enovis™

CHATTANOOGA®

Shockwave and Laser Therapy

Lower Leg Injuries 101

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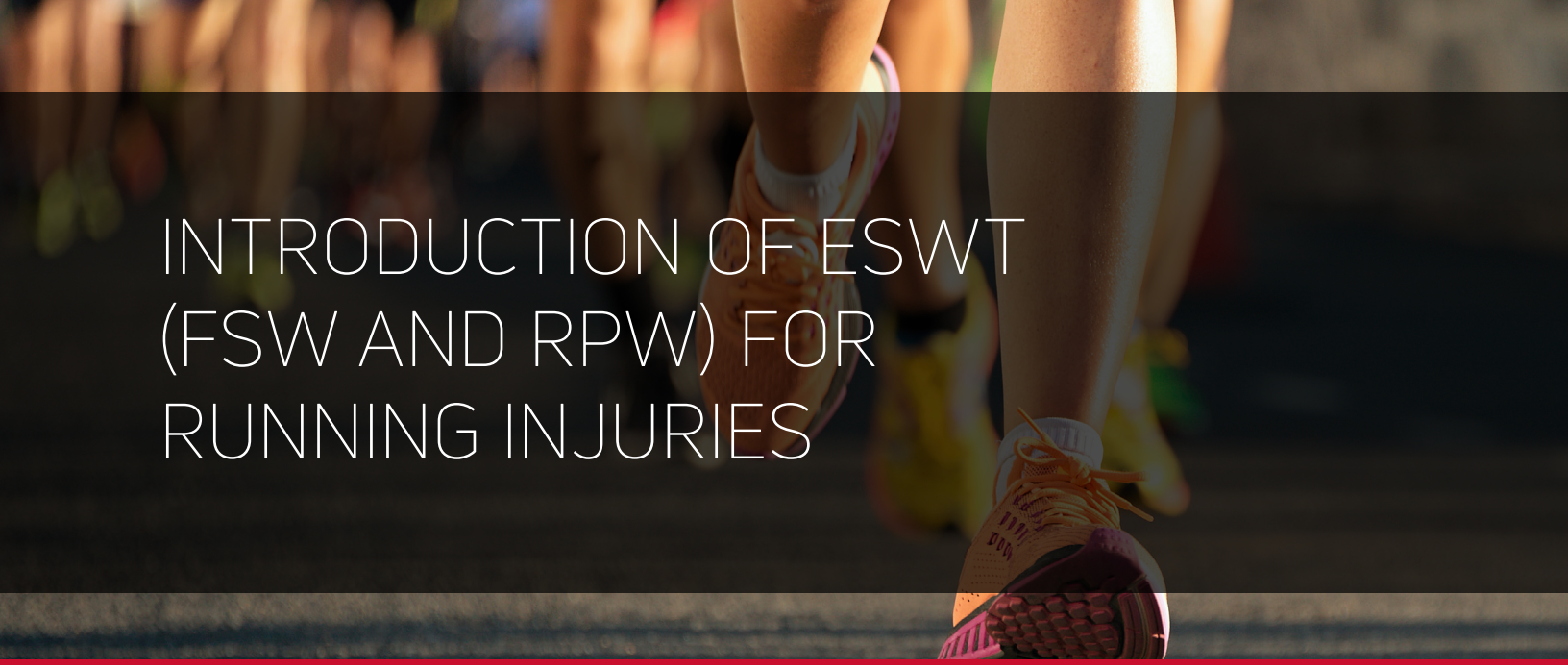
RUNNERS WANT TO RUN, GETTING THEM SAFELY BACK TO ACTIVITY

If you treat runners, then you know there is one constant- they just want to run. In this eBook we'll explore ways to help them get back in action when they experience a lower leg injury.

In this ebook we'll share ways to help runners safely get back to what they love doing. There will be a focus on how shockwave and high power laser therapies can help address painful lower leg and foot injuries.



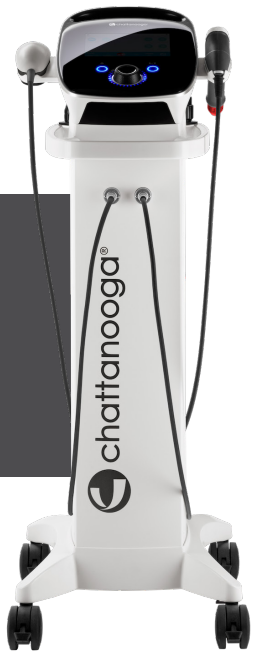
INTRODUCTION OF ESWT (FSW AND RPW) FOR RUNNING INJURIES

Soft tissue injuries are common to runners and athletes that depend on their legs to get them where they need to go. About 65% of regular runners get hurt each year. It's estimated that the average runner will sustain one injury for every 100 hours he or she runs.[1] When an injury occurs, athletes and weekend warriors are usually looking for solutions to get them back on the road as soon as possible.

What is shockwave?

Shockwave therapy, often referred to as ESWT (Extracorporeal Shockwave Therapy), is a non-invasive treatment option that has support in the literature for helping address a variety of common lower extremity conditions.[2, 3] Listed below are conditions that can be treated with Chattanooga Focused Shockwave (FSW) and Radial Pressure Wave (RPW) devices.

- FSW/ RPW: Plantar Fasciitis and Heel Pain[4,5]
- RPW: Achilles Tendinopathy[4]
- RPW: Disorders of Tendon Insertions[4]
- RPW: Myofascial Trigger Points[4]
- RPW: Reduce Muscle Pain & Aches[4]



What is shockwave?

They are high energy waves created by sharp changes of pressure in a narrow region, traveling through a medium like air or water. They are normally caused by an explosion or by a body moving faster than sound.[6]

HOW DOES SHOCKWAVE HELP TISSUE?

