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Epicondylitis

Radial shock wave therapy for lateral epicondylitis: a prospective randomised controlled single-blind study.

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AIM:
Despite the lateral epicondylitis or tennis elbow is a common cause of pain in orthopaedic and sports medicine, the results of the different modalities of conservative treatment are still contradictory. The purpose of this study was to evaluate the efficacy of radial shock wave therapy (RSWT) in the treatment of tennis elbow.

METHODS:
In a prospective randomized controlled single-blind study, of 75 eligible patients, 62 with tennis elbow were randomly assigned to study group and control group. There were 31 patients in the study group and 31 patients in the control group. Both groups had received a treatment a week for 4 weeks; the study group had received 2000 impulses of RSWT and the control group 20 impulses of RSWT. All patients were evaluated 3 times: before treatment, at the end of treatment and to 6 months follow-up. The evaluation consisted of assessments of pain, pain-free grip strength test, and functional impairment.

RESULTS:
Statistical analysis of visual analogue scale (VAS), disabilities of the arm, shoulder, and hand (DASH) questionnaire and pain-free grip strength test scores has shown, both after treatment and to the follow-up at 6 months, significant difference comparing study group versus control group (P <0.001). Statistical analysis within the groups, showed always statistically significant values for the study group. Also the control group showed statistically significant differences for some analyzed parameters. Nevertheless such differences resulted to be more statistics that not clinics as it showed the percentage of satisfied patients in the study group (87% post-treatment; 84% follow-up) in comparison with that of the control group (10% post-treatment; 3% follow-up), and the number needed to treat (NNT) that is of 1.15 at post-treatment and of 1.25 to the 6 months follow-up.

CONCLUSION:
The use of RSWT allowed a decrease of pain, and functional impairment, and an increase of the pain-free grip strength test, in patients with tennis elbow. The RSWT is safe and effective and must be considered as possible therapy for the treatment of patients with tennis elbow.
**Plantar fasciitis**

**Long-term results of extracorporeal shockwave treatment for plantar fasciitis.**

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

**HYPOTHESIS:**
Long-term results of shockwave treatment are comparable with short-term results.

**STUDY DESIGN:**
Randomized controlled clinical trial; Level of evidence, 1.

**METHODS:**
This prospective study consisted of 149 patients (168 heels) with an established diagnosis of chronic plantar fasciitis, including 79 patients (85 heels) in the shockwave treatment group and 70 patients (83 heels) in the control group. In the shockwave group, patients received 1500 impulses of shockwaves at 16 kV to the affected heel in a single session. Patients in the control group received conservative treatment consisting of nonsteroidal anti-inflammatory drugs, orthotics, physical therapy, an exercise program, and/or a local cortisone injection. Patients were evaluated at 60 to 72 months (shockwave group) or 34 to 64 months (control group) with a 100-point scoring system including 70 points for pain and 30 points for function. The clinical outcomes were rated as excellent, good, fair, or poor.

**RESULTS:**
Before treatment, the groups showed no significant differences in the scores for pain and function. After treatment, the shockwave group showed significantly better pain and function scores as compared with the control group. The overall results were 69.1% excellent, 13.6% good, 6.2% fair, and 11.1% poor for the shockwave group; and 0% excellent, 55% good, 36% fair, and 9% poor for the control group (P < .001). The recurrence rate was 11% (9/81 heels) for the shockwave group versus 55% (43/78 heels) for the control group (P < .001). There were no systemic or local complications or device-related problems.

**CONCLUSION:**
Extracorporeal shockwave treatment is effective and safe for patients with plantar fasciitis, with good long-term results.
**Fasciitis plantaris - comparison between 3 devices**

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**Introduction:**  
During the last 6 years we have the opportunity to use 3 different devices for treatment of chronic fasciitis plantaris and this paper is about our results on 212 feet.

**Methods:**  
We had treated all patients without anaesthesia, the point of application is the medial insertion of the fascia on the heel and the direction of the waves was plantar. All patients received 3 sessions with 2000 shock waves with low and medium energy with one week interval.

**Results:**  
The evaluation was done with one, 3 and 6 months after the conclusion of the treatment. We use clinical aspect like pain when stand, walk and palpation the medial side of the heel. All of the 3 devices offer good and comparable results with 70 to 75% of good results.

**Discussion:**  
Unfortunately we work only in a private clinic with no possibility to develop a placebo group.

**Conclusion:**  
ESWT is effective for treatment of chronic plantar fasciitis independently of the device.
ESW for plantar fasciitis in patients with type 2 diabetes
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Introduction:
Patients with Type 2 diabetes often exhibit plantar fasciopathy that fails to respond to conservative therapies. Increased weight may be a significant factor. Repeated injections and surgical release are associated with increased risks of infection and poor incisional healing. Alternative non-invasive treatment with shock waves should be considered.

Methods:
Patients with plantar fasciopathy and Type 2 diabetes were evaluated. There could be no open wounds or recent history of such. There could be no significant neuropathy. Patients underwent multidirectional focused electrohydraulic shock wave treatment to the involved heel or heels. Visual analogue scoring was done in three pain categories at baseline and three months after treatment.

Results:
Forty-seven patients (51 heels) were treated with shock waves. The composite pain score decreased from 8.3 to 2.9. The results were excellent in 15 heels; good in 19 heels; fair in 9 heels; and poor in 8 heels. Fifteen patients (16 heels) had complete pain relief. The overall satisfaction rate was 67%. No patient developed any neurovascular or cutaneous complications.

Conclusion:
Shock waves should be considered as a reasonable treatment alternative in patients with concomitant plantar fasciopathy and Type 2 diabetes, with the stipulation there be no open wounds at the heel and no significant neuropathy. Overall satisfaction is less compared to non-diabetic patients treated with shock waves.
Study to determine the effectiveness of rESWT for chronic plantar heel pain regarding the short- and long-term outcomes

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Introduction: RCT are needed to prove efficacy of treatment options. If rESWT showed significantly better outcomes at short-term follow-up (FU), long-time FU has to be analyzed as well.

Methods: A total of 254 patients were enrolled. All patients had been suffering from painful heel syndrome for at least 6 months. RESWT was performed without local anesthesia. Two thousand impulses were applied with the working pressure of 0.4 MPa (4 bar). Subjects received 3 shock wave treatments of 2000 therapeutical shock wave impulses each. The primary criteria were: heel pain when taking the first steps of the day (VAS) and heel pain while doing daily activities (VAS). Second criteria were also defined. The endpoints were 3 and 12 months after rESWT. Efficacy was analyzed by comparing the success rates between the treatment and placebo groups and was defined as a 60% reduction in VAS pain scores. The study was performed in accordance to GCP guidelines.

