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P1

Raman Study of the Shockwave Effect on Collagens

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Introduction

Raman spectroscopy is an optimal tool for the structural characterization of collagen. Raman spectroscopy is a non-destructive tool for the structural/conformational characterization of biological systems with several advantages, such as high sensitivity to small structural changes, non-invasive sample capability, minimal sample preparation and high spatial resolution of the micro-Raman system. This highly selective technique provides an impressive set of tools to tackle the problem of identification of the changes that may be induced by shockwave (SW) at the molecular level. We report recently that the conformation of collagen in aqueous medium changes after 2 hours and a week of the shock waves treatment and, at the third week, they return to their original conformation. The main objective of this contribution deals with the effect that SW in aqueous media have on the structure of collagens using a shock wave flow constant or increasing power. We used Raman spectroscopy to draw inferences about the evolution time observed in the structures of type I collagen from rat and bovine after two hours, one week and three weeks following SW application. As a control we performed identical experiments without SW application. The present study should contribute to interpret the Raman spectra of collagen areas in human tissues before and after SW treatment.

Methods

Different density flux energy of single SW were applied over collagen suspensions in plastic chambers containing cold sterile water. To this end we used a Duolith SD1 device (Storz, Germany). The Raman spectra were scanned with a Raman Renishaw Microscope System RM1000, by using the 785 nm laser line; this apparatus is equipped with a Leica microscope and an electrically cooled CCD camera. Macro Raman measurements were obtained by using adequate accessories. The signal was calibrated by using the 520 cm^{-1} line of a Si wafer and a 50 \times objective. The resolution was set to 4 cm^{-1} and 5–20 scans of 40 s each were averaged.

Results

Collagen types I display the amide I bands at about 1678 cm^{-1} , the amide III modes in the range 1280–1240 cm^{-1} and the skeletal vibrations around 940 cm^{-1} . These data suggest a 31-Helix conformation for the collagens in the solid. Some amino acid bands are observed in the spectrum of collagens. This is the case for the bands of rat collagen type I at 1102, 942 and 859 cm^{-1} assigned to the δNCH , νCC skeletal and νCC ring modes of proline, respectively. The band at 1007 cm^{-1} is attributed to phenylalanine, while the weak band at 532 cm^{-1} corresponds to a δCCN , COO^- mode of alanine. The weak bands in the collagen series at 879 cm^{-1} could be assigned to glycine. The Raman spectra of the collagens recorded 2 h, one week and 3 weeks after SW application exhibit several differences. The rat collagen type I evolves to a new conformation that is detected 2 h after the SW treatment. Spectral changes are more evident at the end of the first week of the treatment. The collagen structure at the end of the third week tends to return to its original conformation that is nearly identical to that without the SW effect. Raman spectrum modifications of the rat type I collagen are observed after 2 hrs of SW treatment by increasing the density flux energy; these changes, ascribed to conformational changes, remain after 1 and 3 weeks SW treatment.

Discussion

Raman spectral changes observed in the relative intensities and widths of specific bands of rat collagen types I after shockwave treatment are consistent with conformational changes. By using a low and constant density flux energy a conformational modification is observed. The new conformation remains until the third week SW application. After that, collagen evolves to its original conformation. By

increasing the density flux energy the observed conformational changes are not modified even after three weeks of the treatment.

Conclusion

Our study indicates that the spectral changes appear within the first week after the SW treatment; then, the spectra evolve to the original spectrum as recorded without the SW effect. The spectral analysis allows us to conclude that the observed changes in the collagens are mainly originated by conformational modifications, without exclusion of possible orientational modifications, and that the new conformations appearing in the first week do not persist until the end of the third week. The collagen conformation and orientation evolved by three weeks returning to the original structural situation. Our results also indicate that when we increase the SW density flux energy, the new collagen conformation is maintained in time. This work is supported by Fondecyt project 1090074. J.J.C. acknowledges a Doctoral Fellowship and Becas Chile 2010 from CONICYT and a Doctoral Fellowship from CONICYT. We thank the BioSurgery Unit (ShockWave Center), AraucoSalud Clinic, for instrumental facilities.



P2

Force Fields of Different RPW Transmitters

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Introduction

Radial pressure waves, referred to also as EPAT or RSWT devices use typically pneumatically accelerated projectile which hits a stationary transmitter. There are meanwhile many different transmitters in use which proved practically to be useful for different indications. Still there is only the driving pressure of the projectile the only parameter available for describing their performance. The influence of their design on their therapeutical effect can only be circumscribed by the different feelings of the patient. First the driving pressure which is the source of energy should be replaced by the impulse (mNs) which represents the impact or energy respectively transmitted from the transmitter to the tissue. Secondly the force (N) or pressure (MPa) field respectively should be used to describe the typical performance of a transmitter. Finally the pulse speed and repetition frequency are additional parameters which affects the therapeutical effects.

Methods

Special experimental set-up has been developed to measure the force field by calibrated force transducer within a tissue phantom.

Results

Force distribution fields of different transmitters were measured.

Discussion

Considering pressure waves as shock waves by evaluating only the ultrasonic, low energy pulse does not provide any correlation to the transmitter design and thus to their therapeutical performance. On the other hand the measured force distribution fields confirm this approach as the correct way for describing the physical behavior of the different transmitters used.

Conclusion

The presented investigation is another proof that the biological and therapeutical effects are due to the low frequency pressure waves.



P3

Evaluation of the Comparability of In - Vitro and In -Vivo Shockwave Treatment

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Introduction

In recent years shockwave induced therapeutical effects could be demonstrated both in empirical in-vivo studies as well as in experimental in-vitro setups for different cell types. However, the results obtained from the in-vitro studies cannot easily be transferred to in-vivo settings because the pressure wave is changed substantially by the material surrounding the target tissue (water/cell flask or bone/tissue interfaces).

Methods

In order to estimate the difference between in-vitro an in-vivo settings, the in-vitro treatment of isolated cartilage within a falcon tube in a water bath and the in-vivo treatment of articular cartilage on a bone segment has been analyzed and compared using FEM-simulations.

Results

In both of the examined cases we could determine an essential difference of energy flux density on the cells compared to the theoretical value of the device measured in a water bath. The evaluation revealed that the maximum pressure, energy flux density and strain acting in-vitro and in-vivo are significantly different even though the same shockwave generating device has been used with exactly equal calibration.

Discussion

The comparability of experimental results of different researchers is the main requirement to be able to confirm the results and find correlations between physics and biology. By stating only the theoretical energy flux density of the device, the real shockwave parameters acting on the cells are ignored and in-vitro and in-vivo studies are not comparable.

Conclusion

To be able to find the effective principle of shockwaves it is of utmost importance to specify the real physical parameters like the energy flux density or the strain at the tissues' position, considering the effects of the interfaces behind and in front of the target tissue. Knowledge about the differences and commonalities of the time-pressure history, the energy flux density and the deformation of the tissue in-vitro and in-vivo may possibly offer the opportunity to change the in-vitro experimental setups in a way that the same mechanical stress is acting on the tissue as expected in-vivo.



P4

Shockwave and Ischemic Heart Disease: From Laboratory to Clinical Application

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Introduction

With a previous research we evaluated the effect of SW on cardiac cell progenitors. We observed a redistribution of different cellular components in vitro after SW: marked reduction of fibroblastic component and increase of myoblastic and angioblastic components. The explanation of this phenomenon was probably found in a subsequent work on rats, in which we assessed both the safety and cardiac function and morphology too.

Methods

Four months old Fisher 344 male rats were subjected to echocardiography-guided ECSW therapy with 100 shots at energy flux density 0.25 mJ/mm^2 three times over 1 week. Echocardiographic measurements of cardiac function were performed before and at 1 and 3 months after the treatment. Troponin-I levels were assessed in plasma one hour after the treatment. Control and treated rats were sacrificed after 1 and 3 months and the signs of inflammation, fibrosis, apoptosis and angiogenesis were examined by histochemistry and immunohistochemistry

Results

SW treatment did not provoke arrhythmia or Troponin-I levels increase ($0.159 \pm 0.003 \text{ ng/ml}$ treated vs 0.156 ± 0.001 control). At all time points, left ventricular function remained stable, with ejection fraction of $86 \pm 3\%$ (control) vs $84 \pm 4\%$ (treated) and fractional shortening of $62 \pm 5\%$ vs $64 \pm 4\%$. Histomorphometric analysis did not reveal differences in extracellular matrix collagen content or loci of fibrosis. At 3 months after ECSW treatment, capillary density increased and CD117(+) CD34(-) cells were more numerous and formed Ki67(+) clusters in the treated hearts.

Discussion

We conclude the proliferation, migration and differentiation of CD117(+) cardiac primitive cells should be taken into consideration when investigating the mechanisms of shock waves-induced myocardial regeneration.

Conclusion

The results of this study demonstrate that ECSW therapy is safe and its application is not associated with cardiac tissue damage. ECSW-induced activation of cardiac primitive cells can be responsible for angiogenesis and cardiac tissue regeneration, followed by improvement of heart function observed in patients with coronary artery disease.



P5

Raman and Surface – Enhanced Raman Scattering of Molecular Systems in Human Rotator Cuff Tissues After Shockwave Treatment

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Introduction

Important improvements of chronic tendinopathies tendons diseases are seen after shockwave (SW) treatment. Neo-angiogenesis stimulation and hypercellularization are the result of short time periods of treatment. The present work provides a first approach from a molecular view point of these bio-processes, most likely associated to structural aspects resulting from biochemical changes originated by the SW. Immunohistochemical data indicate that collagen areas in the tissues are influenced the most by SW. Additional presence of collagen types I and III by SW treatment is inferred from an observed increasing of the tissues tinctorial properties. The tools selected for the study are Raman spectroscopy and the ultrasensitive technique surface-enhanced Raman scattering (SERS). Here we extract information from spectra of 52 biopsies of human tendon tissues on Ag nanoparticles before and after SW treatment. The spectral information is analyzed on the basis of Raman and SERS data of collagens type I and III and its most abundant amino acid components. SERS spectra on the collagen area of tissues reveal the presence of characteristic modes related mainly to amino acids. It has been found that the main differences between tissue samples are correlated with collagen structural conformational aspects

Methods

Patients with symptomatic rotator cuff tears received surgical indication with complete information and signed informed consents for the SW procedure and late surgery/biopsy study (8–10 weeks). The SW treatment was applied in a single session, percutaneously, releasing 4000 impulses 0.3 mJ/mm² over the affected areas in the shoulder. We used an Orthospec device (Medispec/Israel) and a Duolith SD1 device (Storz, Germany), both tuned for equal flux energy density. The Raman spectra of biopsy were scanned with a Raman Renishaw Microscope System RM1000, with excitation at the 514, 633 and 785 nm laser lines, equipped with a Leica microscope and an electrically cooled CCD camera. Macro Raman measurements were obtained by using adequate accessories. The signal was calibrated by using the 520 cm⁻¹ line of a Si wafer and a 50× objective. The resolution was set to 4 cm⁻¹ and 5–20 scans of 40 s each were averaged.