High energy waves, that can be created via different mechanisms, create a phenomenon referred to as mechanotransduction. In simple terms, it is the process of imparting brief, physical deformation to cells that lead to biochemical changes. These changes have the potential to positively impact pain and tissue repair.[7]

In some instances, the negative pressure created during the tensile phase of a shockwave creates cavitation bubbles within cells.[8] If intense enough, it can lead to disruption of damaged cells which is why shockwave can be classified as a proinflammatory modality.

Disruption of cells can lead to cell death (apoptosis) which triggers a low-level inflammatory response that benefits the process of removal and replacement of damaged tissue. This is another way that shockwave therapy can uniquely assist in treating chronic soft tissue problems.

Terminology

Names that refer to therapeutic shockwave are varied. This can create confusion when trying to investigate this technology. Common names include but are not limited to:

ESWT: Extracorporeal Shockwave Therapy
FSW: Focused Shockwave
EPAT: Extracorporeal Pulsed Activation Therapy
RPW: Radial Pressure Wave
AWT: Acoustic Wave Therapy

The list seems to grow by the month as companies try to differentiate their products.

CLASSIFICATION OF FSW VERSUS RPW

Generally speaking, there are two primary families of devices under the ESWT umbrella, the focused shockwave (FSW) and radial pressure wave (RPW) devices. While the two waves possess different physical characteristics, they generate similar results when treating various conditions in the musculoskeletal system with equivalent dosing.[2, 3]

Definition of shockwave components and characteristics.

A FSW is a high intensity, low-frequency (1 to 8 Hz) wave that impacts tissue differently than therapeutic ultrasound (US). Therapeutic shockwaves are non-thermal waves that create mechanotransduction and in some cases cavitation in tissues as deep as 12 cm.[4, 8]

FSW energy delivery is measured in mJ/mm^2 which is referred to as Energy Flux Density (EFD). EFD ranges between 0.01 and 0.55 mJ/mm^2 on Chattanooga FSW equipment.[5] Preferable dosing ranges exist when treating different conditions. For example, treating with extremely low energy levels (below 0.08 mJ/mm^2) has been shown to be ineffective and/or less effective than treating in higher energy ranges.[3, 9]

On the other end of the spectrum, treating at energy levels >0.60 mJ/mm^2 has been shown to be deleterious to tendons.[9] Understanding correct dosing parameters and treatment approaches is imperative to achieving consistent results with this equipment.

Interpreting bar pressure vs energy flux density (EFD)

RPW devices are commonly measured in bar pressure. This is likely due to the pneumatic mechanism that generates pressure waves. Bar pressure should ideally be measured at the point where the applicator meets the skin to ensure accurate clinical relevance. 1 bar is equivalent to 14.5 psi. With the correct conversion factors, bar pressure can be converted to EFD. This allows for equivalent dosing parameters to be calculated when comparing RPW and FSW treatments of a given condition. An example of a radial pressure wave is pictured here next to a traditional focused shockwave for ease of comparison. Notice the differences in peak pressure, rate of the wave cycle, as well as the general shape of the 2 waves.

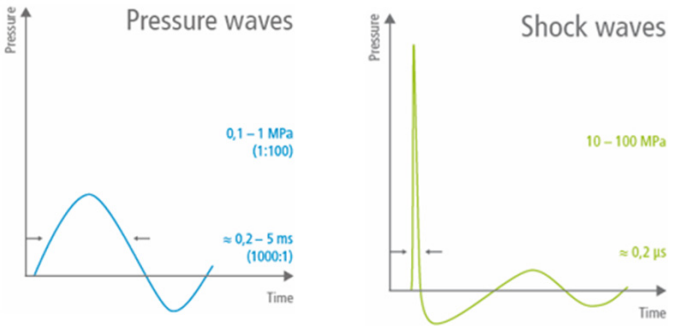
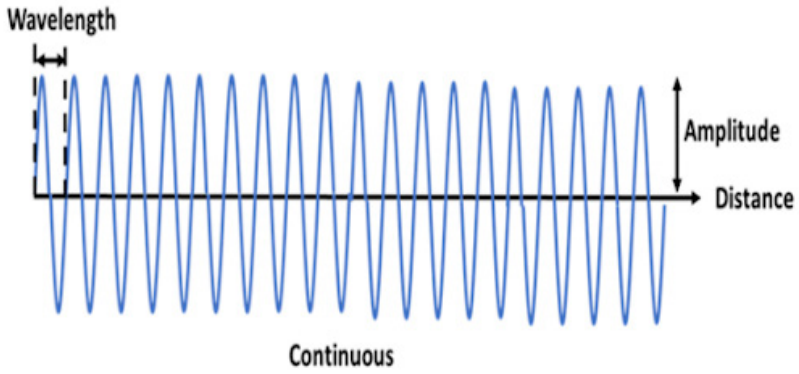


Image obtained from Reference 10 in the bibliography.

The physical impact of shockwaves can help improve the environment surrounding recalcitrant problems in muscle, calcific tendons, plantar fasciitis, as well as different connective tissues.

ARE ALL SOUNDWAVES THE SAME?

Some clinicians falsely assume that shockwave equipment is similar to therapeutic ultrasound (US) since they both utilize soundwaves. It should be noted that therapeutic ultrasound uses a lower intensity sound wave (20 to 1000 mW/cm^2) that is delivered at a higher frequency (0.7 to 3.3 MHz.).[11] Therapeutic US waves look like this:



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Continuous US creates thermal effects in tissue by alternating compression and rarefaction of sound waves within tissue. Maximum energy absorption in soft tissue occurs from 2 to 5 cm and intensity decreases as the waves penetrate deeper.[11]

Hopefully this review will provide some clarity for readers that are looking to better understand how ESWT can help various conditions as well as which device is best suited for a given practice setting.