Results: With regard to the demographic criteria, groups are well comparable. At 3 months after rESWT treatment, overall therapeutic success was observed in 75 out of 123 ESWT patients and in 49 out of 116 placebo patients. The rate difference was statistically significantly better in favor of the rESWT treatment. The VAS composite score showed similarly significantly better outcomes. Thus, the difference between the groups (in favor of the ESWT group) at the primary endpoint (visit 7) was enlarged during the follow-up II period. Regarding the percent change of VAS pain reduction on the composite score 12 months after rESWT (end of the follow-up II period), the reduction in the ESWT group was 84.8%, whereas the placebo group showed a 43.2% reduction. The difference at the end of the follow-up II period is 41.6% in favor of the ESWT treatment. The same outcome was found in the secondary criteria as well. The a priori ordered hypotheses of the final statistical analysis plan were statistically significant (P < 0.025 one-sided. All effect sizes (Mann-Whitney) denote more than small superiority of the ESWT group. Only minor side effects, such as petechial bleeding, swelling and discomfort during treatment, were detected.

Discussion: RESWT is effective in treating chronic plantar heel pain after long-term FU. Another RCT is needed to compare focussed and unfocussed ESWT.

Conclusion: Radial shock wave therapy is effective and safe for the treatment of chronic heel pain. The data showed high homogeneity and all analyses confirmed a more favourable outcome with radial shock wave therapy, the effects of which are clinically relevant. The significant difference between the groups increased with the length of the follow-up interval.

No significant side effects were reported, but some minor side effects could occur.
Focused and defocused ESWT. The comparison of the results in the treatment of heel spurs
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Introduction:
In the former time only shockwave devices with focused and radial therapy heads were used in the orthopedic field. Since ca. 2 years defocused shockwave therapy head was used for wound and skin treatment. This was the reason to use therapy head for the heel spur treatments as well.

Methods:
Between 1/2002 and 10/2005 there were treated 179 patients with heel spurs. Follow up: 6, 12, 18 and 124 weeks. Focus head: 1200 shocks, 0,12 - 0,14 mJ/mm2, local anaesthesia 5Hz. Between 11/2005 und 12/2006 95 heel spur patients were treated with defocused therapy head, 1200 shocks 0,14 mJ/mm2, no local anaesthesia, 5 Hz.

Results:
Group 1: 20 weeks after the 1. treatment (in some cases 2 and 3 treatments), VHS 69 %, Roles and Maudsley score 67 % excellent and good, 33 % acceptable and poor Group 2: Defocused therapy head, 24 weeks, VHS 74% Roles and Maudsley score, 75,8 % excellent and good, 24,2 % acceptable and poor (drop out: group 1 45 patients, group 2 21 patients)

Discussion:
better results in group 2, because of the defocused therapy head or of no use of local anaestheia?
ESWT in Plantar Fasciitis - 7 years of experience with two different devices

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Introduction: Comparison of the efficacy of ESWT in the treatment of plantar fasciitis using two different devices at similar levels of energy and the same number of sessions.

Methods: From January 1999 to August 2006 we performed 429 sessions of ESWT on 143 patients. We included 95 patients and excluded 48 due to the impossibility of follow up. The electromagnetic device was used on 51 patients between January 1999 and June 2005. The pneumatic device was used on 44 patients during the period of January 2004 to August 2006. Patient age was between 20 to 81 years; 49 female, 46 male; 50 right foot, 45 left foot, 9 bilateral. The point of application was guided with ultrasound of 7.5 MHz, and with the pneumatic device we applied directly at the point of maximum pain. The energy applied was 0.22 mJ/mm² and 0.18 mJ/mm² with the focused and radial, respectively. We applied 2,000 shock waves over 3 weekly sessions with no anesthesia. The follow up was done using the VAS at 2, 6 and 12 months.

Results: The improvement of pain and function with the electromagnetic device was 52.4% at 2 months post-treatment, 73.2% at 6 months post-treatment and 85.2% at 12 months post-treatment. The improvement with the pneumatic device at 2-month follow-up was 55.2%, at 6-month follow-up was 72.9% and at 12-month follow-up was 84%.

Discussion: Similar levels of energy and numbers of sessions demonstrated similar clinical results.

Conclusion: The effectiveness of ESWT is similar in both devices. ESWT should be the treatment of choice before surgical intervention.
The Effectiveness of Extracorporeal Shock Wave Therapy for Patients with Plantar Fasciitis who Satisfy a Clinical Prediction Rule
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Introduction: Plantar fasciitis is a common cause of heel pain, affecting 10% of the general population. Extracorporeal shock wave therapy has been recommended as treatment for chronic plantar fasciitis in patients unresponsive to conservative treatment. The efficacy of extracorporeal shock wave therapy in plantar fasciitis cannot be ascertained owing to the poor quality of methods in previous studies. The primary goal of this study was to determine the effectiveness of extracorporeal shock wave therapy compared with placebo in the treatment of chronic plantar fasciitis.

Methods: A prospective, randomized, blinded, controlled study with two groups of subjects was proposed. Fifty patients (50 heels), including 25 patients (25 heels) in the shockwave treatment group and 25 patients (25 heels) in the control group. All patients had been suffering from plantar fasciitis for at least 6 months. Pre-treatment measurements including a visual analog pain scale and the modified Roles and Maudsley scale were completed by the subjects. In the shockwave group, therapy was applied twice within a oneweek interval (2 x 2,000 impulses at an air pressure of 3.5 bars and frequency of 8 Hz were given at each sitting). The patients in the placebo group received treatment with the clasp on the heel. ESWT was performed without local anesthesia. At 4 and 12 weeks the subjects again completed a VAS and the modified Roles and Maudsley score.

Results: Before treatment, the groups showed no significant differences in the scores for pain and function. At 12 weeks after treatment, the shockwave group showed significantly better pain and function scores as compared with the control group. There were no systemic or local complications or device-related problems.

Discussion: Extracorporeal shock wave therapy has a statistically significant decrease in pain scores than placebo for patients with plantar fasciitis. Extracorporeal shock wave therapy has a statistically significant increase in functional outcome (better quality of life) than placebo on patients with plantar fasciitis.

Conclusion: Shock wave therapy is effective and safe for the treatment of chronic plantar fasciitis.
Painful shoulder

Effectiveness of radial shock-wave therapy for calcific tendinitis of the shoulder: single-blind, randomized clinical study.

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BACKGROUND AND PURPOSE:
Radial shock-wave therapy (RSWT) is a pneumatically generated, low- to medium-energy type of shock-wave therapy. This single-blind, randomized, "less active similar therapy"-controlled study was performed to evaluate the effectiveness of RSWT for the management of calcific tendinitis of the shoulder.

SUBJECTS:
Ninety patients with radiographically verified calcific tendinitis of the shoulder were tested.