Results

The selected SERS spectra of human tissues (HT) before and after the SW treatment (HTSW) are analyzed. The SERS spectra contain bands ascribed to different vibrations of the amino acid components. In the HT, signals correspond mainly to NH vibrations at 1631, 1252, 1207 and 1161 cm⁻¹ and coupled NH and carboxylate deformations and Lys modes at 1523 and 1365 cm⁻¹. In HTSW, the most intense bands are ascribed to the aliphatic and skeletal modes at 1448, 1375, 964 and 813 cm⁻¹; medium carboxylate bands are observed at 1544, 1348 and 668 cm⁻¹. The most relevant spectral modifications (wavenumbers shift and intensity) by the SW treatment are observed for the amino, carboxylate and aliphatic as well as the skeletal bands. The spectral modifications of the molecular carboxylate and amino fragments in the SERS spectra in both tissues suggest that these groups in collagens are exposed to the metal surface in different ways. Thus, the structural changes could be associated with the conformational changes in the collagen structure. In fact, most bands attributable to the vibrations of amino acids and collagens keep their wavenumbers but change the relative intensities in some cases. The differences could be also related to an immature state of both collagens, considering that all biopsies were taken 8–10 weeks after the SW procedure. In normal conditions, according turnover/remodeling of collagens in

tendons occurs, they must suffer conformational/structural changes also due to their relationship with other collagens and proteoglycans during maturation.

Discussion

Immunohistochemical data of human rotator cuff samples in degenerated and SW-treated tissues directed the present spectral study to the collagen areas of the tissues. The additional presence of collagens I and III by SW treatment is concluded from an increase of the tissue's tinctorial properties. The data analyses from 1016 SERS spectra of 52 biopsies of tendon tissues coated by Ag nanoparticles before and after the SW treatment and performed on the basis of vibrational data of collagens type I and III of rat and bovine tissues and their most abundant amino acid components indicate that the spectra are mainly dominated by the vibrational modes of the amino acids in the collagen protein.

Conclusion

A comparison of the tissues indicates that the main observed differences between both tissue samples before and after the SW treatment are related to structural modifications in collagen, probably conformational changes. The minimal spectral differences observed in the Raman spectra of isolated collagens before and after SW treatment were also related to differences in conformation. This work is supported by Fondecyt project 1090074. J.J.C. acknowledges a Doctoral Fellowship and Becas Chile 2010 from CONICYT and a Doctoral Fellowship from CONICYT. We thank the BioSurgery Unit (ShockWave Center), AraucoSalud Clinic, for instrumental facilities.



P6

Original Exploratory Case Study: Utilization of ESWT to Restore Peripheral Vibro–Sensory Perception in a Non-Sensitive Type I Diabetic Foot

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Introduction

Peripheral insensitivity due to diabetes polyneuropathy is a common syndrome associated with both types of diabetes that places patients at a greater risk of developing ulcers and the associated complications.

Methods

Case-study involving a 59yr male patient with a 50yr history of Type 1 diabetes with a distal symmetrical sensorimotor polyneuropathy. One limb selected as the treatment limb (Tx1), and the other as control (Ctrl). 10g monofilament, 128Hz tuning fork, neurotips, biothesiometer and electro-sensory stimulation (ESS) measured baseline and post-intervention outcomes. Six sessions of extracorporeal shockwave therapy (ESWT) was administered over the 1st and 5th metatarsals, lateral and medial malleolus, and the hallux. 500 impulses at 0.10mj/mm² were administered over each region at 1 week intervals. Co-investigators were blinded to selection of the Tx1 and Ctrl.

Results

At 8 weeks post-ESWT Tx1 required less stimulus utilizing biothesiometer (Baseline-average 37.74volts, 28.04volts average post-ESWT). Similarly detection (DE), discomfort (DC) and pain (PN) thresholds utilizing ESS required less stimulus in each domain respectively (Baseline 25mA; 15mA post-ESWT); (Baseline 45mA; 35mA post-ESWT); and (Baseline 135mA; 105mA post-ESWT). The Ctrl limb demonstrated further progressive degeneration requiring increased stimulus from biothesiometer and ESS. Tx1 demonstrated similar improvements of sensory perception to basic instrumentation such as monofilament, tuning fork and neurotips post-ESWT, while Ctrl remained unchanged.

Discussion

The findings of this case-study suggest that ESWT may potentially reverse vibro-sensory deficits rising from distal symmetrical sensorimotor polyneuropathy in diabetics.

Conclusion

Further investigations are warranted to give further results.



P7

Extracorporeal Shockwaves Show Regression of Osteoarthritis of the Knee in Rats

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Introduction

Emerging evidences suggest that subchondral bone may play an important role in osteoarthritis (OA) of the knee. This study investigated the effect of extracorporeal shockwave therapy (ESWT) in OA knee in rats.

Methods

Thirty-six male S-D rats were randomly divided into three groups. Group I was the control and received sham surgery and no ESWT. Group II underwent anterior cruciate ligament transection (ACLT), but no ESWT. Group III underwent ACLT and received 800 impulses of ESWT at 14 KV at 12 weeks after surgery. X-ray and bone mineral density (BMD) were obtained at 0, 12 and 24 weeks. The animals were sacrificed at 24 weeks, and the knee specimens were subjected to bone strength test, histomorphological examination and immunohistochemical analysis.

Results

X-rays of the knee at 12 and 24 weeks showed progressive OA changes in group II, whereas, very subtle OA changes were noticed in groups I and III. BMD and bone strength were significantly lower in group II, but no difference between group I and III. The cartilage degradation was significantly higher in group II, but no difference between group I and III. The subchondral bone remodeling was significantly less pronounced in group II, but no difference between group I and III.

Discussion

Some studies reported that pharmacotherapy using alendronate shows chondroprotective effect with improved subchondral bone remodeling. The current study may be the first to utilize physical shockwave to improve OA changes of the knee with similar results.

Conclusion

ESWT shows regression of osteoarthritis of the knees in rats.



P8

Shockwave Stimulation of Bone Turnover and It's Clinical Applications

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Bone is a special connective tissue, that continuously self - renewal during life (bone turnover or remodeling), and also, after injury, is able to repair without a scar (osteogenesis). Bone formation in soft tissues is a "pathological osteogenesis" (especially after trauma), called heterotopic ossification (HO) and associated with painful articular rigidity.

Osteogenesis and bone remodeling are related to a complex interplay between bone cells, endothelial cells, VEGF and other growth factors (GF). Osteogenesis is related to growth and differentiation of Mesenchymal Stem Cells (MSCs) and very often is an enchondral ossification, in which, according to recent studies, both Nitric Oxide (NO), and osteoclasts (OCs) and angiogenesis, have their own role.

Bone remodeling makes it possible the periodic replacement of old bone with new one: through the so - called OC - Osteoblasts (OBs) coupling, a certain quantity of bone is reabsorbed and replaced by new bone. OC are rare cells in bone and there is a close relationship between OC and angiogenesis: one of the key components of bone remodeling is constant development of vasculature.

NO has been described to have an important regulatory and osteoprotective role also in bone remodeling, with an autoregulatory pathway, that may afford new approaches for therapeutic interventions in bone diseases characterized by excessive OC formation and bone resorption. Pharmacological NO donors have been shown to increase bone mass, these agents may also influence bone turnover in man. These data indicate that the L-arginine/NO pathway represents a novel target for therapeutic intervention in the prevention and treatment of bone diseases.

Which role for Shock Waves (SW) in disorders of bone healing and remodeling? They are not used to disintegrate tissues, rather to induce neovascularization, improve blood supply, and tissue regeneration. SW have been described to be as effective as surgery in stimulating osteogenesis in non-unions and to yield better short-term clinical outcomes, in conditions of mechanical stability, both by inducing osteogenic differentiation from Mesenchymal Stem Cells (MSCs) and GF as well. In stress fractures, the positive results may be due also to reduced secretion of osteoclastogenic factors.

In those osseous diseases characterized by local altered bone turnover of different origins (except hormonal causes), like bone vascular diseases (algodystrophy or bone marrow edema syndrome, avascular osteonecrosis and osteochondropathies), SW have been described to be effective, in significantly increasing angiogenesis, GFs and cell proliferation (trophic effect). Moreover, SW seem to be able to slow or reduce the progression of osteonecrosis/osteochondropathy, thus avoiding or delaying surgery and consequent sequel. In those conditions characterized by bone marrow alterations and increased bone turnover (like in algodystrophy), SW have been hypothesized to have a prostacyclin - mimetic, vasoactive effect, other than to normalize an altered (up - regulated) bone turnover.

SW seem to be a valid therapy also for HO and they can be considered as a complementary solution to the usual medical and physical treatments, before surgery, for diminishing pain and improving range of motion. SW might be effective both in osteopenia and osteoporosis, although the data, nowadays, are still experimental ones.

In summary, we can consider SW as a valid, not invasive therapy for all bone diseases characterized by local altered bone turnover, both by inducing "de novo" osteogenesis and by positive interfering on bone

remodeling cycle, offering new perspectives in regenerative medicine as biosurgery or as an orthobiological treatment.



P9

Radial Shockwaves in Delayed Bone Unions

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Introduction

The management of delayed bone unions is difficult and represents an increase in costs. Extracorporeal shock wave therapy (ESWT) has been used in the treatment of non-unions and delayed bone unions since 1988, with a success rate ranging from 60 to 85 %. The purpose of this study was to determine the effect of the application of low energy extracorporeal shock wave therapy in delayed bone unions. (Radial shock wave therapy with focal terminal device)

Materials and Methods

We performed a retrospective study from January 2006 to December 2011. 170 patients were treated, 40 female and 130 male. The average age was 28 years (range 20-52). We included patients up to 6 months without bone healing. The diagnosis was made with the clinical history and x rays at the beginning of the treatment. Delayed unions in large bones were 14 humeri, 142 femurs 142 and 12 tibias. Delayed unions in short bones were 2 metatarsus (hallux). We had 3 patients without internal fixation. 69 patients had external fixators, 2 Ilizarov systems and 67 tutors. 98 patients had internal fixation, 37 plates and 61 intramedullary nails. We used as exclusion parameters the presence of infection, blood disorders, neoplasias, pregnancy, bone immaturity, polyneuropathies and tobacco smokers. We did a fluoroscopic identification of the fracture, and then proceeded to the application of 2,000 impulses, using a frequency of 12 Hz and an intensity of 1.5 mbar. We used a three-session protocol, one week apart. We used a Swiss Dolorclast radial shockwave low energy device, with a focal applicator.