THE ROLE OF SHOCKWAVE IN LOWER LEG RUNNING INJURIES

Physical management of tendon pain

The first step when addressing tendon related pain is differentiating between tendinitis and tendinosis as they usually require different management.

Tendinitis is defined as inflammation of the tendon and results from micro-tears that happen when the musculotendinous unit is acutely overloaded with a tensile force that is too heavy and/or too sudden.[12]

- Symptoms can include localized pain, possible inflammation around the tendon, and pain with exertion.
- Symptoms can last from days to 6 weeks depending on when treatment starts.[13]
- "Tendinitis can occur in any tendon. But it's most common around shoulders, elbows, wrists, knees and heels."[14]
- "Most tendinitis can be treated with rest, physical therapy, and medicine to reduce pain."[14]

Tendinosis is a degeneration of the tendon's collagen in response to chronic overuse; when overuse is continued without giving the tendon time to heal and rest, such as with repetitive strain injury, tendinosis results.[12]

It is generally considered a chronic progression of tendonitis and is differentiated from tendinitis by histological changes in the tendon.

THE ROLE OF SHOCKWAVE IN LOWER LEG RUNNING INJURIES CONTINUED...

Changes can include:[15]

- Hypercellular activity with increase nucleus size of tenocytes
- Areas of apoptosis
- Formation of chondroid (pseudo cartilage)
- Increased Type III collagen presence
- Disorganized collagen bundles
- Ground substance accumulation (Aggrecans)

Tendinosis recognized at an early stage can have athletes return to prior levels of activity in a 6–10 week time frame; however, when chronic and not addressed in the early stages, the window can increase to 3–6 months.[16]

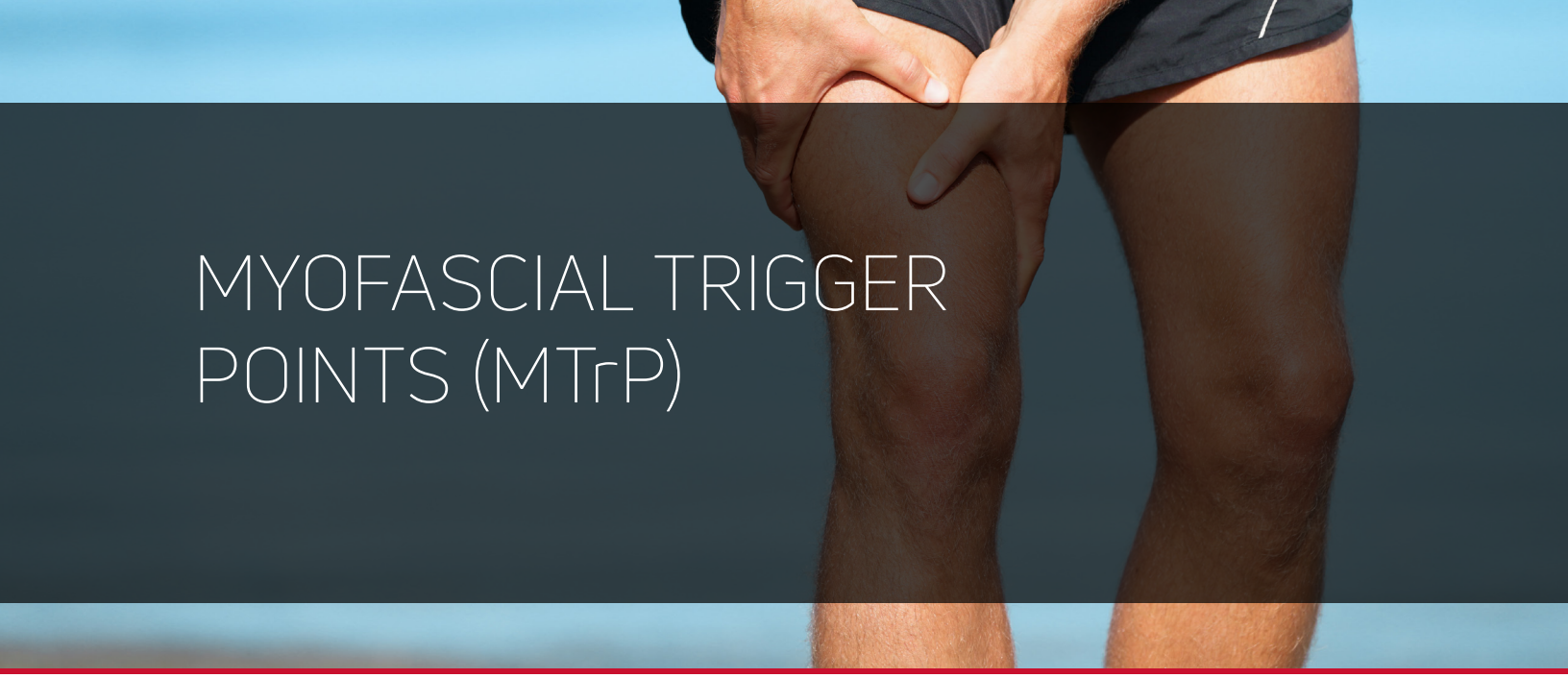
Treatment for this condition can be difficult as it requires exercise programs that last for several months. Additionally, exercise based approaches require progressive tendon loading which often requires individuals to tolerate moderate levels of discomfort while exercising to restore function. This can be complicated further by patients developing kinesiophobia (fear of motion) due to ongoing pain at the tendon.[17]

It is generally accepted that applying repeated high load, long duration (low intensity) stress on the tissue is required as part of a successful plan of care.