METHODS:
Subjects were randomly assigned to either a treatment group (n=45) or a control group (n=45). Pain and functional level were evaluated before and after treatment and at a 6-month follow-up. Radiographic modifications in calcifications were evaluated before and after treatment.

RESULTS:
The treatment group displayed improvement in all of the parameters analyzed after treatment and at the 6-month follow-up. Calcifications disappeared completely in 86.6% of the subjects in the treatment group and partially in 13.4% of subjects; only 8.8% of the subjects in the control group displayed partially reduced calcifications, and none displayed a total disappearance.

DISCUSSION AND CONCLUSION:
The results suggest that the use of RSWT for the management of calcific tendinitis of the shoulder is safe and effective, leading to a significant reduction in pain and improvement of shoulder function after 4 weeks, without adverse effects.
Nov. 18, 2003 — Both high- and low-energy extracorporeal shock wave therapy (ESWT) are beneficial for treating rotator cuff calcifying tendonitis, although high-energy ESWT appears to be more effective than low-energy ESWT, a randomized trial suggests. Previous trials of ESWT for the treatment of calcific tendonitis of the shoulder have been deficient in their methodology; therefore, whether this treatment is beneficial for this condition is unclear.

Ludger Gerdesmeyer, MD, from the Technical University Munich in Germany, and colleagues sought to determine whether fluoroscopy-guided ESWT improved function, reduced pain, and diminished the size of calcific deposits in patients with chronic calcific tendonitis of the shoulder. Their study, in the Nov. 19 issue of The Journal of the American Medical Association, included 144 of 164 patients who were recruited from seven orthopaedic departments in Germany and Austria. Patients were randomized to receive high-energy ESWT, low-energy ESWT, or a sham procedure. The treatment groups received the same total dose of energy. Treatment was given in two treatment sessions approximately two weeks apart and was followed by physical therapy. Patients were evaluated with the Constant and Murley Scale (CMS) score at baseline, 3 months, 6 months, and 12 months after treatment. Patients also reported self-rated pain and were x-rayed at 3, 6, and 12 months.

All 144 patients completed treatment as randomized, and 134 patients completed the six-month follow-up. Compared with sham treatment, the high-energy and low-energy ESWT significantly improved the CMS score at six months (\(P < .001\) for both comparisons). However, patients who received high-energy ESWT had significantly higher CMS scores than those receiving low-energy ESWT (\(P < .001\)) at six months. "We found similar results for both the 3-month and 12-month CMS comparisons, as well as for self-rated pain and radiographic changes at 3, 6, and 12 months," the researchers report.

According Dr. Gerdesmeyer and colleagues, deposits completely disappeared in 60% of the patients six months after they received high-energy ESWT; this was a nearly threefold greater rate of complete disintegration than was seen in those receiving sham treatment.

Further studies are necessary to determine long-term prognosis and should "examine less-systemic forms of anesthesia, including regional nerve block or local anesthesia," the authors maintain. They add that the threshold between high- and low-energy ESWT has yet to be defined.

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**Learning Objectives for This Educational Activity**

Upon completion of this activity, participants will be able to:

- List the benefits of ESWT for the treatment of chronic calcific tendonitis of the rotator cuff unresponsive to medical therapy.
- Evaluate the efficacy of high- vs. low-energy ESWT for this indication.

**Clinical Context**

The incidence of calcific tendonitis of the rotator cuff is reported at 2.5% to 20%, with similar variability in prognosis. One study, published in the September/October 1993 issue of *Zeitschrift für Orthopädie und ihre Grenzgebiete*, suggests that calcifications with sharp margins disappear in 33% of patients over 3 years, while those with fluffy margins resolve in 85% of patients. Patients tend to suffer limitation in shoulder mobility, tenderness and pain at the site of the lesions. Management ranges from conservative, consisting of nonsteroidal anti-inflammatory drugs (NSAID), physical therapy and subacromial cortisone injections, to invasive surgical removal of deposits using an open procedure. Efficacy for most treatments is not well documented by randomized controlled trials, according to the authors of this study. Ultrasound treatment for calcific tendinitis of the shoulder was reported in the May 20, 1999, issue of the *New England Journal of Medicine*, but it did not show long-term benefit compared to placebo. Previous studies of ESWT have demonstrated benefit in symptom control but had methodological shortcomings. It is unclear which parameters of shock wave therapy are related to absorption of calcific deposits, but studies have shown that ESWT is more effective for calcifying tendonopathy than for impingement syndromes without calcified masses.

This multicenter, double-blind, placebo-controlled 12-month study conducted at seven tertiary orthopaedic sites in Germany and Austria compared the effect of high- vs. low-energy ESWT with sham treatment for symptomatic relief of calcific tendonitis of the supraspinatus tendon.

**Study Highlights**

- 144 of 164 patients screened were selected after referral from primary care physicians, orthopaedists, sports physicians, or health insurance companies.
- Inclusion criteria were age older than 18 years, type I or II (Gärtner criteria) idiopathic calcific disease, at least 6 months of symptoms (pain and tenderness), calcific deposits more than 5 mm in diameter on radiography, and failed conservative treatment (including physical therapy, local anesthetic or steroid injection, and nonsteroidal anti-inflammatory drugs). Rotator cuff injury was excluded by clinical, sonographic, and, if indicated, magnetic resonance imaging before assignment.
- Exclusion criteria were concurrent medical diseases, pregnancy, previous surgery for shoulder pain, bursitis, infection or tumor, instability of the rotator cuff, type III (severe) calcific deposits by Gärtner criteria, neurologic disease, and prior failed ESWT.
- Assignment was by centrally controlled block randomization (48 per block) with concealed allocation (opaque envelopes). Both patients and evaluators were blinded for the duration of the study.
- All patients received 2 treatment sessions 12 to 16 days apart. 48 patients in each group were assigned to 1 of 3 interventions: (1) high-energy ESWT with 1,500 shock waves of 0.32 mJ/mm², (2) low-energy ESWT with 6,000 shock waves of 0.08 mJ/mm², both at 120 impulses per minute, or (3) sham treatment in which no coupling gel was applied but 1,500 shocks with 120 impulses per minute were delivered and patients could hear the sound of shock waves.

- Patients were allowed rescue analgesic therapy throughout the study but no additional intervention was offered other than 10 structured physical therapy sessions after the ESWT treatments. Patients were informed that the ESWT could cause pain at the site of administration.

- Primary outcome was mean CMS score from baseline to 6 months. The 100-point CMS measures both subjective (35 points) and objective (65 points) pain and function, and it includes a functional assessment by a blinded expert. Clinically relevant improvement was defined as a 30% increase in CMS score from baseline. Patients needing additional therapy (such as surgery) were defined as treatment failures.