Results

X rays were performed at 4 weeks and 2 - 4 - 6 months after the treatment. Out of the 170 patients treated with ESWT, 158 completed healing of the delayed bone union. 12 patients required surgery, 8 with tibia fracture and 4 with femoral fracture. A local dermic change on the application site was observed in most cases, with redness and no petechiae or hematoma. No systemic or neurovascular complications were observed. No analgesics or narcotics were required after the ESWT treatment.

Conclusion

In our study, the radial extracorporeal shock wave applied with a focused applicator in the delayed bone union site developed complete bone healing. It is a non-invasive method, well tolerated by the patient. The only secondary effect was a dermic change on the application site. Surgical procedure was discharged in the majority of patients treated with ESWT. The time for the beginning of fracture healing was approximately 8 weeks.



P10

Radial PW for Delayed Bone Unions: Is It Possible?

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Introduction

We had used Focused ESWT since 2000 for delayed and nonunion with good results for cases with a gap less than 5 mm and minimal mechanical insufficiency. After 2007 we started to use Radial SWT to treat very specific cases on subcutaneous bones with bone delayed and non-unions, in patients who could not afford the Focused treatment, or when we had no possibilities to use Focused devices. After our preliminary observations, we believe that Radial ESWT can promote bone periosteal stimulation and neovascularization on superficial pathologies.

Methods

On ISMST 2009 at Sorrento we showed our first 7 cases, and now we present 42 cases treated in two Brazilian ESWT centers: one at São Paulo and other at Natal. We treated tibias, metatarsals, lateral and medial malleolus, scaphoids, ulnas, radius, distal femurs and clavicles with and without previous surgery. We treated all cases with or without regional anesthesia, using a 3 sessions protocol with 3000 pulse 0,18 mJ each.

Results

After 6 months on 31 of 42 cases we had had satisfactory bone healing. 11 cases failed to heal, most of them because of mechanical instability.

Discussion

There is until now a lot of discussion about Radial and Focused ESWT roles in bone healing. We show our preliminary positive experience with radial for bone pathologies,

Conclusion

We conclude that for very specific cases, Radial ESWT could be an option when there are no possibilities to use focused ESWT.



P11

Piezoelectric Shockwaves for Delayed Bone Unions A Report of 10 cases

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Introduction

Up to now little experience exists in the use of Piezoelectric shockwaves for delayed or non-union of bone fractures though these indications are proved and well known for electromagnetic and electrohydraulic devices.

Methods

In ten cases we used piezoelectric shockwaves created by a Piezoson 100 plus, ED 0,22mJ/mm² (stage 6), 4 Hz, a total of 6000-8000 pulses in 6-8 weekly sessions/1000 pulses per session.

Results

In 8 of 10 cases the bones healed without any additional surgery. One of the cases was a forearm fracture of radius and ulna, where the ulna healed but not the radius. The radius needed two more operative procedures done by the author.

Discussion

Piezoelectric shockwaves seem to be a useful tool in healing of delayed or non-unions of bone fractures.

Conclusion

Further investigation has to be undergone to prove our results. Especially the unsatisfactory results have to be examined to find out the reasons of failure.



P12

Effectiveness of Shock Wave Therapy on Pseudoarthrosis and Delayed Bone Unions

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Introduction

The conventional treatment for bone non-unions is based on invasive procedures with bone grafts. The purpose of this study is to evaluate the effectiveness of shock wave therapy on previously failed bone consolidation treatments.

Methods

A retrospective study was done on patients with bone non-unions and delayed unions. All included patients received shock-wave treatments between March 2006 and April 2011. We included 32 patients with diagnosis of delayed bone union for at least 6 months, receiving standard of care treatment with absence of positive results. 20 of these patients had received non-surgical treatments. The remaining 12 patients had surgical treatment. The shock-wave treatment was divided into 4 ESWT sessions, applying an average of 4500 impulses (3200-8000) with 0,82-1.0 mJ/mm²). All 32 procedures were done under sedation. A digital X-ray was used for control and feedback.

Results

27 patients (84.37%) showed radiological bone healing before 20 weeks after the treatment was started. The other 5 patients (15.63%) did not show change on x-rays but 4 of them had a bone gap defect greater than 3cm. No complications were reported and after more or less 6 months, all patients started working again.

Conclusions

Our experience suggests that shock wave therapy is effective in the treatment of bone non-unions if the bone gap defect is less than 3cm. This is a non-invasive, low cost procedure compared to surgical treatment. We recommend this alternative procedure for patients with non unions and delayed bone healing.



P13

Shockwave Treatment for Intraosseous Infections

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Introduction

Our initial experimental studies and clinical experience have suggested that shockwave treatment may be helpful for deep orthopaedic infections. Further experiments have been carried out to assess whether shockwave treatment will also kill bacteria within an intraosseous situation.

Methods

Standard doses of bacteria were placed within the marrow cavity of the shafts of mouse tibial bones. Specimens treated with shockwave treatment were contrasted with controls treated in an identical fashion without shockwave treatment. The numbers of bacterial colonies on agar plates after serial dilution were assessed manually in each group.

Results

In two series of experiments the bacterial counts were reduced in the shockwave treated groups by 57% and 67% respectively.

Discussion

Patients with deep infection usually require radical surgery to remove infected implants and dead or necrotic tissue. A small proportion of patients are not suitable for surgical intervention. Shockwave treatment may offer an appropriate technique for dealing with such infections. There has been concern that shockwaves might be effective for superficial infections, but less effective for bacteria within an intraosseous situation. The current experiments have established that the bacteria within the shaft of the mouse tibia can also be killed with shockwave energy.

Conclusion

Shockwave treatment has been shown to be effective at reducing bacterial contamination within the shaft of the mouse tibia. It appears to be potentially helpful for deep orthopaedic infections, contaminating intraosseous implants.



P14

Focused Shockwaves in the Treatment and Prevention of Tibial Stress Fractures in Athletes

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Introduction

Breithaupt wrote the first clinical presentation of stress fractures in 1855 in Prussian recruits. Stechow described them in 1897 in radiological studies. For over a century, there have been faults in diagnosis, prevention methods, and standardization of the treatment of stress fractures. They represent 10% of all sports injuries and are more frequent in women than men. The use of extracorporeal shock waves has been used as treatment and prevention of tibial stress fractures.

Methods

We performed a retrospective study from January 2002 to December 2010, analyzing the use of ESWT in 127 tibiae on 107 patients with a history of pain and treatment failures for tibial stress fractures. We included patients treated for at least three months. We recorded gender, age, palpation pain level, radiological and scintigraphic images. We included only patients with severe initial vas scores, (8-10 severe, 5-7 medium, 1-4 mild pain). We used a focused electrohydraulic shockwave generator (Medispec - Orthospec ®). Our protocol used an intensity of 0.32 mJ/mm^2 , a frequency of 120 shockwaves / min, total of 3000 shockwaves in one session. We placed the membrane over the topographical area of the injury. We used sedation in all of our patients. We followed our cases at 6 weeks, 3 months, 6 months and 1 year minimum. Statistical analysis was performed with descriptive and inferential differences between means and chi-square technique, with assessment of the significance level of 0.05. We had a study group between 16 and 60 years of age, with an average of 28 years. We had 66% women and 34% male patients.

Results

We found radiologic changes from 87.4% to 64.8%. The reversion of scintigraphic changes was of 59%. Persistent pain in tibia was present in 79.52% of the cases. The vas final score was mild in 71.4%, medium in 8.5% and poor in 20.1%.

Discussion

We found a good clinical outcome using ESWT in tibial stress fractures. There was a clear improvement in scintigraphic studies, progression of bone lesions, and clinical improvement. In this series no patients progressed to complete fracture in tibia at later follow shock waves focal over 10 years of tracking and incorporating physical exercise

Conclusion

Focused ESWT can be an excellent method of treatment to eliminate pain and prevent complete fractures in the tibia in athletes. These methods should be compared with control groups, in order to standardize the ESWT treatment of stress fractures.



P15

Long – Term Result of Extracorporeal Shockwave Therapy in Early Hip Necrosis

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Introduction

Core decompression is considered the gold standard for early stage osteonecrosis of femoral head (ONFH). This study compared extracorporeal shockwave therapy (ESWT) and core decompression for early ONFH with 8- to 9-year follow-up.

Methods

The study included 23 patients with 29 hips in ESWT group and 25 patients with 28 hips in surgical group of similar demographic characteristics. The ESWT group received 6,000 impulses of shockwave at 28 Kv to the affected hip. The surgical group underwent core decompression and bone graft. The evaluations included clinical assessment, X-ray and MRI of the affected hip. The average length of follow-up was 103.5 ± 3.4 (ranged 93 to 106) months for ESWT group and 104.5 ± 4.3 (ranged 95 to 108) months for surgical group.

Results

The overall clinical results were 76% good or fair and 24% poor for ESWT group; and 21% good or fair and 79% poor for surgical group. THA was performed in 3% and 21% at one year, 10% and 32% at 2 years and 24% and 64% at 8 to 9 years for ESWT and surgical group respectively. The ESWT group showed significantly better pain and Harris hip scores, and a trend of decrease in the size of the lesion.

Discussion

The mechanism of shockwave therapy is not fully understood. Some studies reported regenerative effect of ESWT with increased BMP-2 and VEGF expressions in subchondral bone of osteonecrotic femoral head.

Conclusion

ESWT appears to be more effective than core decompression and bone grafting in early stage ONFH in long-term.



P16

7 Year Experience on Treating Elbow Epicondylitis with High Energy Shock Wave Therapy

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Introduction

The purpose of this study is to present our 7 year experience using high energy Shockwave Medicine for elbow epicondylitis.

Methods

This is a retrospective study on 154 patients who suffered Elbow Epicondylitis and received high energy shock-wave therapy treatment from July 2004 to July 2011. The protocol involved 4 sessions under sedation every 15 days with focused shock wave at $0.64\text{mJ}/\text{mm}^2$ (high energy) applying 3200 impulses. A visual analog scale was used to evaluate pain for a 6 month follow up.

Results

We studied 81 men and 73 women. 148 patients had diagnosed epicondylitis on their dominant side. Starting the treatment: 82 individuals (53.4%) reported severe pain, 60 patients (38.9%) described their pain as moderate and 12 (7.7%) labeled it as minor. 4 weeks after the shock-wave treatment: 98 of the patients (63.63%) reported minimum or no pain, 30 (19.48%) reported having minor pain., 18 (11.68%) described it as moderate, and 8 of the 81 patients (5.19%) continued complaining of severe pain. 128 patients returned to their jobs within 30 days after finishing the treatment. 24 returned around 30 to 90 days after the treatment was over and 4 did so after 90 days passed.

Conclusions

In our own experience, 7 years of high-energy shockwave therapy treating elbow epicondylitis show good and excellent results in 84% of our patients. We can recommend this shockwave protocol as a safe and satisfactory method. It also helps restore labor and overall activities sooner than other procedures.