Tendon loading is one form of the phenomenon known as mechanotransduction.

"Mechanotransduction" is a biological pathway to which many cell types (including Stem Cells) sense and process the mechanical information from the extracellular environment. These biomechanical forces are converted in biochemical responses, thus influencing some fundamental cell functions such as migration, proliferation, differentiation, and apoptosis.[18]

Mechanotransduction is also a mechanism attributed to ESWT. These devices create this phenomena passively by imparting high energy sound waves into tissue that causes various degrees of cell deformation. This can be useful when patients cannot tolerate higher levels of tendon loading exercises.



MYOFASCIAL TRIGGER POINTS (MTrP)

Myofascial Trigger Points (MTrP) are hyperirritable, palpable nodules in the muscle causing local pain and limited movement.[19] They are commonly found in the muscle group associated with a painful tendon. Radial pressure wave therapy (RPW) has been shown to be an effective treatment option when addressing these areas in the muscle.

The goal of treating trigger points with RPW equipment is to localize and deactivate them.

Trigger points are localized at the low energy level (approximately 2 bar) by passing the transmitter over the muscle region being treated. Muscle tissue that is in a normal state will generally have no reaction to passing over the area with the RPW set at this level. Once an irritable area is located, there will be immediate subjective feedback from the patient which will help localize the MTrP.

If the pain in the area doesn't resolve in 500-1000 pulses, deactivating the MTrP may require using a higher energy level (approximately 3 bar) to help resolve the complaint.[4] Multiple painful areas can contribute to the primary MTrP, so additional pulses may also be given in those areas to help resolve the MTrP.

Addressing MTrP in this fashion should result in improved range of motion (ROM), improved tissue texture, and reduced subjective pain levels not only after treatment, but can impact pain associated with MTrP for as long as 3 months.[20]

HOW IS RADIAL PRESSURE WAVE THERAPY MODIFIED TO HELP TREAT DIFFERENT RUNNING INJURIES?

Radial shockwave energy delivery is modified by the following:

- **The volume of shocks provided.** Most studies, and Chattanooga, recommend 2000 pulses per location when treating tendon dysfunction. Trigger points may require fewer shocks. Patient biofeedback will dictate length and intensity of treatment over an area.
- **The rate at which the shocks are provided (Hz).** Some patients will subjectively prefer higher frequency treatments. Treating at higher rates will also shorten treatment times.
- **The bar pressure** of the machine which dictates the intensity of the radial pressure wave. Deeper tissue dysfunction requires higher bar settings in most cases.
- **The applicator used.** Softer materials transmit less energy and are useful for superficial tissues/ sensitive areas. Harder metals (steel and titanium) are used to treat deeper tissues as they transmit more energy into the tissue. Examples of different applicators are listed below:

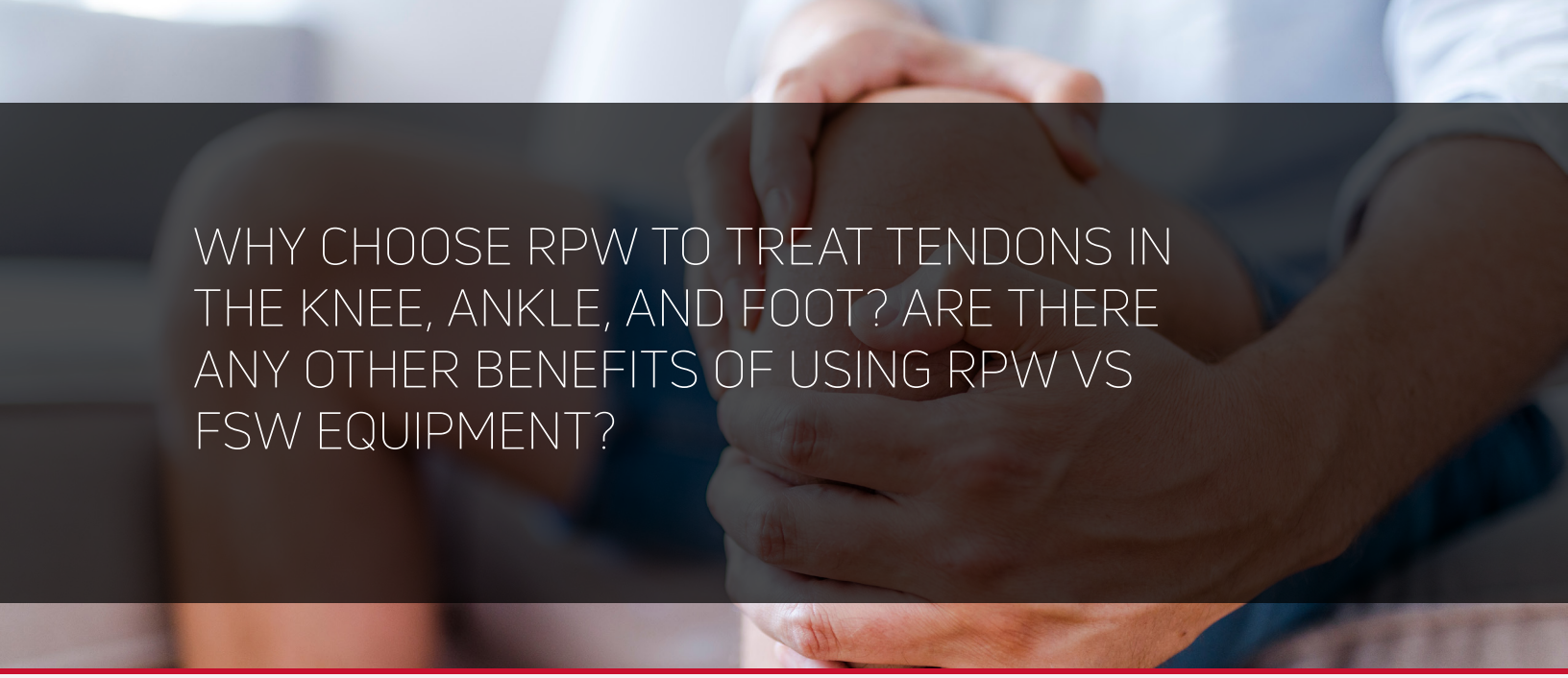
F15
White soft transmitter 15mm for superficial pain regions, muscles of mastication, cervical spine
Penetration depth 0-30mm
Intensity level: Very Low