- Secondary outcomes were changes in mean 3- and 12-month CMS scores, self-rated pain at 3, 6, and 12 months by a 10-point visual analog scale (VAS), and presence and size of calcific lesions by conventional radiography (blinded evaluator).

- Patients in the 3 groups were similar in age (mean age, 47-51 years), ESWT location (85%-90% at supraspinatus tendon), baseline VAS pain score (mean, 6), CMS score (mean, 62), and deposit classification (63%-71% type I). They differed in sex in that the sham group had fewer women (42%) compared with the treatment groups (67% and 73%). The sham and high-energy ESWT groups had smaller mean calcific deposit size (128 and 132 mm²) compared with the low-energy ESWT group (195 mm²).

- At 6 months, both high- and low-energy ESWT groups had significantly improved CMS outcomes compared with baseline ($P < .001$ for both groups) and to the sham group response.

- 6-month improvement in CMS scores were better for the high- than the low-energy ESWT group ($P < .001$), and this was also significant for self-rated pain and radiographic changes at 3, 6, and 12 months.

- Patients in the sham group showed some spontaneous improvement but were more likely to undergo surgery during follow-up and required more pain medication.

- No serious adverse effects were noted. Problems included temporary petechial bruising, subcutaneous hematoma, or skin reddening immediately after therapy, which resolved by 3 months.

**Pearls for Practice**
- Both high- and low-energy ESWT reduce shoulder pain and lesion size and improve function in calcific tendonitis of the rotator cuff compared with placebo.
Achillodynia

Shock Wave Therapy in chronic achillodynia - results of a prospective investigation

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Purpose:
We investigated the influence of shock wave therapy in cases of chronic achillodynia in a prospective manner.

Method:
30 patients (14 male, 16 female; mean age 47,8 years; 7x right, 23x left foot; 8x sport injuries; mean duration of complaints 30,68 months (6 - 240); mean sick leave 1,64 weeks) were presented to our hospital for further therapy. Ambulatory conservative therapy had been unsuccessful (9x physiotherapy; 9x local infiltrations with corticosteroids; 12x insoles; 16x ultrasound; 30x NSAIDS oral medication; 3x radiation; 16x electrotherapy).
Clinical investigation showed the maximum point of tenderness about 5 cm above the insertion of the Achilles tendon in the calcaneus. Ultrasound investigation showed a hypodense area in three cases. Achilles tendon ruptures or partial tears were excluded. MRI showed a mild tendinitis in 2 of those cases. X ray investigation showed Haglund’s exostosis in three cases. 6 times an upper heel spur was found. All patients were treated 3 times in weekly intervals. The epicenter of pain was marked sonografically and was treated with 2000 impulses 0,24 mJ/mm² from the medial aspect of the tendon. No anesthesia was used.

Results:
Following therapy patients were free of symptoms for 2,17 days on average. In patients with Haglund’s exostosis or upper heel spur the pain free period lasted only 1 to 2 hours. The development of pain on the visual analogue scale (3 years follow up) will be demonstrated. Subjective improvement rating following the first treatment session was 42%, after the second session 44% and 60% after the last one. Four weeks following therapy one patient suffered a Achilles tendon rupture. The results could not be improved by using NSAID gel for purpose of coupling. Three months after therapy 60 % of the patients were unsatisfied with the result (Roles and Maudsley Score)

Discussion:
Shock wave therapy may be a useful procedure for treating acute pain after sports injuries. It is value in chronic achillodynia is however restricted. High-energy shock wave therapy should not be used for the Achilles tendon as necrosis of tenocytes may occur. Further prospective controlled randomized studies should follow comparing the effect of this therapy with an untreated control group or a conservative therapy modality.
Achilles tendinopathy: Treatment by extracorporeal shockwaves

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Introduction:
To evaluate the safety and effectiveness ESWT in the treatment of Achilles tendinopathy in three Brazilian orthopedic centers.

Methods:
From May 2002 to February 2006, 118 cases with chronic Achilles tendinopathy were treated. The age of the patients was between 33 and 87 years (average age = 56 years). There were 104 patients, 14 with bilateral treatment; 37 women and 67 men. Inclusion criteria: pain for at least 6 months, three months of unsuccessful conservative treatment and failed surgical procedure. The exclusion criteria were: inflammatory arthritis, corticosteroid injection within the previous 6 weeks, neurological abnormality, gout, malignant diseases, blood coagulation disorders and Achilles rupture. The treatments were performed with an electrohydraulic device. One treatment was performed on 105 cases, 9 underwent a second treatment and 4 cases underwent a third treatment. The subjects were evaluated by means of a clinical evaluation according to Roles and Maudsley score and Visual Analogue Scale analysis 45, 90 and 180 days after the end of the therapy.

Results:
The study showed the efficacy of ESWT was excellent in 26.27%, good in 44.92%, acceptable in 16.95%, and poor in 11.86%, 180 days after ESWT.

Discussion:
ESWT must be considered as an alternative in the treatment of Achilles tendinopathy which has been resistant to conventional procedures.

Conclusion:
ESWT has the advantages of being non-invasive: no significant complications, lower operating costs, and eliminating the substantial potential risks of traditional surgical procedures.
Eccentric loading versus shock wave treatment for chronic insertional Achilles tendinopathy
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Introduction: Nonoperative management of chronic tendinopathy of the Achilles tendon insertion is poorly studied. With demonstrated effectiveness of eccentric loading and of repetitive low-energy shock wave therapy in patients with midsubstance Achilles tendinopathy recently, this randomized controlled trial aimed at verifying effectiveness of both procedures exclusively in patients with insertional Achilles tendinopathy.

Methods: Fifty patients with chronic recalcitrant (> 6 months) insertional Achilles tendinopathy were enrolled in a randomized controlled study. All patients had been treated unsuccessfully for at least 3 months, including local injections and non-steroidal anti-inflammatory drugs and physiotherapy. A computerized random-number generator was used to draw up an allocation schedule. Twenty-five patients were allocated to Group 1 (eccentric loading), 25 patients were allocated to Group 2 (repetitive low-energy shock wave therapy).

Analysis was on an intention-to-treat basis. Primary follow-up was at 4 months, afterwards patients were allowed to cross over. The last follow-up was at one year after completion of the initial treatment. The patients were assessed for pain, function and activity using a validated questionnaire (the VISA-A).

Results: At 4 months from baseline, the VISA-A score had increased in both groups, from 53 to 62 points in Group 1, and from 53 to 80 points in Group 2. The pain rating decreased in both groups, from 7 to 5 points in Group 1, and from 7 to 3 points in Group 2. Seven patients (28%) in Group 1, and sixteen patients (64%) in Group 2 reported that were “completely recovered” or “much improved”. For all outcome measures, Group 1 and 2 differed significantly in favour of shock wave therapy. At 4 months, 18 of 25 patients from Group 1 opted to cross over, as did 9 of 25 patients from Group 2. The favorable results after shock wave therapy at 4 months were stable at 1-year follow-up.