P17

Radial Shockwave Treatment of the Posterior Capsule Contracture of the Shoulder in Young Volleyball Players

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Introduction

The posterior capsule contracture is a common cause of pain of the shoulder in overhead athletes. It usually occurs as a limitation of the glenohumeral internal rotation (GIRD) and dominant shoulder pain. The initial treatment of the posterior capsule contracture must be conservative, and must focus on mobility and stretching exercises to restore the range of motion. The objective of this study is to describe the results of two protocols of treatment of the GIRD in young volleyball players.

Methods

A controlled prospective observational study was done. Twenty players of the National Argentinian Volleyball juvenile team were evaluated. We recorded the internal rotation range of motion of the dominant and non-dominant upper limbs with a digital inclinometer. They were divided into two groups. While the under-18 group (n = 10) performed a gradual program of stretching, the under-20 Group (n = 10) performed the same plan of stretch combined with the application of radial shock wave therapy in 4 sessions of 2000 impulses, using a 10 Hz and 3 Bar protocol.

Results

Three months after the initial assessment, both groups showed improvement in the glenohumeral internal rotation ROM on the dominant Member. The U20 group improved from $53.89^{\circ} \pm 5.99^{\circ}$ to $59.65^{\circ} \pm 5.31^{\circ}$ (p = 0.02;). The U18 group improved from $53.34^{\circ} \pm 9.85^{\circ}$ to $57.66^{\circ} \pm 10.42^{\circ}$ (p = 0.1). We found a decrease in the difference between the internal rotation of the dominant and non-dominant upper limbs. The U20 group had a loop change from ± 16.81 to 8.25 (p = 0, 06) The U18 group also showed a loop change from $13,81^{\circ} \pm 6.89$ to $17.86^{\circ} \pm 6.53^{\circ}$ (p = 0, 1). The under 20 group showed a statistically significant increase in the glenohumeral internal ROM as compared to the under 18 group.

Conclusion

The application of radial shock wave therapy combined with a gradual plan of stretching exercises showed to improve the GIRD as compared to a stretching program alone. This option can be a good alternative for conservative treatment of the contracture of the posterior capsule of the shoulder in overhead athletes. Future randomized clinical studies are needed to confirm the preliminary results of this research.



P18

The Effect Of Shockwave Therapy In Shoulder Tendinopathies In Work Compensation Patients

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Introduction

Extracorporeal Shockwave Therapy ESWT has earned a place in the therapeutic arsenal of tendinous pathology of the shoulder. Numerous studies have shown its efficacy in the treatment of the Tendinopathies in general, and shoulder is not an exception. In this study we wanted to evaluate the effectiveness of ESWT in a population of labor compensation patients that underwent an accident that acutely affected the rotator cuff and had a diagnosis of a tendinopathy. The results were compared with those obtained in occupational accident patients treated with conventional therapy (ultrasound, magnetic therapy, laser therapy and exercise plan).

Methods

We carried out a prospective study between March 1st 2007 and March 1st 2009. The experimental group treated with ESWT had 15 cases with acute rotator cuff tendinopathies, with 13 male and 2 female subjects. The control group was treated with the conventional protocol, and also included 15 patients, 13 male and 2 female. The experimental and control groups received conventional treatment with 15 sessions of physical therapy that included a simple plan of exercises to maintain mobility, 15 sessions of magnetic therapy, laser therapy, ultrasound and basic exercise plans. The experimental group additionally received two ESWT sessions. Goniometric rating, VAS pain score and a DASH functional assessment scale was measured in all cases.

Results

Fisher's exact test and Kruskal Wallis methods were used for the statistical evaluation, by means of a non-parametric ANOVA. We assumed a p-value of 0,05 as significant. The experimental group showed highly significant values of positive outcomes at the end of treatment as compared with the control group, both in pain control and the DASH scale.

Conclusion

The use of shockwave therapy in the experimental group produced a highly significant improvement in pain control and the functional scores of the upper limb as compared with the control group. According to our results, the treatment in the acute phase of tendon injuries in the shoulder is superior to the conventional treatment of rehabilitation.



P19

Extracorporeal Shockwaves For The Treatment Of Rotator Cuff Calcific Tendinopathies

From A Shoulder Surgeon Perspective: Is It Worth it?

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Introduction

Tissue regeneration by means of mechanotransduction stimulus in the form of ultrasound shockwaves has been a growing field of research in the past two decades. The use of shockwave medicine in the treatment of chronic tendinopathies has shown excellent results, but the clinical use is still not a popular therapeutic tool within the common shoulder surgeon. We wanted to approach this technology as shoulder surgeons and evaluate it's clinical results.

Methods

We studied 44 consecutive cases of symptomatic calcifications located in one of the rotator cuff tendons in 43 patients that underwent failed surgeries (n=7) or had been treated previously in a conservative way for at least 6 months with persistent symptoms. Patients received 3 sessions of 2000 impulses of 0,20 mJ/mm² using a focal ESWT applicator (Orthima / Direx/Israel ®). Evaluation included VAS for pain, UCLA score, self ASES and shoulder X-rays before shockwave treatment and at the 6-month follow-up visits. Results were evaluated using SSPS17.0 with the statistical Student Test for related samples.

Results

Six months after completing the shockwave sessions, in 20 patients (45.5%) the calcification completely disappeared. In 13 cases (29,5 %) there was a significant change in size or density. We did not find any changes in 11 cases (25%). Pain decreased according to the visual analogue scale from a mean baseline of 5,5 to 1,4 (P <0000.1). The UCLA score increased from an initial average of 15.7 to a final value of 29,3 (P <0000.1). The Self ASES evaluation scored 84.6 as compared to the initial value of 48 (P <0000.1). In 77,2 % of cases, patients were satisfied with the procedure. We could observe that in all the cases in which the calcification disappeared there was an almost complete absence of symptoms. Of the 10 cases with poor results, 5 were finally operated. Of these, 4 had good results and one a bad result. No complications were reported in any patient on this study.

Discussion

Our results show good and excellent outcomes in terms of pain control and function. We found better results in the cases where the calcification disappeared. This study suggests that the shock-wave therapy can be a valid alternative in patients in whom the conservative or even surgical treatment has failed. Our results are similar to those shown in previous reports of the literature.

Conclusion

From a Shoulder's surgeon's perspective, it becomes an attractive, safe and effective noninvasive procedure to treat Rotator Cuff Calcific Tendinopathies.



P20

Piezoelectric Shockwave treatments in Calcified Achilles Tendinopathy

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Introduction

The aim of this study was to evaluate the effect of piezoelectric shock wave therapy in the treatment of calcific Achilles tendinopathy.

Methods

Between August 2005 and August 2008, fifty patients (52 Achilles tendons) aged 56 years on average (between 27 and 81 years) were included in this retrospective study. Treatment was applied to a piezoelectric shock wave generator. The protocol consisted of at least three and a maximum of nine sessions at weekly intervals. In each session 2500 impulses with energy between 0.22 and 0.32 mJ/mm² were administered. The symptoms were classified using the Visual Analogue Scale and clinical assessment according to the Roles and Maudsley score at 45, 90 and 180 days after applications completion.

Results

Were evaluated results as excellent in 40.4%, good in 38.5%, acceptable in 5.8% and poor in 15.3% of patients, 180 days after treatments. Side effects were rare and associated with pain during and shortly after the applications, but not observed in monitoring cases of worsening of the problems reported initially.

Discussion

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

Conclusion

The piezoelectric shock-wave therapy should be considered as an option for treatment of calcific Achilles tendinopathy that had failed conservative therapy. It is safe, noninvasive, without significant complications, reducing the risks and costs of a surgical procedure.



P21

Shockwave Medicine for Achilles Tendinopathy

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Introduction

A significant number of patients suffering from Achilles tendinopathy, after more than three months of treatment with conventional procedures, go to the specialist in search of pain relief and reinsertion into his usual daily activities without the expected results, and many of them ending in rupture. The goal is to analyze the influence of radial and focus ESWT in Achilles tendinopathy.

Methods

A retrospective study was performed in 41 feet of 34 patients, all of them with three months of conventional treatment without response. We used a focal ESWT generator (Orthospec – Medispec). We used a one session protocol with 0.16 mJ/mm^2 , 196 SW per minute for a total of 2000 SW. We also used a radial pressure wave generator (Radialspec - Medispec) with a two session protocol at 3 bar of pressure and a total of 2000 pressure waves. Musculoskeletal ultrasonography was used as anatomical reference. We studied 17 male (50%) and 17 female (50%) patients with an average age of 47 years.

Results

Analgesia started at 820 waves with a deviation of 390. The difference between initial average VAS and final average VAS and the comparison between Final VAS and satisfaction level at 6 weeks, 3 months, 6 months, and 1 year was significant at 0.05. $p = 0001$. The Achilles tendon thickness was modified from an average of 8.1 mm to less than 6mm. We found good clinical progress in 76.47% of the cases, fair results in 14.73%, and poor results in 8.8%.

Conclusion

ESWT in Achilles tendinopathy with 2000 shock waves in one session of focal, or two sessions of 2000 radial pressure waves is a useful, non-invasive, therapeutic option for the management of this medical condition.



P22

Shockwave Treatments for Chronic Insertional Achilles Tendinopathy

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Introduction

Achilles tendinopathy is a common overuse injury, especially among athletes involved in activities that include running and jumping. A shock wave is an acoustic pulse, with a high peak pressure and a short life cycle. There are different techniques through which shock waves may be generated. In this study we used a piezoelectrically generated shockwave system. Aim: To evaluate the long-term clinical results and complications of shock wave in the treatment of chronic insertional Achilles tendinopathy.

Methods

Retrospective study. Between November 2009 and February 2011, 47 male athletes (non- professional), 30-58 years old, with a chronic (six months or more) insertional Achilles tendinopathy have been treated with SW. A shock wave device Swiss-Piezo-Clast (EMS-Switzerland) was used. The treatment was administered once weekly during 3 weeks. At each session, 2000 pulses were applied with a energy flux density of 0.12-0.18 mJ/mm². The treatment frequency was 8 pulses/s. The pain center was detected by biofeedback. No local anesthesia was applied. The patients were assessed for pain, function, and activity with a VISA-A questionnaire (the Victorian Institute of Sport Assessment-Achilles). The non-parametric Wilcoxon test for dependent samples has been used to compare means of VISA-A score.

Results

At one month from baseline, the mean VISA-A score had increased, from 48 to 61 points ($p < 0.01$). At four months, the improvement was from 48 to 82 points ($p < 0.001$). Thirty-two patients (68%) reported that they were completely recovered or much improved. The favorable results after shock wave therapy at four months were stable at the one-year follow-up evaluation. There were no complications. Twenty-one patients expressed their dissatisfaction about the pain felt during the therapy.

Conclusion

Shock wave is an effective treatment method for chronic insertional Achilles tendinopathy. Nevertheless, we need randomized controlled trials to confirm the results of our experience.