Ro40
15mm Energy beam transmitter with concave coupling surface, best for pain zones near the skin surface
Penetration depth 0-35mm
Intensity level: Medium

DI15
Golden Depth 15mm Deep Impact® transmitter for deep target areas, chronic disorder, local trigger points
Penetration depth 0-60mm
Intensity level: High

D20-S
Standard Oscillator, 20mm transmitter or muscle and connective tissue
Penetration depth 0-50mm
Intensity level: Medium

C15 CERAma-x®
Ceramic Energy 15mm transmitter for any type of tendonopathies
Penetration depth 0-35mm
Intensity level: High



WHY CHOOSE RPW TO TREAT TENDONS IN THE KNEE, ANKLE, AND FOOT? ARE THERE ANY OTHER BENEFITS OF USING RPW VS FSW EQUIPMENT?

It has been well established that treating most tendon related conditions between 0.08 mJ/mm^2 and 0.28 mJ/mm^2 is desirable.[9] When treating tendons in the lower leg, radial pressure wave technology can easily generate the required level of energy to impact these superficial tissues.

The chart below highlights the specific performance characteristics of the Di15 attachment listed previously. The Y axis indicates depth of penetration in cm from the skin's surface, where the X axis indicates the bar pressure applied. (The far right column indicates the bar pressure required to deliver a minimally effective dose at a given depth 0.1 mJ/mm^2) This chart demonstrates how the RPW can reach tissues as deep as 6 cm when the Di15 transmitter is utilized at 5 bar of pressure.

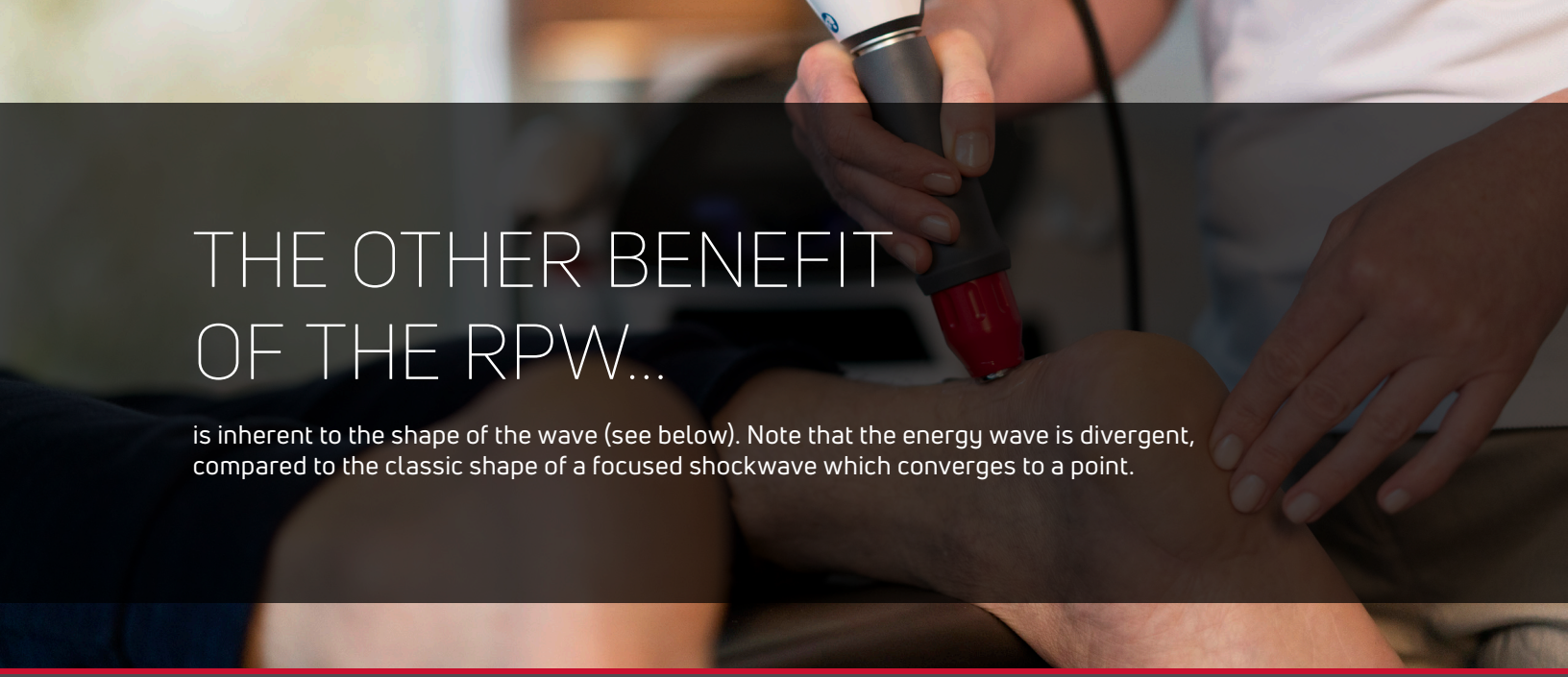
chattanooga
Moving Rehabilitation Forward