Discussion: Eccentric loading as applied showed inferior results to low-energy shock wave therapy as applied in patients with chronic recalcitrant tendinopathy of the insertion of the Achilles tendon at 4 months of follow-up.

Conclusion: Further research is warranted to better define the indication of this treatment modality.
Chronic Achilles tendon pain: tendon microcirculation and radial extracorporeal shock wave therapy (rESWT)

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Introduction: Achilles tendinopathy is a common cause of posterior heel pain and is often difficult to treat. This condition is more frequent in athletes, particularly runners and jumpers, but it can affect non-athletes as well. The origin and pathogenesis of the tendinopathy are unknown, however some intrinsic and extrinsic factors have been implicated (1,2). Intrinsic factors include abnormal range of motion of the subtalar joints such as those seen in hyperpronation syndrome or a leg length discrepancy. Extrinsic factors for athletes include training errors with subsequent excessive mechanical overload. Other possible extrinsic causes are advanced age, fatigue, and obesity (3,4,5,6,7,8). Recently, some clinical studies have demonstrated the association between increased tendon microvascularity and the symptomatic chronic Achilles tendinopathy. Using Doppler Ultrasonography, an increased vascular density in the Achilles tendon has been demonstrated that is clinically associated with chronic Achilles tendinopathy (9,10,11,12,13). Traditional non-operative treatment of chronic Achilles tendinopathy consists of rest and the administration of NSAIDS. Some studies have suggested different types of therapeutic interventions such as: steroid injection, sclerosing therapy, aprotinin injection, eccentric training, heel lifts and custom orthoses (14,15,16,17,18,19,20). Recently, extracorporeal shock wave therapy (ESWT) has been reported to be effective for the treatment of Achilles tendinopathy, but until now few studies have investigated the efficacy of ESWT for the treatment of chronic Achilles tendinopathy (21, 22, 23 and 24). The purpose of this study is to evaluate the correlation between increased tendon microvascularity and pain and to determine the efficacy of low energy radial ESWT for the treatment of chronic Achilles tendinopathy.

Methods: Twenty-four subjects were evaluated. Twelve athletes (group A – 9 males and 3 females) with an average age of 25.9 years were included. The athletes were runners of mid and long distance races. All twelve patients displayed evidence of chronic Achilles tendinopathy in painful phase and had undergone medical treatment and physical therapy for a minimum of 3 months without clinical improvement. For the control group, we selected 12 subjects (group B – 9 males and 3 females) with an average age of 25.6 years and morphologic characteristics similar to subjects of group A, but who were sedentary. All subjects were chosen for this study after obtaining informed consent and undergoing accurate clinical examination, excluding patients with associated pathologies that would prohibit them from receiving ESWT; coagulopathies, local infection, or tumors. The intensity of pain was registered using a VAS scale for pain with direct palpation of the tendon as well as pain during ambulation. In group B subjects no pain was reported. All 24 subjects underwent one identical ultrasonographic evaluation with Color Doppler, provided by a single operator, using a Toshiba Power Vision 9000 scanner with a small parts 5-12 mHz transducer. The twelve athletes with tendinopathy demonstrated a diffuse disomogeneous hypoechogenicity of the Achilles tendon with blood flow at the depth
over 5 mm (mean 5.5 mm, range 4.5/6.5 mm). All 12 group B subjects demonstrated normal sonographic characteristics of the tendon.

All 24 subjects underwent low energy (less than 3 bar) radial ESWT by the same operator. Treatment consisted of three sessions, one every 72 hours, during which subjects received 2,000 shocks each session, for a total of 6,000 shocks, using a flux of energy density averaging 2.2 bar. No local anesthetic was used and no patients required pain medication. A Color Doppler examination was performed one month and six months following the end of the treatment with ESWT and all subjects underwent clinical evaluation one month and six months after the end of the treatment. We also evaluated whether patients had pain under direct palpation or pain with ambulation. All subjects were asked to refrain from athletic activities and allowed only to walk normally during the treatment phase. A return to normal activities was allowed for all subjects one month after the end of the treatment.

Results: Doppler Ultrasonographic evaluation of subjects who underwent radial ESWT treatment demonstrated a reduction of the microvasculaity present prior to treatment in group A subjects, with a disappearance of microvasculaity in 58.3 % of group A subjects (7 out of 12) at one month and 83.3 % (10 out of 12) at six months. In group B subjects we noted no significant differences and no symptoms. Furthermore, at six months after the end of the treatment we registered a reduction of local pain on walking or running in 83.3% of the athletes of the group A (P<0.0001 – T test) (TAB. II). No significant complications were observed in either treatment group, except for a temporary increase in paratendon edema in three subjects of group A, which responded to local cryotherapy.

Discussion: Many studies have evaluated the association of increased microvasculaity of the Achilles and patellar tendons and the associated clinical symptoms in patients with Achilles and patellar tendinopathy with Color Doppler. This test has proven to be highly specific (100%) and 50% specificity for the evaluation of altered microvasculaity with tendinopathy (10,25). Ohberg (9) used Colored Power Doppler ultrasonography to demonstrate an increase of microvasculaity in patients with Achilles tendinopathy. The same author also noted a reduction of pain in 8 of 12 subjects in whom he injected a sclerosing agent in the paratendon near the Achilles tendon insertion. In 2003 Silvestri observed a hypervascularity (paratendinosis) in patients with acute tenosynovitis, compared with normal subjects (26). Other authors have also demonstrated an increase of microvasculaity in patients with Achilles tendinopathy, while in asymptomatic subjects no altered microvasculaity was observed (12,13). Treatment of Achilles tendinopathy has included many types of treatment, but in some cases complications have occurred (17,18). Injection of steroids may reduce pain and microvasculaity, but are associated with rupture of the tendon (17). Some studies have evaluated the effect of eccentric exercise on the pain and microvasculaity of the Achilles tendon and have shown successful results in 83% of patient symptoms and alteration of the microvasculaity in 17% of patients (16). Recently injection of aprotine, a proteinase inhibitor, has been proposed, but results have been unsatisfactory (18). Among treatment modalities of Achilles tendinopathy, ESWT has become for many authors a treatment of choice with satisfactory results in more than eighty percent of patients (22,24).
We observed a similar improvement in 83% of patients without significant side effects. In our study we observed a decrease in tendon microvasculature in group A subjects within one month of treatment with radial ESWT. This was associated with a significant decrease (P<0.0001) in discomfort at rest and during ambulation (average VAS 1.04 at rest and 1.25 during ambulation), and allowed the majority of athletes to return to sports activity. No significant difference in pain was noted in group B subjects.