P23

Piezoelectric Shockwave Treatments in Chronic Plantar Fasciitis

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Introduction

The aim of this study was to evaluate the effect of piezoelectric shock wave therapy in the treatment of Chronic Plantar fasciitis.

Methods

One hundred and forty-two patients (168 plantar fascia) aged 58 years on average (range, 31 to 84 years) were included in this retrospective study. Treatment was applied to a generator of shock waves piezoelectric. The protocol consisted of at least three and a maximum of nine sessions at weekly intervals. In each session were administered 2000 impulses with energy between 0.22 and 0.32 mJ/mm². The symptoms were classified using the Visual Analogue Scale and clinical assessment according to the Roles and Maudsley score at 45, 90 and 180 days after completion of applications.

Results

Were evaluated as excellent in 38.7%, good in 28.6%, 17.9% acceptable and poor in 14.8% of patients, evaluated 180 days after treatment. Side effects were rare and associated with pain during and shortly after the applications, but not observed in monitoring cases of worsening of the problems reported initially.

Discussion

The results were evaluated in a consecutive series of patients who do not achieve satisfactory results after conservative treatment for three months or complaints for more than six months. The procedures were performed in the office without anesthesia.

Conclusion

The piezoelectric shock-wave therapy should be considered as a treatment option for chronic plantar fasciitis that had failed conservative therapy, it is a safe, noninvasive, without significant complications, reducing the risks and costs of a surgical procedure.



P24

Radial Shockwave Treatment for Plantar Fasciopathy

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Introduction

There are a lot of scientific evidence on the benefit of the shock waves to treat plantar fasciopathy. We use radial shock wave treatment to treat acute, subacute and chronic plantar fasciopathy.

Methods

We conducted a prospective intervention study, forty-two patients with plantar heel pain were enrolled; for treatment this group received three to five applications of 2500 impulses of radial shock waves. Follow-up examinations were performed at a week, then two weeks and at 8 weeks.

Results

After 8 weeks, an evaluation taking into account the reduction of pain in visual analog scale, reduced from an average of 6.9 to 2.1. In the last control we observed that 77.4% of patients had a good evolution, only 19.4% had a regular trend, and 3.2% had no response to treatment.

Discussion

This is a preliminary study demonstrates the utility of radial shock waves not only in chronic plantar fasciopathy but also for the treatment of acute and subacute fasciopathy, however requires higher studies.

Conclusions

Three to five treatments with 2500 impulses of radial shock waves were a safe and effective method for treatment of acute, subacute and chronic plantar fasciopathy



P25

Comparison of Low Dose and High Dose Shockwave Application in Plantar Fasciitis Treatment

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Device and producing company: MTS Orthowave 100, MTS Orthowave 180

Introduction

When it comes to the treatment of plantar fasciitis there is a wide field of therapeutic approaches. Extracorporeal Shockwave treatment (ESWT) is known to improve pain symptoms, however there are discussions going on about the level of dosage for permanent pain relief. Therefore we conducted a study to compare the clinical outcome of high dose ESWT under general anesthesia and low dose ESWT without any anesthesia.

Methods

Plantar fasciitis was diagnosed clinically and radiologically in 40 feet (32 patients) of which 22 underwent ESWT without any anesthesia (group 1: 1400 impulses, 0.09mJ/mm²) and 18 underwent ESWT under general anesthesia (group 2: 2000 impulses, 0.27mJ/mm²). The patient's condition was examined initially and in follow-up observations.

Results

The feet were assigned into following scale for evaluation: 1=worse, 2=same complaints, 3=improvements, 4=asymptomatic. In the first group in 13 feet the same complaints remained, 7 feet showed improvements of symptoms and 2 were free of any symptoms. Whereas in group 2 improvements could be found in 5 feet and in 13 feet pain was extinguished completely. Worsening was not seen in any case.

Discussion

most cases the threshold for effective treatment lies beyond the bearable pain level. Hence improvements appear but the complete therapeutic effect may not be reached with low dose ESWT.

Conclusion

The different appearance of improvements in our study on plantar fasciitis can be charged to a higher level of dosage. Therefore we suggest a use of high dose shockwave treatment, if possible.



P26

Number of Waves and the Beginning of Analgesia as a Key Variable in the Clinical Course of Plantar Fasciitis

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Introduction

Proximal plantar fasciitis is defined as a clinical entity characterized by pain and inflammation of the plantar fascia at the subcalcaneal area of the foot. NSAIDS, physiotherapy, orthosis, shock waves and surgery have demonstrated variable results.

Methods

A retrospective study was performed from November 2001 to august 2010, which included 423 patients (555 feet) with proximal plantar fasciitis. The patients received focused shock waves with electro hydraulic equipment (ORTHOSPEC®); intensity: 0, 16 mJ/mm², frequency: 196 waves/minute, in a single session, Clinical and ultrasound evaluation was performed, visual analogue scale (V.A.S.) and satisfaction level measured. Beginning of Analgesia to collect question`s patient. Subsequent follow-up was performed every six weeks after treatment, with a minimum of year, Descriptive and inferential statistical analysis was used with a difference between averages and technique of Squared Chi, significance level of 0.05.

Results

The patients were predominantly female, mean age 47 years; beginning of analgesia 816 waves, deviation of 397 waves, total waves/session 1800. The difference between Initial and Final VAS, and VAS/Level of satisfaction, was significant at the level of 0.05 $p=0.0001$; good (69.5%), fair -80 (13.3%), poor -62 (17,2%).

Discussion

There was a low correlation (0.02) between number of waves necessary for beginning of analgesia and time of evolution. There also was a clear dependency between level of satisfaction and number of waves at the beginning of analgesia.

Conclusion

A lower number of shockwave impulses applied at the beginning of analgesia showed better clinical results in our series. It should be considered in acute injuries.



P27

Treatment of Chronic Plantar Fasciitis with Two Sessions of Radial Extracorporeal Shock Wave Therapy: 24 Weeks Follow – Up RCT

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Introduction

Background: Radial extracorporeal shock wave therapy (RSWT) has been previously demonstrated as an efficient treatment option for chronic plantar fasciitis (PF) when administered in three sessions. The present study tested the hypothesis that chronic PF can also be treated successfully with RSWT when only two treatment sessions are performed.

Methods

A total of n=50 patients with unilateral, chronic PF were randomly assigned to either RSWT (n=25) or placebo treatment (n=25). RSWT was applied in two sessions one week apart (2,000 impulses with energy flux density = 0.16 mJ/mm² per session). Placebo treatment was performed with a clasp on the heel. Endpoints were changes in the Visual Analog Scale (VAS) score and the modified Roles & Maudsley (RM) score from baseline to four weeks, 12 weeks, and 24 weeks follow-up.

Results

Mean VAS scores were reduced after RSWT from 8.52 ± 0.34 (mean \pm SEM) at baseline to 0.64 ± 1.52 at 4 weeks, 1.08 ± 0.28 at 12 weeks and 0.52 ± 0.14 at 24 weeks from baseline. Similar changes were found for mean RM scores after RSWT but were not observed after placebo treatment. Statistical analysis demonstrated that RSWT resulted in significantly reduced mean VAS scores and mean RM scores at all follow-up intervals compared to placebo treatment (each with $p < 0.001$). No serious adverse events of RSWT were observed.

Discussion

The results of the present study demonstrate that RSWT for chronic PF resulted in profound and lasting reduction in pain as well as improvement of the patients' quality of life, with short-term treatment success of 92% and long-term treatment success of 100% compared to only 4% short-term and 16% long-term treatment success in the group of patients treated with placebo.

Conclusion

RSWT is efficient in the treatment of chronic PF even when only two sessions with 2,000 impulses each are performed one week apart.



P28

Evaluation of the Diagnostic Ultrasound Fibrillar Pattern as a Prognostic Variable in Patients with Plantar Fasciitis Treated with Shockwave Therapy

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Introduction

The purpose of this study was to analyze the improvement of the fibrillar diagnostic ultrasound pattern on patients with insertional plantar fasciitis as a prognostic of resolution of the symptoms after shock-wave therapy treatment.

Methods

This is a retrospective study on patients who received ESWT from April 2011 until February 2012. This study was conducted on 113 patients followed with diagnostic ultrasound evaluation of plantar fascia and pain scale: before, during and after treatment for a period of 3 to 6 months. We applied 2 focal ESWT sessions with 3200SW, 0.43mJ/mm with intervals of 7 days followed by 2 sessions of radial ESWT, 3500SW, 2.5 Bar with intervals of 15 days. All of the procedures were done under sedation.

Results

95 patients of 113 obtained resolution of the symptoms and diagnostic ultrasound improvement of fibrillar pattern.

Conclusions

The diagnostic ultrasound improvement of fibrillar pattern after the treatment with EWST shows, a reliable prognosis on patients with Plantar Fasciitis.



P29

ESWT in Diabetic Foot

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Millions of people worldwide suffer from diabetes mellitus, and one of the most serious complications is foot ulcers, which can lead to amputation, as well as socio economic costs generated by the disease. It is estimated that in Brazil there are 10 million diabetics and 10% have foot ulcerations .Peripheral neuropathy, foot deformities and trauma are important in the development of ulcers. Shock waves have been indicated in the treatment of orthopedic pathologies with safety and effectiveness and more recently other indications as in treating chronic skin wounds has been reported by several authors. The mechanism such as shock waves act has not yet been clarified, but it is likely that multiple elements collaborate to bring the tissue regeneration, such as the neo angiogenesis, activation and migration of stem cells, among others. Many questions about extracorporeal shock wave treatment must still be answered, as which the ulcers respond better, what is the frequency of applications, how much power should be used. In our institution, a research paper in patients with diabetic foot is in progress and some cases will be presented.



P30

Unfocused Shockwave Treatment of Skin Injuries

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Introduction

Skin ulcers and vicious scars are produced by means of fibrotic and inflammatory changes of the dermis, and a mix of fibrous outskirts and thrombosis of small and superficial blood vessels that cause ischemia. Extracorporeal Shockwave Treatments ESWT have been recently used for chronic skin injuries, based on the principles of the good results in managing different Musculoskeletal conditions. ESWT produces analgesia, anti-inflammatory effects, increase of vascularization, angiogenesis activation, and osteogenesis. Our objective was to determine the efficacy of shock waves for medical use in the treatment of chronic skin lesions.

Methods

We performed a prospective case series study that included 7 patients with chronic skin injuries of skin that received treatment with unfocused ESWT. We used an unfocused applicator with an electrohydraulic generator (Dermagold 100 – MTS). We used a protocol with 350 + 100 shockwaves/cm², with an intensity of 0.01 to 0.03 mJ/mm². We measured skin closure with a ruler and caliper. 28.5% of our patients had injuries of 2-3cm². 14.2%, injuries were of 3.1-4 cm², and 57.1%, injuries were bigger than 4.1cm². 42.8% of our patients had diagnosed diabetes mellitus, 14.4%, varicose syndrome, 14.4%, lower limb palsy, 14.4%, rheumatoid arthritis, and 14.4% had no previous medical issues.