Half life of DI15 0.32mJ/mm2 at 19mm depth*

* unverified

DI15	Channelled beam for deep seated lesions & MTPs, Chronic & high energy requirements.					0.63mJ/mm2 at 5bar to 50mm
Bar pa Depth cm	1	2	3	4	5	Bar pa for 0.1 mJ/mm2
0	0.13	0.25	0.38	0.50	0.63	1.0
1	0.07	0.13	0.19	0.25	0.32	1.0
2	0.04	0.10	0.16	0.22	0.29	1.0
3	0.00	0.05	0.11	0.17	0.24	1.3
4	0.00	0.00	0.06	0.12	0.19	2.0
5	0.00	0.00	0.01	0.07	0.14	4.0
6	0.00	0.00	0.00	0.02	0.09	5.0

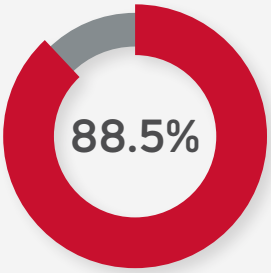
Produced by Cliff Eaton MSc MCSP (2015, 2018)



THE OTHER BENEFIT OF THE RPW...

is inherent to the shape of the wave (see below). Note that the energy wave is divergent, compared to the classic shape of a focused shockwave which converges to a point.

While focused waves can penetrate deeper (12 cm) at higher energy levels, the divergent wave of the RPW makes it easier to locate painful tissue when scanning for painful areas.



This is a key factor in why RPW has been shown to be statistically more effective in 88.5% of studies that compared RPW to either placebo or alternative treatment modalities when treating different types of tendinopathies.[3]

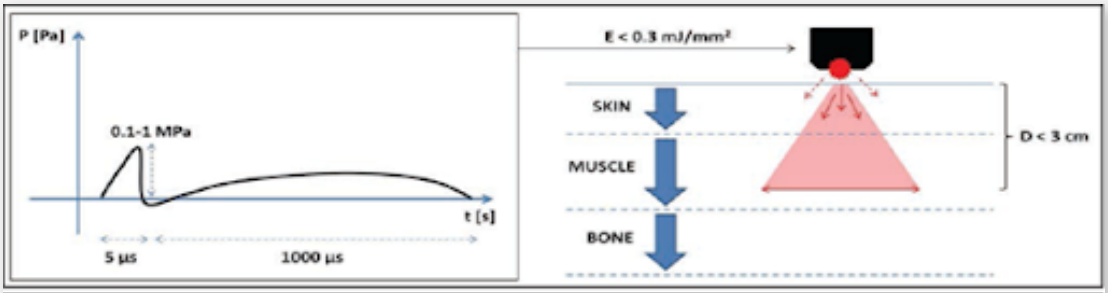


Figure 1. Schematic illustration of wave propagation with physical characteristics of radial extracorporeal shock wave therapy (ESWT).

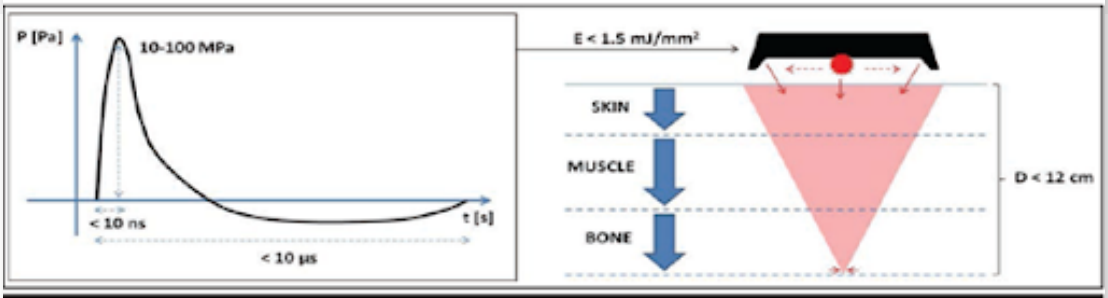


Figure 2. Schematic illustration of wave propagation with physical characteristics of focused ESWT.

Image obtained from reference 21 in the bibliography.

CAN'T I GET THE SAME RESULTS WITH FRICTION MASSAGE?

Friction massage is used to increase circulation and release areas that are tight; particularly around joints and where there are adhesions within the muscles or tendons.[22] Manually moving tissue in this fashion is actually another form of mechanotransduction. However, the practice is generally not comfortable for patients and can only be applied to superficial structures. Applying these techniques at depth is not tolerated by most patients.

Luckily, ESWT therapies are more comfortable and have the ability to reach much deeper tissues. An added benefit is that these devices also require significantly less work by the practitioner which can help save a clinician's most valuable equipment, their hands!

Mechanotransduction

- Mechanical forces that are applied to cell membranes impact ion exchange which impacts biochemical responses within the cell.
- Influences migration, proliferation, differentiation, and apoptosis.[18]
- Proteins containing Integrins when manipulated by shockwave energy convey force and transmission to the cell nucleus which leads to increased gene transcription. The increased nuclear activity results in increased collagen production in damaged areas.[23]

Shockwave Indications

- FSW Indications: The Chattanooga Intelect FSW is indicated for extracorporeal shockwave treatment of heel pain due to chronic proximal plantar fasciitis for patients of age greater than 18 years with a history of failed alternative conservative therapies for at least six months.
- Intelect RPW 2 Indications: The Intelect RPW 2 device is intended to be used to temporarily increase bloodflow and help reduce muscle pain and aches associated with:
    - Myofascial trigger points (MTrP),
    - Achilles tendinopathy,
    - Disorders of tendon insertions,
    - Plantar Fasciitis, and others.