**Conclusion:** This study was designed to demonstrate the changes of the microvascularity of the Achilles tendon in patients with chronic Achilles pain, before and after treatment with radial extracorporeal shock wave therapy (rESWT). Twelve athletes with chronic Achilles pain (group A) were compared with twelve athletes free of Achilles pain (group B), all of whom were of a similar age, sex, and weight. Each group received the same treatment protocol with radial ESWT. Clinical evaluation was undertaken prior to treatment and at one month and six months after treatment was terminated. The microvascularity of all 24 subjects was evaluated with Color Doppler echography both prior to treatment with radial ESWT and at one month and six months following treatment. In group A we observed greater microvascularity of the tendon than in group B. This hypervascularity was noted to have decreased when patients were evaluated one month after the treatment with radial ESWT. Clinically, 80% of patients of group A experienced absence of pain and were able to return to sports activity at one month after the end of the treatment with radial ESWT. No significant clinically adverse effects were noted in any subjects who received radial ESWT.
Eccentric loading, shock wave treatment, or a wait-and-see policy for tendinopathy of the main body of tendon Achilles

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Introduction: Few randomized controlled trials compare different methods of management in chronic tendinopathy of the main body of tendo Achilles. Our purpose was to compare the effectiveness of 3 management strategies: Group 1, eccentric loading; Group 2, repetitive low-energy shock wave therapy (SWT); and Group 3, wait-and-see in patients with chronic tendinopathy of the main body of tendo Achilles in a randomized controlled trial.

Methods: Seventy-five patients with a chronic recalcitrant (>6 months) non-insertional Achilles tendinopathy were enrolled in a randomized controlled study. All patients had received unsuccessful management for >3 months, including at least: (1) peritendinous local injections, (2) nonsteroidal anti-inflammatory drugs, and (3) physiotherapy. A computerized random-number generator was used to draw up an allocation schedule. Analysis was on intention-to-treat basis.

Results: At 4 months from baseline, the Victorian Institute of Sport Assessment (VISA)-A score increased in all groups: from 51 to 76 points in Group 1 (eccentric loading); from 50 to 70 points in Group 2 (repetitive low-energy SWT); and from 48 to 55 points in Group 3 (wait-and-see). Pain rating decreased in all groups: from 7 to 4 points in Group 1; from 7 to 4 points in Group 2; and from 8 to 6 points in Group 3. Fifteen of 25 patients in Group 1 (60%), 13 of 25 patients in Group 2 (52%), and 6 of 25 patients in Group 3 (24%) reported a Likert scale of 1 or 2 points ("completely recovered" or "much improved"). For all outcome measures, Groups 1 and 2 did not differ significantly. For all outcome measures, Groups 1 and 2 showed significantly better results than group 3.

Discussion: At 4-month follow-up, eccentric loading and low-energy SWT showed comparable results.

Conclusion: The wait-and-see strategy was ineffective for the management of chronic recalcitrant tendinopathy of the main body of the Achilles tendon.
**Bursitis trochanterica**

**Shockwave therapy for the treatment of the trochanteric bursitis with tendinosis of the gluteus**

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**Introduction:**
Trochanteric bursitis has potential risk factors which include local trauma, overuse activities, and leg length discrepancies. These factors are thought to lead to increased tension of the gluteus maximus on the iliotibial band producing bursal inflammation and tears or tendinosis of the gluteus medius, present on magnetic resonance imaging (MRI) in over 63% of patients clinically diagnosed. The studies of basic research have demonstrated that the application of ESWT produces a biological response in the tissues, including the induction of neo-vascularization at the tendon–bone interface associated with the increase of angiogenic growth factors. The aim of this study was to evaluate the effectiveness and the safety of ESWT in the treatment of trochanteric bursitis with tendinosis of the gluteus in three Brazilian orthopedic center.

**Methods:**
From June 2002 to February 2006, 56 cases with chronic trochanteric bursitis were treated - 50 patients, 6 with bilateral treatment; 41 women and 9 men. The age of the patients was between 27 and 95 years (average age = 61 years). The treatments were performed with an electrohydraulic device. One treatment was performed on 52 cases and 4 underwent a second treatment (minimum interval of 90 days). The subjects were evaluated by means of a clinical evaluation according to Roles and Maudsley score and subjective outcome on Visual Analog Scale (VAS) analysis 45, 90 and 180 days after the end of the therapy.

**Results:**
The study showed the efficacy and safety of ESWT were excellent in 41.1%, good in 48.2%, acceptable in 3.6%, and poor in 7.1%, 180 days after ESWT.

**Discussion:**
Based in this new concept of “tissue regeneration,” ESWT must be considered as an alternative in the treatment of chronic trochanteric bursitis which has been resistant to conventional procedures.

**Conclusion:**
ESWT must be considered as an alternative in the treatment of chronic trochanteric bursitis. ESWT has the advantages of being non-invasive: no significant complications, lower operating costs, and eliminating the substantial potential risks of traditional surgical procedures.
Effect of radial extracorporeal shock wave therapy for trochanter pain syndrome.

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Introduction: Trochanteric pain syndrome or trochanteric bursitis is a common regional pain syndrome. It is characterized by chronic and intermittent aching pain over the lateral side of the hip and limitation of function. The prevalence is higher in females than males (rate 4:1), and the incidence is highest between the ages of 40 to 60, even though cases have been reported in all age groups. The etiology is not well known. Upon physical examination, the clinical signs are pain on resisted abduction and pain to the palpation of the greater trochanter. Treatment includes physical therapy methods, painkillers, and local steroid injection. The aim of this study was to evaluate the effect of radial extracorporeal shock wave therapy (rESWT) in trochanter pain syndrome. This study is a starting point for a future randomized clinical trial.

Methods: Between June 2005 and March 2007, 81 patients with trochanter syndrome were treated with rESWT, 15 of them with bilateral syndrome (total of 96 trochanter pain syndromes). These patients consisted of 14 men and 67 women, aged 29-69 years old (mean 56). The patients must have had clinical symptoms for at least 3 months before the treatment. The patients were treated in 3 sessions (at intervals of 1-2 weeks, mean 12 days) with 3,000 impulses per session. Energy flux density: 0.12-0.16 mJ/mm2. The pain center was detected by biofeedback. The intensity of pain was evaluated by a Visual Analogue Scale (VAS). The pain on palpation of the greater trochanter and pain during daily activity were evaluated in each examination. Evaluation was performed several times: immediately before treatment and on the week 4th, 26th and 52nd week after treatment. Analyses: The non-parametric Wilcoxon test for dependent samples has been used to compare means of VAS. At the end of follow-up, the patients were asked to assess their level of residual pain compared with pain before treatment, according to the Roles & Maudsley scale (RM scale).

