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Instructions for Authors

Newsletter of Extracorporeal Shockwave Therapy is an international, peer-reviewed journal produced by the International Society for Musculoskeletal Shockwave Therapy (ISMST) and is issued three times a year.

Extracorporeal Shockwave Therapy offers the opportunity to publish original research, clinical studies, review articles, case reports, clinical lessons, abstracts, book reviews, conference reports and communications regarding the scientific or medical aspects of shockwave therapy.

Manuscript Submission

All manuscripts should be sent to the Editor:
By e-mail: prds@uol.com.br
On disk and mail to: Dr. Paulo Roberto Dias dos SantosRua Nathanael Tito Salmão, 233Osasco - São Paulo - Brazil
CEP 06016-075
We encourage authors to submit manuscripts via e-mail. When submitting by e-mail, print mail address and telephone and fax numbers also should be included.

Manuscript Categories

All articles should be well-written in plain English, whereby jargon, acronyms, abbreviations and complicated data should be avoided.

Scientific research:
Theoretical or experimental (basic or applied) scientific research or the practical application of this research. The article should consist of an abstract, key words, introduction, methods, results, discussion, and conclusion.

Case reports:
Review articles on topics of general interest are welcomed. Reviews should include the specific question or issue that is addressed and its importance for the shockwave therapy community, and provide an evidence-based, balanced review on this topic. The article should include a description of how the relevant evidence was identified, assessed for quality, and selected for inclusion, synthesis of the available evidence such that the best-quality evidence should receive the greatest emphasis, and discussion of controversial aspects and unresolved issues. Meta-analyses also will be considered as reviews. Authors interested in submitting a review manuscript should contact the editorial office prior to manuscript preparation and submission.

Length: Approximately 2,000 to 2,500 words and a maximum of 5 references.

Clinical lessons:
Authors are invited to give a description and background information of developments in the field of further diagnostics and clinical tests and methods that are relevant to all aspects of shockwave therapy, training and rehabilitation. It is not necessary to include examples of patients, as in case reports. The articles should be up-to-date, short, accurate, and easy to understand and should contain the following:

- A summary with the clinical relevance (max. 150 words)
- And introduction with the theme of the article
- A description of the used test method or diagnostic
- A conclusion with the practical relevance and practical tips.

Length: Approximately 750 to 1,200 words and a maximum of 5 references.

National organisation communications:
National organisations are invited to describe any aspect of medical care or science in their country, e.g. the function of their medical committee, medical care of their players, research that is being conducted etc.

Approximately 300 to 500 words

Letters to the Editor:
Letters discussing an article that has been published in Journal of Extracorporeal Shockwave Therapy have the greatest chance of acceptance if they are sent in with 2 months of publication. Letters that are approved will be forwarded to the author, who will have 6 weeks to respond. The original letter and the reply will be published simultaneously.

Length: Such letters should not exceed 400 words of text and 5 references. Research Letters reporting original research also are welcome and should not exceed 600 words of text and 6 references and may include a table or figure.

Review of the Literature:
Authors are invited to submit summaries of published articles of particular interest for the shockwave therapy community. The scope of the author should be stated following each summary.

Length: Such a review should be approximately 500 to 700 words. A review of three articles simultaneously should be no longer than 1,000 words.

Conference reports and Abstracts:
Authors are invited to submit reports of conferences they have attended, and to include one to three photographs taken at the meetings. Please include the names and highest titles of the persons that can be identified in the photographs.

Summaries of work presented at the conference may be submitted for publication as well. The article should consist of an abstract, key words, introduction, methods, results, discussion, and figures should be included in the same file.

Letters that are approved will be forwarded to the author, who will have 6 weeks to respond. The original letter and the reply will be published simultaneously.

Length: Such letters should not exceed 400 words of text and 5 references. Research Letters reporting original research also are welcome and should not exceed 600 words of text and 6 references and may include a table or figure.

Approximately 300 to 500 words

References:
Number references in the order they appear in the text; do not alphabetise. In text, tables, and legends, identify references with superscript Arabic numerals. When listing references, follow AMA style and abbreviate names of journals according to Index Medicus. List all authors and/or editors up to 6, if more than 6, list the first 3 followed by et al. Journal: Kibler WB. The role of the scapula in athletic shoulder function. Am J Sports Med. 1996;24(2):325-337.


Footnotes should be avoided.

Review process:
Contributions will be reviewed by the editorial board for scientific research, review papers, case reports, clinical lessons, and abstracts. Manuscripts should meet the following criteria: material is original; writing is clear; study methods are appropriate; the data are valid; conclusions are reasonable and supported by the data; information is important, and topic has general shockwave therapy interest.

Manuscripts with insufficient priority or quality for publication are rejected promptly. Other manuscripts are sent to expert consultants for peer review. Peer reviewer identities are kept confidential, but author identities are known by reviewers. The existence of a manuscript under review is not revealed to anyone other than poor reviewers and editorial staff.

Intellectual property:
• The article must be your own original work.
• If the article contains any photographs, figures, diagrams, summary tables, graphs or other non-textual elements that are not your own original work, you must ensure that you have obtained written permission from the copyright owner to include their work in your article.

Manuscript Preparation:
Manuscripts should be prepared in accordance with the Uniform Requirements for Manuscripts Submitted to Biomedical Journals (Vancouver Style).
http://www.nlm.nih.gov/bsd/uniform_requirements.html

- If submitting by e-mail, text, tables, and figures should be included in the same file. Do not submit duplicate copies by mail or fax.
- Articles should be in Microsoft Word format.
- Double-space throughout, including title page, abstract, text, acknowledgements, references, figure legends, and tables.
- Do not use abbreviations in the title or abstract and limit their use in the text.
- Please use Times New Roman, size 12.
- On the title page include the full names, highest academic degrees, and affiliations of all authors. If an author's affiliation has changed since the work was done, list the new affiliation as well.
- Figures, summary tables and diagrams should be numbered consecutively throughout the paper. Photographs should be clearly labelled.
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- Do not use abbreviations in the title or abstract and limit their use in the text.
- Please use Times New Roman, size 12.
- On the title page include the full names, highest academic degrees, and affiliations of all authors. If an author's affiliation has changed since the work was done, list the new affiliation as well.
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