WHY RUNNERS LOVE LASER THERAPY

For so many, running is more than exercise – running is freedom. It's an emotional and physical triumph for the human body. There is nothing else like it. Human beings were born to run. In fact, it is a critical survival skill. Just ask our ancestors that ever faced a hungry bear!

Running into problems

However, while enjoyable to many, running comes with risks. Applying repeated, high loads to the body can often result in injuries due to poor load management by novice runners or athletes that are ignoring signs of overuse.

Common areas of injury for runners include *hip, lower leg, lower back, and knee.*




These areas can be influenced by problems in the kinetic chain when mechanical issues are present at one or more joints in the system. It is not uncommon that poor lower extremity mechanics can result in joint pathology over time.

Combine joint dysfunction with weak muscles or muscle imbalances that may or may not be related to joint pain and you have multiple factors that can contribute aches and pains in the body.

Often runners turn to NSAIDs to help manage inflammation and pain. While many clinicians know that when taken for prolonged periods these meds can negatively impact the stomach and other organs, fewer clinicians realize that NSAIDs can have negative impacts on scar formation and muscle repair which can predispose athletes to chronic muscle strains.[24] A better solution for patients may be laser therapy, now correctly referred to as photobiomodulation.

PHOTOBIOMODULATION (PBM) THERAPY

A proven way to impact tissue at the cellular level

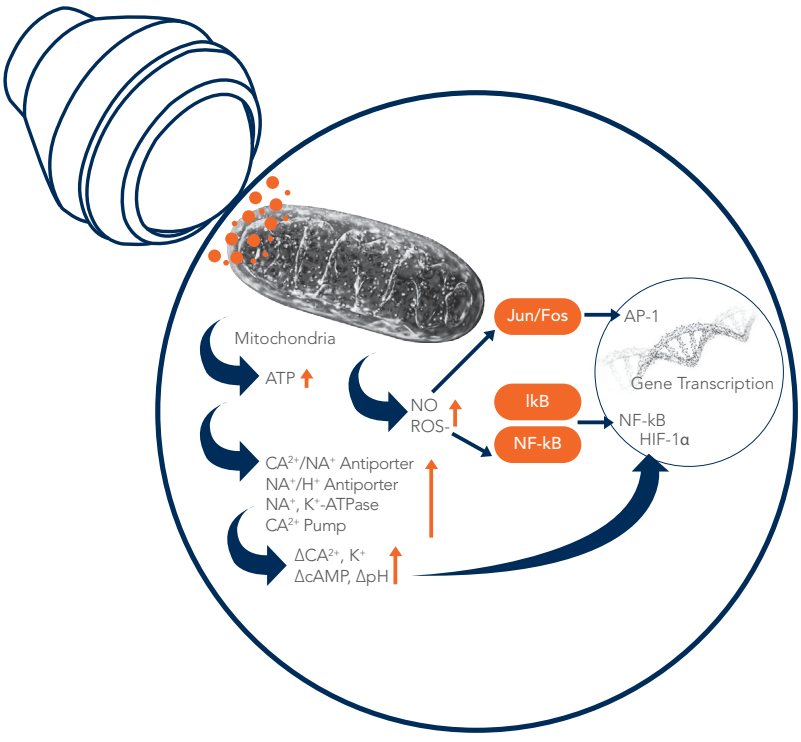
Photobiomodulation therapy (PBMT) is a form of light therapy based on the photochemical process called photobiomodulation (PBM). In photobiomodulation therapy, a light source is placed near or in contact with the skin, the light energy penetrates the skin reaching the mitochondria of damaged or diseased tissue leading to photobiomodulation. This process can result in beneficial therapeutic outcomes such as the alleviation of pain, increased blood flow, muscle relaxation, and relief from joint stiffness.[25-27]

PBM mechanisms of action

The application of a therapeutic dose of light to impaired or dysfunctional tissue leads to a cellular response mediated by mitochondrial mechanisms involved in pain relief and tissue repair processes.[20]

The primary target (chromophore) for the process is the cytochrome c complex which is found in the inner membrane of the cell mitochondria. Cytochrome c is a vital component of the electron transport chain that drives cellular metabolism. As light is absorbed, cytochrome c is stimulated, leading to increased production of adenosine triphosphate (ATP), the molecule that facilitates energy transfer within the cell.[20-22]

In addition to ATP, laser stimulation also produces free nitric oxide and reactive oxygen species. Nitric oxide is a powerful vasodilator and an important cellular signaling molecule involved in many physiological processes. Reactive oxygen species have been shown to affect many important physiological signaling pathways including the inflammatory response. In concert, these molecules have been shown to increase growth factor production and promote extracellular matrix deposition.



Physiological effects

- Analgesic
- Increased tissue oxygenation and nutrition
- Increased synthesis of ATP
- Impacts the biochemical pathways involved in tissue repair
- Increased microcirculation