Results: Patients showed a considerable pain level decrease four weeks after the treatment (to the palpation p<0.05 and during daily activity p<0.05), and pain levels decreased further in the following examinations (to the palpation p<0.01 and during daily activity p<0.01). Good and excellent results (grades 1 and 2 by RM scale) were obtained in 69 trochanter pain syndromes (72%). These side effects were observed: small superficial haematomas (76%), petechiae (32 %), swelling (52%) and pain (88%). All side effects were tolerated by all the patients and disappeared after 2-15 days.

Conclusion: rESWT is an effective treatment method for trochanter pain syndrome. Further randomized and controlled studies are necessary to underline the results of this investigation.
**Others**

**Radial shock wave therapy as an aid to physiotherapy**

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**Introduction:**
Radial waves (RW) are currently used for orthopedic treatment. The RadialspecTM is a device for RW treatment, used by our department for about a year.

**Goals:**
Proving the effectiveness of RW in the treatment of multiple orthopedic pathologies.

**Methods:**
Sixty-five patients were treated with the Radial SWT. Their clinical diagnosis, disease’s acuteness status, treatment parameters, pain intensity, and functional level were documented. Follow-up was conducted following treatment.

**Results:**
Clinical diagnoses were: 31% Shoulder pathologies, 31% Epicondylitis, 22% Plantar Fascial pathologies, and 16% “other” pathologies. Twenty-nine percent of the patients’ pathologies were “chronic”, 12% “sub-acute” and 6% were “acute on chronic”. The average number of waves per treatment was: 4001.5.

Eighty-five percent of patients were treated at low intensity (10Hz) and 15% at high intensity (20Hz). Sixty-eight percent of patients were treated at low energy (80 mJ) and 32% at high energy (115 mJ). Patient’s average number of treatments was: 5.6. The average change in pain intensity at treatment’s completion (1-10 scale) was 3.75 points. Eighty percent of the patients showed improvement in pain. Sixty-three percent demonstrated functional improvement.

Follow-up was achieved in 60% of the patients. Average follow-up duration was 4.12 months. Follow-up demonstrates long-term improvement in 79% of the patients. Comparing their follow-up condition to their treatment completion status – 44% had stable results, 33% improved and 23% deteriorated.

**Discussion:**
Long term improvement is achievable in about 80% of our patients. Some of them were previously treated unsuccessfullly with conventional physiotherapy techniques.

**Conclusion:**
RW Therapy is effective, safe and has added value to current conventional physiotherapy treatments with poor past response.
New RSWT protocols validation in inflamed tendon
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Introduction: The diversity of tendon injury could limit the use of RSWT. Our aim was to validate new RSWT protocols adapted to the type and location of tendonitis.

Methods: Patients suffering from pathologic tendonopathies were treated with RSWT and followed prospectively for six months. Selection criteria included prior radiology, only one therapy (IB), and the scrupulous respect of established protocols. Tendon tears were excluded. Pain killers without local injection were permitted if present before RSWT. Three protocols (P1, P2A, and P2B) were established. P1 was used for undamaged painful tendon of the shoulder and elbow. P2A was designed for tendon injury in the shoulder and infra-patella. P2B was used for hip, Achilles and sole tendonitis. Device parameters were adapted to both the protocol and patient tolerance. Each patient signed a written informed consent, and the study was approved by the local ethical committee.

Results: Out of 244 inflamed or injured tendons initially selected, 119 were excluded. In the remaining 125 pathologic tendons (100 patients) analysed, a five-month follow-up evaluation showed patient satisfaction of 100% for Achilles (7 tendons), 91% for plantar fascia injuries (18 patients, 22 locations), 89% for hip involvement (30 patients, 55 tendons), 88% for shoulder problems (15 patients, 17 tendons), and 58% for the 19 tendons located in the lateral elbow.

Discussion: No discussion

Conclusion: Our RSWT protocols could be validated for the hip, shoulders, plantar fascias, and Achilles tendonitis.
The practicalities of the application of the komplex enthesopathy theory in orthopaedics

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Introduction: The effectiveness of extracorporeal shock-wave therapy for treatment of musculoskeletal system diseases is recognized worldwide. As is well known, the effectiveness of SWT treatment methods average 80%, however the algorithm of treatment which we use allows us to attain positive results in 96-98% of cases.

Methods: We began our procedures with the necessary diagnostics, including only exploratory, USI or R-graphical research, but also the using the device on a feed-back principle.

Results: It is known that the causes of chronic diseases of the musculoskeletal system connected with the bands overpressure are the changes in the form of calcinosis and fibrosis. Moreover the same changes are certainly present in the “contiguous” bands of that anatomical area also. In this way the algesic impulse will be associated with such a band in which these changes are more expressed. Therefore, for every chronic disease of the musculoskeletal system there needs to be an examination of the complex of ligaments, tendons and myogeloses.

Discussion: In our practice we use the term “Complex enthesopathy” to refer to all ligamentoses, tendinoses and myogeloses of one anatomical area (complex enthesopathy of the 1st order) or of some contiguous anatomical areas (complex enthesopathy of the 2nd order). Consequently, when diagnosing and treating a disease, it is necessary to pay attention to the condition of the entire ligamentous apparatus of that area, not only to the “painful” band.

Conclusion: Our new approach to the diagnosis and treatment of musculoskeletal system diseases allows us to attain good and excellent results in 96-98% of cases.
ESWT as an option when surgery fails
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Introduction: Treatment with ESWT for tendinopathies is a well-known treatment option with good results reported in a large number of publications. We treated some cases after failed open or arthroscopic procedures.

Methods: We treated two cases with recalcitrant plantar fasciitis after open surgery, two after open repair of Achilles tendon rupture, two patellar tendons after open procedures and three cases of lateral epicondylitis after arthroscopic surgery. All patients underwent three sessions with 2000 shocks at 0.3 mJ/mm2 within a week interval.

Results: With the exception of one patellar tendon, in all cases, after 3 months pain was reduced and the patients could return to their daily activities.

Discussion: The treatment with ESW in our clinic is very effective for chronic tendinopathies and is offered to the patients before any surgical procedure.

Conclusion: ESWT is an option for patients with tendinopathies after failed surgery.
Focused or Radial Shockwave Therapy?
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Introduction: Much discussion surrounds patient tolerance, effectiveness and cost per treatment of focused and radial ESWT. We analysed our results of using: (i) a combination of focused and radial ESWT, (ii) focused ESWT alone and (iii) r-ESWT alone, in the treatment of pain related to AVN of the left hip in a 45-year-old Chinese male.