Results

The recovery of our patients was good or excellent in 85.7%. Only one patient in our seven cases series did not show skin lesion healing. This was a ten year old skin ulcer. Only 14.4% of our cases showed wound closure after one session. 14.4% required two sessions, 42.8% three sessions and 28.4% four sessions. We had no complications during the study period.

Conclusion

In our case series we found encouraging results that have also been observed in previous studies and reports in the literature. ESWT showed effectiveness in the treatment of our patients in over 85% of the cases, reducing healing time and improving wound closure with no complications. Further studies must be performed, as this pilot trial shows excellent findings similar to other published experiences.



P31

Radial Pressure Waves in Skin Injuries

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Introduction

The usefulness of shockwaves for medical purposes has been demonstrated in diverse pathologies. In the last times, its applicability has been developed in skin injuries (ulcerate or skin defects) with encouraging results that have led to the formulation of protocols with dosage adjustments, intensity, and other parameters as well as unfocused shock wave devices. The present study has the purpose of documenting the utility of the radial shock waves (pressure waves) in healing skin injuries.

Methods

This experimental research was made at the Trauma and Orthopedic Service of the University Hospital Dr Angel Larralde of the Venezuelan institute of the social services, Carabobo State, Venezuela. We treated patients from September 2011 to March 2012. Our inclusion criteria were patients with conventional treatment (surgical creams, scar creams) previous failed treatment (without improvement in the lesion size), skin defects smaller than 7x7 cm. We performed treatments in a series of five patients with six skin injuries, 2 in breast area, 1 in wrist, and 3 in leg. We used a Radial Shockwaves device (Radialspec - Medispec) with a ballistic applicator. We used a 25mm diameter bolster covered with a silicone membrane. We used a conductive gel and an insulating plastic wrap. We performed a weekly session for 3 or 4 weeks. It was established a number of shock waves according to the initial size of the skin defects: lesions under 3x3 cm, were treated with 1000 shocks per session with an intensity of 0.06 to 0.09 mJ/mm², and a frequency of 5 Hz. Injuries between 3x3cms and 7x7 cm, were treated with 1200 shockwaves per session with an intensity of 0.06 to 0.09 mJ/mm² and a frequency of 5Hz. Patients had an average of 10 weeks of treatment prior to the ESWT protocol.

Results

We observed a decrease of 40% or more of the initial injury size in 5 cases (83%) before 4 weeks, and total healing of the injury at 7 weeks in 4 cases (67%). Lesions with initial size less than 3x3cms (3 cases) healed in 5.2 weeks in average. Lesions with initial size over 3x3cms (3 cases) healed in 9 weeks in average.

Discussion

The Radial pressure waves with ballistic non pneumatic applicators may stimulate skin defects and achieve of lesions. Regeneration and closure are variable in time according to the location. It is evident an inverse relationship between the time of evolution and the injury closure.

Conclusion

The usefulness of the unfocused shockwaves in skin injuries has been demonstrated before. However, in small skin defects less than 7x7 cm the radial shockwaves can also be useful. It is necessary to perform a largest series of cases and controls in order to develop solid parameters and protocols.



P33

Radial Pressure Waves in the Treatment of Infected Skin Lesions after Bilateral Mammary Plastic Surgery

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Introduction

Multiple studies have demonstrated the utility of the unfocused shock waves in skin lesions (ulcerate or cutaneous defects), with encouraging results that have led to the formulation of protocols with dosage adjustments, intensity, and other parameters. The present research has the purpose of documenting the usefulness of the radial shock waves (waves of pressure) in a patient with a postoperative skin injury in both mammary regions.

Methods

We treated one 57 year old female patient. She had a previous breast augmentation surgery with high profile breast implants. The 520 cc filled "La Femme" implants with cohesive gel of double lumen were applied by a sub muscular technique under the pectoralis major. The pathology studies showed negative cellularity for neoplasia or fibrocystic conditions. After 11 weeks of evolution with conventional treatment, she developed a bilateral infected scar. She was treated with surgical cleanings and local application skin creams, as well as 3 doses of platelet-rich plasma without improvement. The right breast scar measured 5x4cm, and the left breast scar 3x3cm. The bacterial culture reported pseudomonas aeruginosa sensitive to ciprofloxacin. We decided to apply radial shockwave treatment to improve her healing. We used a Radialspec (Medispec) electromagnetic ballistic device. We used a sterile gel, insulation and a membrane. The left side protocol used 1000 shockwaves with an intensity of 0.06 mJ/mm², and a frequency of 5 Hz. The right side protocol used 1200 shocks with and intensity of 0.06 mJ/mm² and a frequency of 5 Hz. We performed three sessions with a weekly interval.

Results

Clinical and photographic evaluation demonstrated decrease of the cutaneous defects in approximately 80% at 3 weeks, and full closure at 5 weeks with a scar that had a great elasticity.

Discussion

Radial pressure waves with an electromagnetic ballistic applicator seemed to have a favorable effect in the tissues healing in our case.

Conclusion

Radial pressure waves could be useful in order to improve healing with low energy and frequency devices, controlling wave penetration into deeper tissues. This is especially relevant in this case, preventing damage to the mammary implant. A thorough study of pathology as well as the type and placement of the implant are mandatory. This case report must be followed by larger studies in order to determine results with control groups, and then develop treatment protocols and guidelines.



P34

Summing-Up of the Experiences Using Defocused ESWT for Chronic Skin Lesions in the Trauma Centre Meidling

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Introduction

Chronic or delayed healing wounds are a significant burden to both the healthcare system and the patient, often requiring protracted, intensive and quality-of-life-altering treatment. Due to multiple factors (e.g. longer life span, higher rate of co-morbidities such as diabetes) the incidence of chronic wounds is increasing worldwide. We could show in our open study that extracorporeal shock wave therapy has great potential in the treatment of delayed or non-healing wounds.

Methods

In our open study patient enrolment is done during routine clinical work. Between August 2004 and April 2012 patients of both sexes with sub-acute and chronic soft tissue wounds of different ethology were included. The primary outcome measure was complete wound healing.

Results

Until April 2012, 632 patients (590 in 2011) could be included in the analysis, which were treated with unfocused extracorporeal shock waves (male: 59%, female: 41%). Mean age was 57.8 years \pm 19.6 (SD). The incidence of wounds located on the lower extremities was highest (79%) followed by the upper extremities (15%) thereby the posttraumatic wound ethology was most frequent (78%). In total 71% of the wounds treated with defocused ESWT healed completely (2011: 70%). Wounds non-respondent to ESWT were seen in 8% of treated patients which was same as seen in 2011. The percentage of patients who missed follow-up was also almost at the same level (16%) in comparison to 2011 (17%). Wounds which healed completely in response to ESWT had a mean healing time of 48 days (SD 48): In mean the patients received only 2.8 treatments (SD 2.2) with an average of total pulses of 1438 (SD 2276).

Conclusion

In the open clinical trial performed in the trauma Centre Meidling since 2004 we could show consistently excellent results in treating sub-acute and chronic wounds with ESWT without observing any clinical relevant adverse effects.



P35

Extracorporeal Shockwave Therapy in Pain and Rehabilitation of Tendinopathies

Dr. Osvaldo Patiño

Tendinopathies represent a challenge for Doctor's, PTs and patients. People of different ages with tendon under different loads present varying levels of pain, irritability and functional capacity. Some tendons recover with simple interventions but others remain resistant to all treatments including ESWT. There is a continuum of tendon pathology that has three stages: reactive tendinopathy, tendon disrepair (failed healing) and degenerative tendinopathy (Cook 2008). There is no consensus about ESWT protocols. Controversy exists about method of application and shockwave generation (focused or radial), energy level to be used and number and frequency of treatments. In the first stage, the tendinopathy may involve generation of collagenolytic injuries and the overuse can evoke the release of pro-inflammatory mediators therefore low level of energy and controlled protocols of rehabilitation may be useful. In the second stage, healing response were activated but failed to repair the collagenolytic injuries and it was necessary to promote a tissue reaction to begin the healing process and high level of energy and eccentric exercise protocols can help it. In the third stage, the consequences of failed healing to collagenolytic injuries involve significant changes in extracellular matrix and there are limitations to find good response to ESWT. It is important to modify the sport activities to achieve less pain for ADL.



P36

The Effects of Biological Topic Analgesics in Pain Control Before and After Extracorporeal Shockwave Therapy

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Chronic tendinopathies are a common disease among athletes and regular patients. They cause significant pain and loss of function. Treatment is usually positive by means of load controls, physical therapy, bracing and medication. However, at least 20% of the cases remain in pain and dysfunction developing a healing disturbance commonly known as angiofibroblastic dysplasia. The biomechanical effects of this devascularization results in poor biomechanical function and ultimately, pain.

Shockwave medicine has proven to be effective in the treatment of chronic tendinopathies. However, one of the side effects of shockwave application is pain during the treatment, petechiae and superficial swelling in the area of application. The use of NSAID medications is contraindicated in shockwave treatments, as it blocks the inflammatory chain stimulated by ESWT. Local anesthesia has also been demonstrated to decrease results as it alters the local tissue acoustic resistance and hides the pain locations.

One alternative is to use topic biologic medications that do not alter the normal inflammatory process and may relieve pain during the procedure, as well as preventing swelling and petechiae. We have used Traumeel cream (*Heel laboratories, Germany*) as a local analgesic before and after the shockwave treatments.

Traumeel cream is made up of 14 components of natural origin, associated to the management of inflammatory process without altering the healing process of the injured tissues. It has a different mechanism of action of anti-inflammatories commonly used in medical practice. These compounds act synergistically together to accelerate the process of tissue repair and pain control based on the inflammatory response.

We performed a case-control study in patients diagnosed with chronic lateral elbow epicondylitis, treated for over six months with pain medication, physical therapy and steroid injections without improvement of the disease and who were booked for surgery. We included 76 patients diagnosed with lateral epicondylitis who were treated with two sessions of radial shockwaves. Our protocol is done with two weekly sessions of 2000 therapeutic shockwaves from 2 – 4.5 bar, using a BTL5000 power radial shockwave generator (*BTL Industries, Czech Rep.*) We randomly assigned 27 patients in the study group who received Traumeel cream 6 hours before the treatment and every 12 hours for 7 days after the shockwave sessions. A placebo group of 25 patients received the same protocol, using a commercial moisturizing cream. A control group of 25 patients only received shockwave therapy with no topical additional treatment. We recorded pain with a VAS chart, and any possible adverse or side effects. We evaluated the patients on weeks 1, 2, 3 and 6.

Our results showed a significant loss of pain in the treatment group as compared with the placebo and control groups during the treatment, as well as on weeks 1 and 2. VAS pain reduction in the treatment group was 24% higher at the moment of the treatment, 20% higher at one week and 18% higher at two weeks. There were no significant differences on weeks 3 and 6. Placebo and control groups were significantly similar at all points. We did not find any differences in the presence of petechiae or hematomas on the application areas.



