Extracorporeal Shockwave Therapy. Outcomes in Shoulder Tendinopathy and Plantar Fasciitis

Nagham HADDAD, PT
American University of Beirut Medical Center
Introduction:

• Tendinosis is the non inflammatory intra tendon degeneration that causes a decrease in the mechanical properties of the tendon
• The development of shock wave therapy was very fast and successful. Shockwave Therapy is a non-invasive technique
• Shock Wave therapy is a therapeutic modality without need of surgery and surgical risks as well as surgical pain
• The main cause of this study is to prove the effectiveness of extracorporeal shockwave therapy in calcified tendinopathies
Definition:

• Shock waves are single pulsed acoustic or sonic waves, which dissipate mechanical energy at the interface of two substances with different acoustic impedance.

• There are two main types of shockwave machines:
  1. High-energy (focused)
  2. Low-energy (radial)
Types of shockwave machines:

- Spark discharge
- Piezo-electric
- Electromagnetic
- Pneumatic

Focused
- Hard shockwave

Radial
- Soft shockwave
Definition:

- Radial therapy is actually quite different from the other three technologies
- It is not considered true extracorporeal shockwave therapy but more of a pressure wave therapy
- Radial shock wave therapy utilizes a ballistic technique
- A projectile accelerated by compressed air and propelled at high kinetic energy hits an applicator placed on the skin
- By using a coupling medium such as ultrasound gel, this impulse is delivered to the tissue in the form of a shock wave
Definition:

- From this point the shock wave continues to spread inside the body in the form of a spherical "radial" wave.
- In this generating principle, the applicator surface constitutes the geometric point with the highest pressure and the highest energy density.
Epidemiology:

• Extracorporeal generated shock waves were introduced in medicine approximately 25 years ago

• In the past 10 to 15 years shock wave therapy had shown effects in the treatment of certain orthopedic disorders including:
  1. non union of long bone fractures
  2. calcific tendonitis of the shoulder
  3. lateral epicondylitis of the elbow
  4. proximal plantar fasciitis
Epidemiology:

- More recently several studies had extended shockwave therapy to patellar tendonitis, osteochondritis and avascular necrosis of the femoral head and had shown satisfactory results.
- The use of extracorporeal shock wave therapy has gained significant acceptance in Europe especially Germany, Australia, Italy and in Taiwan.
Principle of Shockwave Therapy:

- Shockwaves are generated by an underwater high voltage condenser spark discharge and then focused at the diseased area, using an elliptical reflector.
- A shockwave is a sonic pulse that has certain physical characteristics.
Focused Shockwave Therapy:
Radial Shockwave Therapy:

Pressure Measurement
Swiss DolorClast

- Pressure [MPa]
- Time [μs]

- Applicator: K-430
- Power setting: 4 bar
- Hydrophone distance: 1 mm
- Max. pressure: 12.1 MPa
- Rise time (10% - 90%): 1.2 μs
Principle of Shockwave Therapy:

• There are two basic effects of shockwaves:
  1. The primary effect is direct generation of mechanical forces
  2. The secondary effects are the indirect mechanical forces
Mechanism of Shockwave Therapy:

- Physical parameters of shockwave therapy:
  1. The pressure distribution
  2. Energy density
  3. The total acoustic energy

- Effects from direct forces and cavitations from indirect forces cause trabecular micro fractures or interstitial gaps and hematoma formation, as well as focal cell death, which then stimulate new bone or tissue formation.
Mechanism of Shockwave Therapy:

- When shockwaves hit the cortical bone, 65% are transmitted and 35% reflected.
- Shockwaves cause micro fracture or micro-trauma and hematoma formation that lead to osteoblastic activities, increases callus formation, and bone healing.
- Shockwave therapy relieves pain due to insertional tendinopathy by provoking painful level of hyper-stimulation analgesia.
Microbiological Theory

PHYSICAL ENERGY

Biological Response

BMP-2 → eNOS → VEGF → PCNA → Improved blood supply

Bone repair → Tissue regeneration

Neovascular → Tendon repair
Ultrasound guidance under shockwave therapy treatment:

- An ultrasound localization device is used, depending on the indication.
- If the target zones are close to the body surface, shock wave application can generally be performed without a localization device.
- The target area can be identified using separate ultrasound devices and simply marked on the skin.
- If the configuration of the shock wave source allows the localization device to be centrally integrated on the shock wave axis (in-line), high localization accuracy and easy-to-interpret spatial relationships will be obtained.
Ultrasound guidance under shockwave therapy treatment:

- When treating patients without anesthesia, it is often possible to identify the point of maximum pain through simple communication with the patient.
- This procedure is called bio-feedback and it is used to find superficial and deeper treatment points without requiring an expensive localization device.
Indications:

• Non unions and delayed unions of long bone fractures
• Symptomatic calcifying tendinopathy at least a 6 months duration of symptoms
• Calcific tendonitis of the shoulder
• Lateral epicondylitis of the elbow
• Proximal plantar fascitis
Indications:

- Avascular necrosis of the femoral head in adults
- Osteochondritis of the talus and the knee
- Patellar tendonitis
- Achilles tendonitis
- Medial epicondylitis of the elbow
- Trochanteric bursitis
- Non calcific tendonitis of the shoulder
Benefits of Shockwave Therapy Treatment:

- Fast and effective
- A great option instead of surgery
- Surgical success rates are much lower than the shockwave therapy treatment proven results
- Eliminate the use of medication
Benefits of Shockwave Therapy Treatment:

• Eliminate the use of cortisone, or repeated injections
• Used when all other methods have failed
• Patients feel less pain after treatment, and are able to resume normal physical activities
• Athletes who want to return to their sport and suffer from chronic pain
Contraindications:

- Local tumors or infections
- Neurologic disorders
- Pregnancy
- Rheumatoid Arthritis
- Generalized polyarthritis
- Vascular disease
- Diabetes
- Bleeding disorders
- lung tissue in the focus
- patients with pacemakers
- Patient younger than 18 years
Shockwave Therapy Treatment:

- Physical assessment
  1. Diagnosis: X-ray and ultrasound before the treatment
  2. Impairments (pain): Visual Analogue Scale (VAS)
  3. Disability (function limitation): Range of motion measurements, UCLA shoulder rating scale, VISA questionnaire and Maryland foot score
  4. Participation problems at work or in social life
Shockwave Therapy Treatment:

- Shockwave application
  1. patient positioning
  2. application of local anesthesia or not
  3. assess pain grade during the treatment
  4. Shockwave parameters
  5. Treatment duration:
     - Each session of treatment will take approximately 5-10 minutes
     - During this time 2000 to 3000 pulse waves are delivered into the area being treated
     - 3-5 treatments are needed with 5-10 days between treatments
Shockwave Therapy Treatment:

• Post shockwave treatment
  - immediate relief of pain following the treatment
  - soreness in the area within 2-4 hours
  - no use of ice on the area or anti inflammatory.

1. home exercise program
2. Follow up and reassessment
<table>
<thead>
<tr>
<th>Grade 1</th>
<th>Excellent</th>
<th>No pain, full movement and activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 2</td>
<td>Good</td>
<td>Occasional pain, full movement and activity</td>
</tr>
<tr>
<td>Grade 3</td>
<td>Acceptable</td>
<td>Some discomfort after prolonged activity</td>
</tr>
<tr>
<td>Grade 4</td>
<td>Poor</td>
<td>Pain limiting activity</td>
</tr>
</tbody>
</table>
Patient Education:

• All patients signed an informed consent form
• The details of the procedure and potential risks were discussed fully before treatment
• The choice of the anesthesia was patient dependent
• Patient is instructed to decrease his activity for a period of 24 hours
• Patient is allowed early range of motion and immediately weight bearing activity
Patient Education:

- Patients who worked in a sedentary occupation were immediately returned to their pretreatment work status.
- Patients were instructed on how to perform the eccentric training by receiving practice instruction and a written manual on how to progress.
- The time to return to competitive sports and heavy labor occupations was made on a case by case basis.
Side Effects of Shockwave Therapy:

- Pain
- Aching
- Skin reddening
- Bruising
- Local hematoma
- Swelling
- Tendon Rupture
- Nerve irritation
- Numbness for 24 hours after the treatment
Literature Review:

• Achilles tendinopathy:
  1. Rompe et al (2007): Eccentric loading and shock wave therapy did not differ significantly, but they showed substantially better results than the wait-and-see policy.
  2. Keogh et al. Ge et al. (2006): Treatment of Achilles tendinopathy with ESWT led to a clinically relevant effect. ESWT improves function and activity.
  3. Buchbinder (2004) stated that "ESWT has been proposed as an alternative approach on the grounds that it stimulates healing of soft tissue and inhibit pain receptors."
Literature Review:

• Rotator cuff tendinopathy:
  1. Vulpiani MC et Al (2007): extracorporeal shockwave therapy seems to be encouraging in light of long lasting improvement of the pain symptoms
  2. Loew et Al (2000): the study showed that extracorporal shockwave therapy treatment for calcific tendinosis of the supraspinatus increases resorption of calcific lesion and improves the functional activity of the shoulder
Cases study:

A. Plantar fasciitis:

Patient is 64 years old male has right plantar fasciitis since 1 year. After inefficacy of conservative and orthotic treatment, patient is referred for shockwave therapy treatment.

- Physical therapy assessment:
  1. Impairments:
    - Pain worse on walking up in the morning or after a period of rest graded 8/10
    - The pain often improves after walking, but may recur after prolonged, continued or more stressful activity
Cases study:

- Burning sensation in the sole of the foot.
- Achy feet that he blame on shoes
- Heel pain after starting a new running, walking or exercise routine
- Localized pain at the origin of the plantar fascia from the medial tubercle of the calcaneus graded 8/10

- Passive dorsiflexion of the toes is painful

2. Disabilities: - Visa questionnaire score graded 22/100
   - Maryland foot score graded 35/100
Cases study:

- Shockwave Therapy Treatment:
  1. Patient position
  2. Clinical application

Heel pain fasciitis/heel
Cases study:

3. post-procedure treatment:
Cases study:

• Shockwave therapy reassessment (3 months after treatment)
  1. Impairments: Roles and Mausdley Score grade 1 VAS graded 0/10
  2. Disability: Maryland and foot score graded 87/100 Visa questionnaire score graded 70/100
Cases study:

B. Rotator cuff tendinopathy:
Patient is 60 years old female has left shoulder rotator cuff tendinopathy (supraspinatus tendon calcification) since 1 year

• Physical therapy assessment:
  1. Diagnosis: X ray showed large supraspinatus tendon calcification measuring 8.5 mm located 1.8cm proximal to its insertion
  2. Impairments: left supraspinatus tendon pain upon palpation graded 6/10 according to Visual Analogue Scale
Cases study:

3. Disabilities: UCLA shoulder rating scale showed:
   - Pain always present but bearable strong medication occasionally
   - Able to do light housework or most activities of daily living
   - Active forward flexion: 150°
   - Strength of forward flexion (manual muscle testing) grade 4
   - Satisfaction of patient: not satisfied
Cases study:

- Shockwave Therapy

Treatment:
1. Patient position
2. Clinical application
Cases study:

3. Post–procedure treatment
Cases study:

- Shockwave therapy reassessment (after attending 4 sessions):
  1. Impairments: VAS graded 0/10
      Roles and Mausdley Score graded 1
  2. Disabilities: UCLA shoulder rating scale showed:
      - No more left shoulder pain
      - Normal activities
      - Strength of forward flexion (manual muscle testing) grade 5
      - Satisfaction of patient: satisfied
Conclusion:

- extracorporeal shockwave therapy treatment is a promising method of managing chronic tendinopathies
- Shock wave therapy in orthopedics had shown a cascade of reaction from physical shockwave energy to the biological responses.
- Shockwave therapy is a therapeutic modality with effectiveness, convenience and safety.
- The complication rates are low and there is no device related problem.
- Shock wave therapy is noninvasive, well tolerated and relatively inexpensive compared with surgical treatment.
- It has the potential of replacing surgery on certain orthopedic disorders without surgical risks.
Thank you