Methods: During the first treatment regimen, the patient received 4 combination treatments and 1 rESWT treatment over 8 weeks. The patient then had 2 months rest before receiving a second treatment regimen consisting of 1 combination treatment, 1 Focused ESWT only treatment and 3 rESWT only treatments over 8 weeks.

Results: After the first treatment regimen a 20% decrease in pain was noted (pain rating scale) as well as a 20% increase in ROM. After the second treatment regimen a further 30% decrease in pain and 30% increase in ROM were noted. Pain during focused ESWT was 8 out of 10 and during radial treatment (rESWT) was 4 out of 10. Results were maintained at 15-month telephonic follow up.

Discussion: Both types of treatments appeared to help the patient, with rESWT being much better tolerated. Cost per treatment did not differ between the two machines. A larger study group with a more structured protocol would be useful to explore further.

Conclusion: ESWT appears to be effective in the treatment of pain associated with AVN of the hip, and there appears to be little difference between the effectiveness of the two devices used in the study although there was more tolerance to the rESWT device.
Radial extracorporeal shock wave therapy (rESWT) in the treatment of spasticity in cerebral palsy: a preliminary report.

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**Introduction:** Spasticity is a disorder of excess muscle tone associated with central nervous system disease. Cerebral palsy (CP) is a central nervous system deficit resulting from a nonprogressive lesion in the developing brain. Although the brain lesions are static, the movement disorders that arise are not unchanging and are characterized by atypical muscle tone, posture and movement. The spastic motor type is the most common form of CP and its conventional therapeutic management may include splinting/casting, passive stretching, facilitation of posture and movement, spasticity-reducing medication, botulinum toxin and surgery (Wasiak 2004). ESWT reduces hypertonia of the wrist and finger muscles in patients affected by stroke (Manganotti 2005). The aim of this initial experience was to evaluate the effect of radial extracorporeal shock wave therapy (rESWT) in the treatment of spasticity in patients with cerebral palsy.

**Methods:** In April 2008, 3 patients with spastic cerebral palsy, 2 men (34 and 48 years old) and 1 woman (42 years old), were treated with rESWT. The patients were treated in 1 session only. The muscle groups were the following: biceps, wrist flexors and triceps surae in all patients and the thenar eminence in a sole patient. Number of impulses: 2,000 in each muscle group.

Energy flux density: 0.10mJ/mm². Spasticity was evaluated by the Aschworth Scale from 0 to 4 (0 = no spasticity to 4 = severe spasticity) in each muscle group. Passive elongation of the triceps surae was also measured with a goniometer. Evaluation was performed immediately before treatment and immediately after, on the next day and 4 weeks after treatment.

**Results:** All the patients reduced spasticity immediately after treatment and in all muscle groups. On the Aschworth Scale there was an average reduction of 3 to 1 (+). Passive elongation of the triceps surae increased by 5 degrees. The following day, spasticity returned to initial values in the upper extremity. Gains achieved in the lower extremity continued to the following day and one month later. These side effects were observed: small superficial hematoma (1 biceps), and petechiae (1 biceps). All side effects were tolerated by all the patients and disappeared after 1-7 days. At the end of follow-up, all the patients were asked to assess if they would repeat the experience and all of them said yes.

**Conclusion:** rESWT reduces spasticity of the triceps surae immediately and a month after treatment. rESWT reduces spasticity of biceps, wrist flexors and thenar eminence immediately after treatment, but the benefits are not retained the following day. Further randomized and controlled studies are necessary to underline the results of this initial experience.
Comparative study between the effects and mode of application of focused and radial shock wave treatment on the behaviour of human mesenchymal stem cells (MSC)

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Introduction: Recent studies demonstrate the successful use of shock wave therapies for improvement of tissue repair and regeneration; processes where stem and progenitor cells are involved e.g. wound healing and bone repair. Human adult bone marrow derived mesenchymal stem cells (MSC) have the capability to differentiate into various mesenchymal tissues and rebuild these e.g. bone tissues, muscles, cartilage tissues or tendons. Therefore the question arises as to whether shock waves can influence stem cells involved in tissue regeneration. MSC dependent regeneration can by improved by enhancement of migration, increase of proliferation and reduction of apoptosis. Due to the fact that two different kinds of shock waves (focused and radial) improve stem cell dependent regenerative processes, it seems appropriate to investigate the influence of both kinds of shock waves on MSC.

Methods: The first experiment with treatment conditions where the shock waves are reflected by culture dishes shows a dose dependent increase of MSC migration by shock wave treatment. We established a new experimental cell culture setup for shock wave treatment under absorbing conditions to better simulate in vivo circumstances. We tested the effect of different intensities of shock waves on cell vitality and we are performing different assays on MSC to investigate migration, proliferation and apoptosis under different conditions (impulses, frequency and intensities of energy) with both kinds of shock waves.

Results: We developed methods for in vitro treatments of MSC with both kinds of shock waves with guarantee of cell vitality, which allow investigations of both kinds of shock wave treatments.

Conclusion: The present results indicate that MSC can be dose dependently influenced by shock waves.
Radial extracorporeal shock wave therapy (rESWT) in wound healing – a prospective randomized Placebo-controlled animal trial
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Introduction: Shock waves were initially used to treat wound healing disorders. First results showed good outcomes. Radial shock waves were not applied in wound healing until now.

Methods: In an epigastric skin flap model the effect of radial extracorporeal shock waves was investigated in rats (Male Sprague Dawley rats weighing 300 to 350 g). A total of 25 subjects randomly received assigned treatment. All subjects underwent surgery to create a specific skin flap with reduced perfusion due to ligation of the epigastric artery and vein. After surgery the subjects were assigned into 3 groups. The first group received 300 shock waves with an ED of 0.13 mJ and 2 Hz, the second group received 600 shock waves with an ED of 0.13 mJ and 4 Hz, the third group received a placebo. To quantify the effect, planimetry and laser Doppler imaging (LDI) were performed 7 days after intervention and compared to baseline.

Results: Baseline showed homogeneity regarding all criteria. Seven days after treatment rats receiving a total of 600 SW at 0.13 mJ showed significantly better outcomes compared to placebo and rats receiving 300 SW at 0.13 mJ. These significantly better outcomes after 600 SW at 0.13 mJ were found in both criteria (Planimetry and LDI). The group receiving 300 SW at 0.13 mJ showed slightly better outcomes but they were not significant compared to placebo. Only minor side effects such as petechial bleeding and edema were observed.

Discussion: These findings demonstrate positive effects in a rat model. The clinical effect size remains unknown and needs to be determined.

Conclusion: rESWT is an effective and safe method to treat wound healing with impaired perfusion conditions after surgery. The effect size reaches clinical relevance. These initial findings have to be verified in further studies. Clinical feasibility trials could start to calculate the clinical effect size of radial shock waves in perfusion-related wound healing disorders.