P37

Shock Wave Treatment Advantages on Musculoskeletal Pathologies under Sedation. 7 Years of Experience.

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Introduction

Shock wave therapy treatment (ESWT) on musculoskeletal pathologies is not only favorable on physical results but also on biological outcomes and pain relief. The most common adverse effect is pain intolerance when high energy is applied. There is not yet consensus on an appropriate sedation to accompany this type of therapy with musculoskeletal pathologies. The purpose of this study is to publish and present our experience with sedation and ESWT in musculoskeletal pathologies.

Methods

This retrospective study was made from February 2005 until February 2012. 2766 patients, 8300 shock wave sessions, 5027 focal therapies and 3227 radial treatments, the energy average used was 0.64 mJ/mm² (0.22-1.0 mJ/mm²) on focal therapies and 2.5 Bar (2-3.5 Bar) on radial treatments. We used the visual analogue scale before and after procedures. 7 patients did not accept sedation. The rest received sedation from an anesthesiologist.

Results

0.14% of the patients (4 out of 2759) reported complications after sedation: Vomiting: 3 patients; Propofol allergy: 1 patient. All the patients finished the treatment. There was no pain increase reported on any individual. 41 patients (1.48%) suffered petechiae or ecchymosis. 6 of the 7 patients who decided not to receive anesthesia, were not able to continue with the procedure.

Conclusions

The use of sedation for ESWT on musculoskeletal pathologies, obtains fast results with no pain and less complications. It is a safe and cost effective treatment.



P38

Dynamic Isokinetic Shockwave Therapy in Pain and Rehabilitation

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Introduction

The goal of every physician working in osteotendinous pathologies is to improve pain control and joint function after trauma or repetitive strain. Radial Pressure shockwaves has shown improvement in pain and function in different osteotendinous pathologies. We wanted to determine if there is an effect of the use of radial pressure waves applied with simultaneous movement of the affected joint in osteotendinous injury in elite and recreational athletes.

Methods

We studied 24 patients from October 11th 2011 to March 12th 2012. Patients were treated with Radial SWT for osteotendinous lesions, with acute or chronic pain to improve function of the affected joint. We analyzed the analogue pain scale (VAS) and range of motion measured with goniometers before and after applying RSWT. We followed our cases at 4.8 and 12 weeks, achieving progressive improvement of pain and function. Radial SWT applications were made on osteotendinous lesions of different pathologies, involving the movement of muscles periarticular agonists and antagonists of the affected joint. Were applied for the session 2500 - 3000 shots, a frequency between 12-18Hz and intensity of 2.5 to 3.0 bars for each session, repeating the session every 2 to 3 days for a period of 3 to 4 sessions

Results

We found a decrease in VAS scored pain by 60 -70%, and function improved by 70% from the first session. At the end of the third session we found a decreased pain and improved function by 85-90%.

Conclusion

The application of RSWT in osteotendinous and myotendinous Injury associated with the movement of periarticular muscles, both agonists and antagonists of the affected joint, produced improvement in pain, function and mobility by 85-90% in patients. Being a non- invasive, safe, causes no complications and avoid doping and many surgeries, we recommend Radial SWT as an alternative to acute or chronic myotendinous injuries. In athletes it may improve recovery time getting back to training and competition in a more rapid way.



P39

A Comparative Effectiveness Evaluation of Shockwave Therapy, Steroid Injections and Radiofrequency Medial Branch Neurotomy for Lumbar Facet Joint Pain

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Introduction

The facet (or zygoapophyseal) joints are common sources of chronic low back pain. Lumbar facet syndrome is characterized by localized axial pain, elicited by hyperextension in lumbar area, with typical referred pain to the buttocks and posterior thigh. Facet joints are sources for mixed pain, carrying both nociceptive and neuropathic component, caused by pathological nerve sprouting and/or compression of medial branch of dorsal nerve root within the degenerated facet joint. Therapeutic approaches include pharmacological treatment such as 3rd generation anticonvulsant pregabalin and NSAID and/or opioids. Semi-invasive approaches to facet joints include diagnostic medial branch blocks, corticosteroids or radiofrequency treatment.

Methods

The aim of our study was to compare the possible beneficial effect of SWT against therapeutical approaches, which are more widely used in treatment of facet joint pain - steroid injections and radiofrequency ablations of medial branch. A retrospective study was done on 83 selected patients with unilateral chronic lumbar facet pain, responding to medial branch anesthetic nerve blocks. In all patients, we have provided MRI examination of lumbar spine. Those with lumbar stenosis and moderate to severe degeneration lumbar disc disease were not included in our study. There were 45 women and 38 men. Shock wave therapy was performed in 30 patients (group A) in 5 weekly sessions. Energy flux density was set to 0.12 mJ/mm^2 . 3000 shocks per session were applied under US guidance, covering 2 segments. Group B involved 27 patients. In each patient, 6 ml 1% trimecaine and 7 mg of betamethazone were injected around affected and following facet joint (2 segments) under US and fluoroscopic C-arm guidance. Group C involved 26 patients. Radiofrequency ablation of medial branch covered also 2 segments unilaterally. Ultrasound and fluoroscopic guidance as well as electrophysiological measurements were used for direct placement of electrodes within the medial branch of dorsal nerve root.

Results

The data from 83 patients were collected. Pre-treatment average visual analogue scale (VAS) was 5.6 cm in group A, 4.8 in group B and 5.2 in group C, respectively. We have recorded also the severity of low back pain using the Oswestry low back pain validated score. There were non-significant changes of Oswestry score before treatment in all 3 groups. Follow-up was set to 2.6 and 12 months. At 2 months follow up, we registered significant decrease in average VAS against the baseline value in all 3 groups ($p=0.03$ in group A, $p=0.02$ in group B and $p=0.007$ in group C). After 6 months, shockwave (group A, $p=0.02$) and radiofrequency (group C, $p=0.009$) showed significant changes in average VAS against the baseline, corticosteroid group B, however revealed increase in average pain with non-significant results against baseline VAS ($p=0.08$). After 12 months follow-up, there were still significant differences in group A ($p=0.04$) and group C ($p=0.01$) in comparison to initial values. Oswestry low back pain score was improved in all groups after 2 and 6 months and in group A and C after one year follow-up.

Discussion

In our study, shockwave therapy was more effective than guided corticosteroid injections and only a little less effective compared to radiofrequency ablation of medial branch. Advantage of SWT in facet joint

procedures is overall safety and absence of certain consequences such as increased risk of inflammation, injuries to facet joints cartilage or denervations to lumbar spine muscles.

Conclusion

SWT appeals to be a promising therapeutic approach in the treatment of lumbar facet syndrome.



P41

Piezoelectric Shock Wave Therapy for Treatment of Greater Trochanteric Pain Syndrome

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Introduction

The aim of this study was to evaluate the effect of piezoelectric shock wave therapy in the treatment of Greater Trochanteric Pain Syndrome.

Methods

From August 2005 to August 2008, eighty-eight patients (109 bursitis) aged 64 years on average (between 33 and 93 years) were included in this retrospective study. Treatment was applied to a piezoelectric shock wave generator. The protocol consisted of at least three and a maximum of nine sessions at weekly intervals. In each session 2000 impulses with energy between 0.22 and 0.32 mJ/mm² were administered. The symptoms were classified using the Visual Analogue Scale and clinical assessment according to the Roles and Maudsley score at 45, 90 and 180 days after applications completion.

Results

Were evaluated as excellent in 40.4%, good in 28.5%, 11.9% acceptable and poor in 19.2% of patients, 180 days after treatment. Side effects were rare and associated with pain during and shortly after the applications, but not observed in monitoring cases of worsening of the problems reported initially.

Discussion

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

Conclusion

The piezoelectric shock-wave therapy should be considered as an option for treatment of Greater Trochanteric Pain Syndrome showed that had failure in conservative treatment. It is safe, noninvasive, without significant complications, reducing the risks and costs of a procedure surgery.



P42

Pain Relief in Orthopedics and Sports Medicine by Radial Extracorporeal Shock Wave Therapy: An Update on the Current Concepts

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Introduction

Over the last decade, radial shock wave therapy has become established for the treatment of a variety of indications at the musculoskeletal system. Recently, there have been some discussions in the literature that (i) unlike radial shock waves, only focused shock waves would be “real” shock waves, (ii) focused shock waves would be “high-energy” shock waves whereas radial shock waves would be “low energy” shock waves, and (iii) focused shock waves would outperform radial shock waves with regard to therapeutic efficacy.

Methods

We have performed a comprehensive literature survey about published results of shock wave therapy on the musculoskeletal system, also including reports submitted to FDA and United States and European patents about shock wave treatment.

Results

(i) Most probably no any shock wave treatment on the musculoskeletal system performed today is done using “real” shock waves, irrespective whether the shock waves are applied in a focused or radial manner (“real” shock waves are used in urology for cracking kidney stones). (ii) The differentiation between “low energy” and “high energy” shock waves is arbitrary and should be abandoned. (iii) There is no any proof in the literature that the therapeutic efficacy of radial shock waves is outperformed by any focused shock wave generator.

Discussion

Intense clinical and preclinical research over the last decade revealed a completely different picture than suggested by the discussions mentioned in Introduction.

Conclusion

Discussions about efficacy and safety of different shock wave modalities used for treating the musculoskeletal system should be based on published evidence.



P43

Shockwave Medicine for Carpal Tunnel Syndrome

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Introduction

Carpal tunnel syndrome is considered a peripheral neuropathy by compression and swelling of soft structures that exert pressure on the median nerve within the carpal tunnel, between the carpal bones and the transverse carpal ligament. It is thought that repeated movement causes the synovial membranes to swell therefore increasing the pressure on the nerve without possibility of compression relief in a closed compartment. There are many conservative treatments such as load controls, job changes, splints, NSAIDs, steroids, rehabilitation, and if there is no improvement surgery is considered. There are several surgical techniques described, both open and endoscopic. Even though the results of surgical procedures are usually positive, in many cases there is a persistence of unexplained symptoms in the postoperative period. In this study we used focal shock waves based on the concept of managing the pathophysiology of the symptoms of CTS: decreasing the content within the continent. We want to present the preliminary results, evaluating global hand function, symptoms and clinical signs, satisfaction degree, ultrasonographic changes and / or behavior modification, in the patients treated at the Unitrond Shockwave center in Valencia in 2009-2010.

Methods

We performed a cross-sectional, retrospective, observational and descriptive study. Five patients with carpal tunnel syndrome were treated. Two were unilateral and three bilateral cases. We had only female subjects. The average age was 50 years. Our inclusion criteria were patients with absolute indication for surgery for carpal tunnel syndrome that stated their will not to have a surgical procedure. We informed about the possibilities of this experimental treatment and filled a consent form before the procedure. We evaluated the outcomes using a Carpal Tunnel Syndrome functional score, checking on paraesthesia, muscle strength, Phalen sign, Tinnel sign, sleep disruption, need to shake hands, ultrasound findings, electromyographic findings, muscle dynamometry, initial and final VAS and patient satisfaction scale. We used a focused shockwave generator (Orthogold 100 - MTS-TRT). We applied shockwaves on the upper and lower volar limits of the carpal tunnel and transverse carpal ligament. We used an intensity of 0.08 and 0.10 mJ/mm². We applied a total of 2000 shockwaves in a single session, without sedation. Assessment and follow-up was done at 21 days, 6 weeks, 3 months and 6 months.

Results

All five patients met the inclusion criteria and signed the informed consent. The patient satisfaction level was of 60% satisfied, 20% dissatisfied and 20% not satisfied. Persistence of paresthesia was present in 80% of the cases. Sleep disturbance was also persistent in 80%. Tinnel sign and Phalen signs were negative in all cases. We found a persistent swelling in tendon ultrasound in 60% of the cases. The diameter of the median nerve was measured in the pre ESWT period, finding initial diameters between 8.3 mm to 8.9 mm. After ESWT treatment five nerves showed 6m to 6.6 mm diameter, 2 nerves 5mm and one with 4.2mm. Dynamometry showed that all patients had good muscle strength. In pain assessment, the initial VAS was 40% severe and 60% moderate with no mild scores in average. The final VAS reported no severe cases, 80% moderate and 20% mild.

Discussion

The focused shockwaves treatment for carpal tunnel syndrome used in our five patients showed clinical modifications in pain control as well as positive changes in the Median Nerve size evaluated by ultrasound. Changes could be explained by the already known effects of shock waves in tendinopathy, which would decrease the compression on the median nerve by means of swelling control and increasing

the space into the carpal tunnel.

Conclusion

Although this is a small case series, our results open another door in the treatment of carpal tunnel syndrome. We must establish the precise mechanism of action of shock waves in this proposed theoretical content and continent groups. We would recommend a case control study with ultrasound measurements of the diameter tendons, and propose to establish securely, and that patients can be applied effectively to reduce interventions surgical treatment in carpal tunnel syndrome.



P44

Shockwave Therapy in Professional Football Players

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Football is not only a passion but also a very popular sport and athletic activity. If you compare data from two worlds well known organizations The United Nations have 192 member states, while the FIFA (Federation Internationale de Football Association) has 208 members. That is why soccer is considered the activity that arouses the most interest all over the world.

Professional soccer players have a relatively short career, with an average of 12 years on the field. Economic interests are becoming a primary aspect off the stadium, and inside it physical demand has increased becoming a key piece in their development. Given the high amount of matches, the intensity required in each one of them, the presence of injuries is more common. Physicians are responsible for developing faster and better recovery procedures, which require the constant search for new technologies and protocols.

The application of extra-corporeal shock wave medicine in professional soccer players has been used in our Orthopedic and Sports Medicine Department since 2002, as a primary or combined treatment for some pathologies such as tendinopathies, muscle sprains and spasms, plantar fasciitis, and support in physical rehabilitation.

We use mainly radial shockwaves for pain and soft tissue conditions, after the diagnosis of a chronic injury. However, in many acute conditions such as muscle sprains or pain after a direct trauma, we also support our physical therapy department with shockwave medicine.

As a professional team and national football team orthopedic specialist, I have a lot of referrals of chronic tendon injuries in football players. We treat all chronic conditions with shockwave medicine before surgical procedures for tissue recovery. All mechanical conditions and articular damages are treated surgically or arthroscopically.

In properly indicated cases, shockwave medicine has proven to have a solid space in the football sports medicine physician tools. Besides, this technology is accepted by the IOC (International Olympic Committee) and the FIFA.



P46

Our Experience with Radial SWT in Sever's Osteochondritis

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Our Foot Clinic in Caracas has a very high demand of patients with posterior heel pain and insertional Achilles tendinopathies. We often see cases with swelling and pain, and on the confirmation of insertional tendinopathy with x rays and ultrasound we sometimes find conclusive data of a Sever's osteochondritis.

We followed eleven patients with ages between 7 and 12 years old with diagnosis of Sever's disease. We applied a four session shockwave protocol using a radial applicator. The energy level used was 1.5 to 2 bar for 3000 shockwaves applied per session. The sessions were performed every 15 days. We evaluated clinical outcome, pain using a VAS, ultrasound changes and any adverse effects.

Two patients had significant pain control after the first session (2 weeks), while seven patients had less pain between the second and third sessions (five weeks). Two patients acused increase of pain after two weeks, and recovered later after the third and fourth week. We followed all cases up to the 12th week and all patients had a significant control of pain.

Our results suggest that Radial Shockwave Treatment for Sever's disease is a safe and effective option in the control of pain in adolescents. Further studies are required where we can compare with controls, but our preliminary experience is encouraging.



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Shockwave therapy in patellar tendinopathies

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Introduction

Extracorporeal shock wave therapy (SWT) has proven to be effective in the treatment of chronic tendinopathies. The effects of mechanotransductional stimulation of cells and capillaries result in improved neovascularization, and enhanced cell migration and differentiation. Patellar tendinopathies are difficult and challenging, because the mechanical forces of the extensor mechanism are the largest in the human body and the inferior pole of the patella is poorly vascularized. Previous studies have shown the reduction of VAS evaluated pain of 51% with a single session of radial SWT as compared with 24% in the control group at a 12 month follow up. As we have better results in treating other chronic tendinopathies such as tennis elbow or plantar fasciitis with a two-session protocol of SWT, we wanted to compare the use of single vs. double session SWT treatments.

Methods

49 patients with diagnosis of chronic patellar tendinopathy were studied from June 2009 to January 2012. Twenty-four patients were treated with one session of radial SWT (control group) and twenty-five patients were treated with a double session protocol of SWT (treatment group). Patients were randomly assigned to the treatment or control groups. All treatments were performed using a BTL5000-power radial shockwave device (BTL Industries-Czech Republic). The single session protocol used energy up to 4 BAR. The two sessions used the same protocol with a difference of 7 days between sessions. Evaluation was by change in Visual Analogue Scale (VAS), Victoria Institute of Sport Assessment score for patellar tendinopathy (VISA-P) score and by Roles and Maudsley Score. Follow up was done at one, three and twelve months after the treatment. Mean VAS score was 8.2 in the treatment group and 8.3 in the control group. One month, 3 months, and 12 months after treatment, the mean VAS for the control and treatment groups were 5.7 and 4.8, 4.5 and 3.2, and 2.5 and 1.7, respectively.

Results

One month, 3 months, and 12 months after treatment, the mean VISA for the control and treatment groups were 66.1 and 67.5, 72 and 75, and 78 and 84, respectively. At final follow-up, the good and excellent results for the treatment and control groups were 21 and 18 respectively. The fair and poor results were 4 and 6 respectively.

Conclusion

Using a double session we improved our good and excellent results from 75% to 84%. The pain reduction was of 66% in the treatment group and 57% in the control group. We found similar results as previously reported with a single session SWT, and improved the results using a double session protocol to levels similar to those reported with the use of focused SWT or in other common tendinopathies. We recommend the use of double session radial SWT protocols as an improved effective non-invasive treatment for chronic patellar tendinopathy.



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Shockwave Therapy Enhances Anterior Cruciate Ligament Reconstruction

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Introduction

Extracorporeal shockwave therapy (ESWT) enhances tendon-bone healing after anterior cruciate ligament reconstruction (ACL) in rabbits. This study evaluated the effectiveness of ESWT in hamstring autograft ACL reconstruction in human subjects.

Methods

This study consisted of 26 patients (26 knees) in ESWT group and 27 patients (27 knees) in control group. The ESWT group underwent ACL reconstruction and received 1,500 impulses of ESWT at 20 kV to tibia tunnel. The control group received ACL surgery, but no ESWT. Both groups received similar postoperative rehabilitation. The evaluations included clinical assessment, radiograph, bone mineral density (BMD) and magnetic resonance imaging (MRI).

Results

At 2 years, ESWT group showed significantly better Lysholm score and A-P laxity of the knee, but not the IKDC score as compared to control group. The size of the tibia tunnel on X-ray was significantly smaller in ESWT group as compared to control group ($P=0.016$). However, no difference was noted on bony appearance and BMD values between two groups. On MRI, ESWT group showed significantly better autograft integration to bone marrow and lesser tibia tunnel enlargement as compared to the control group ($P<0.05$).

Discussion

ESWT may accelerate the tendon-bone healing via the increases of vascularity and angiogenic and osteogenic growth factors. In clinical setting, MRI is the best method to evaluate ACL in human subject because it provides prudent information including autograft integration to bone marrow and tibia tunnel enlargement.

Conclusion

ESWT significantly enhances the healing of tendon to bone and decreases the tibia tunnel enlargement after ACL reconstruction.



P51

Shockwave Medicine in Small Animals and Osteoarthritic Veterinary Patients

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The shock wave therapy (ESWT) has been used for veterinary orthopaedic applications. ESWT is a great addition to the arsenal of treatments that we can provide for a variety of injuries. In the last few years, our ability to diagnose conditions has improved greatly (digital x-rays, 3D ultrasound, MRI), but we were still limited in our treatment options (rest, steroids, shoeing). ESWT gives us a great treatment option that is minimally invasive with proven results for osteoarthritis conditions in dogs, cats, horses and other animals. ! ESWT shows improvement in subchondral bone remodeling and chondroprotective effect of the articular cartilage in the initiation of osteoarthritis, ESWT group showed significant increases in chondrocyte concentration and activity and decreases in chondrocyte apoptosis, cartilage degradation and significant improvement in subchondral bone remodeling (Wang, 2011).

In another study in client-owned dogs that had chronic lameness localized to the stifle joints secondary to osteoarthritis. Five of the seven owners of the treated dogs were very enthusiastic about the treatment, the owners appreciated the improvement that resulted from the treatment, and noticed increased activity of their animals (Dahlberg, 2005).

This study was accomplished with routine clinic osteoarthritic patients from small animal service. The goal was to assess the ESWT as a therapy for pain relief and improve activity. The patients were submitted to general anesthesia. The animals were clipped over the joints, coupling gel was applied and usually 500 shock waves were applied for medial and lateral aspect. The efficacy of treating animals with osteoarthritis in multiple joint was great. The evaluation was made by a subjective owner questionnaire.

As a result of these findings it was observed that the average of the patient's improvement was 80% with only one treatment. The non-successful patients usually had chronic osteoarthritis or multiples joints affected by the disease process. Radiographic findings were not found. The significant clinical effect of ESWT suggested that this modality should be considered for treatment of veterinary patients with OA.

The owners appreciated the improvement that resulted from the treatment, and noticed an increased activity of their animals. They were very enthusiastic.