APPLICATIONS & DELIVERY

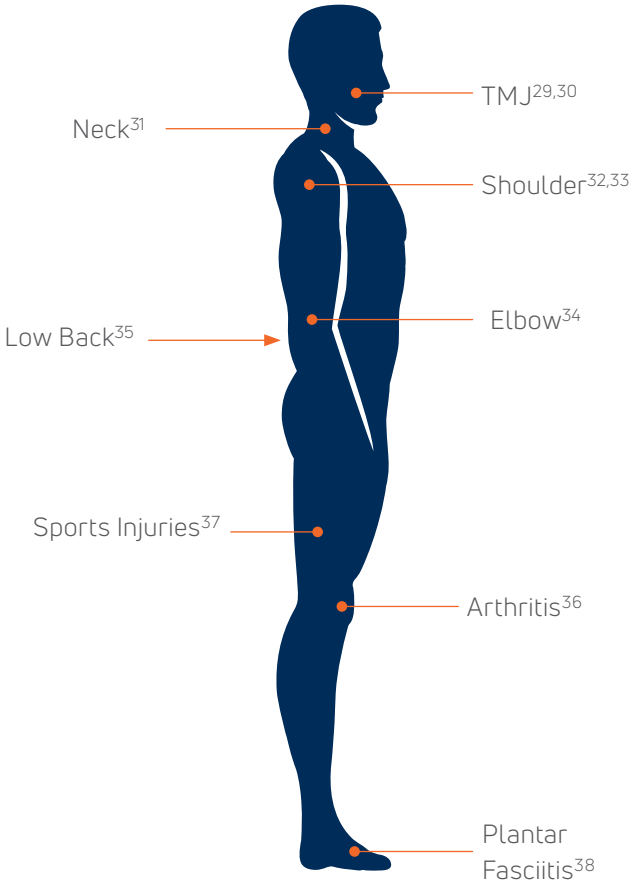
Versatile applications, consistent results

Use photobiomodulation therapy in conjunction with other modalities and treatment techniques with a low risk of side effects.

- Acute Conditions
- Chronic Conditions

Multiple Tissues:

- Tendons
- Ligaments
- Joint Capsules
- Muscles
- And More



The benefits of the massage ball

Help maximize clinical results with the benefits of LightForce's patented, on-contact photobiomodulation therapy treatment application.

COMPRESSION

Gets you closer to target tissue. Blanching reduces obstacles of superficial absorbers

REFLECTION

Contact application of delivery to tissue minimizes energy loss due to reflection

COLLIMATION

The massage ball acts to collimate the delivery of light to tissue reducing energy loss

SOFT TISSUE WORK

Allows you to do manual soft tissue work with the massage ball applicator while delivering energy

REFRACTIVE INDEX

The fused silica composition of the massage ball minimizes light losses as it passes from the massage ball into the skin due to similar refractive indices

PHOTOBIOMODULATION DOSING

A drug-free, surgery-free, non-invasive pain treatment alternative

PBM dosing - the key to results

Dosimetry in photobiomodulation (PBM) therapy is highly complicated - no single "dose" will work for all possible PBM therapies, and in some cases, different dosimetries can be equally effective. Safe and effective PBM dosimetry must consider multiple treatment parameters including: wavelength, irradiance (often called power density or brightness), and irradiation time.[28]

Furthermore, it is important to recognize that PBM is challenged by energy loss that occurs as light enters the skin and travels from superficial to deeper tissues. At the skin's surface this is primarily due to reflection and below the surface by absorption from different tissues competing for different wavelengths of light. Proper configuration of the laser is a key factor in getting sufficient energy to target tissues.

Factors that impact dose delivery at depth

- Wavelength
- Irradiance (power & beam area)
- Mechanism of delivery (contact vs. non-contact)
- Treatment time
- Size of treatment area
- Type of tissue

Laser classes - what do they mean?

Lasers are classified by the FDA according to their output power. In the field of photobiomodulation therapy, there are two common laser classifications:

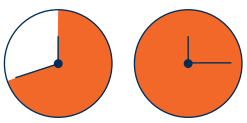
- Class IIIb, Maximum power output of 0.5 watts
- Class IV, Maximum power output of over 0.5 watts

Both Class IIIb and Class IV lasers require that safety eye protection be worn during emission.

The impact of power on treatment time

Power is a key factor when delivering a therapeutic dose to deep target tissues. Not only do LightForce® lasers have higher output powers, but they also have larger beam areas, making them more capable of delivering a therapeutic dose to larger treatment areas.

For example, to effectively treat a 300 cm2 thoracic spine at 10 J/cm2, 3,000 joules of energy are required at the surface of the skin to deliver a therapeutic dose at depth. How long would that treatment take with a Class IIIb laser vs. a ClassIV laser?



Class IIIb
3,000 J at 0.5 W = 100 min

Class IV
3,000 J at 15 W = 3.3 min

PHOTOBIOMODULATION FOR COMMON RUNNING INJURIES

Photobiomodulation has been shown to reduce the amount of exercise required to recover from achilles tendinopathy. The following study by Tumilty showed that exercising 2 times a week when combined with therapeutic laser provided equivalent outcomes to a group that had to exercise 2 sessions per day on a daily basis when not utilizing laser. This is important as patient compliance can be significantly improved when required to exercise 2 times a week compared to 14 times!

Here is a brief summary of the findings of *Photobiomodulation and eccentric exercise for Achilles tendinopathy: a randomized controlled trial:*

- Double blinded research
- Participants were 18-65 years old
- Participants had experienced symptoms for over 3 months
- **There were 4 groups:**
    - Twice a day, every day exercise + placebo laser
    - Twice a day, every day exercise + laser
    - Placebo laser + once a day, twice a week exercise
    - Laser + once a day, twice a week exercises

- Outcome measure: VISA-A (Victorian Institute of Sports Assessment-Achilles)
- Findings: Patients achieved the same results incorporating high power laser with only 2 exercise sessions a week compared to the twice a day everyday exercise program.

Adding laser therapy to treatment protocols for Achilles tendinopathy enables patients to exercise less and achieve the same outcomes.[39]

Learn More at *pubmed.ncbi.nlm.nih.gov/26610637/*

Does your patient have metal implants?

Laser therapy may be used over metal orthopedic implants and hardware since therapeutic light simply reflects off metallic surfaces. Shockwave is, however, contraindicated for the use over implants. For clinicians working with older populations, laser may be a more versatile treatment option for this reason.

LASER THERAPY: A SIMPLE TREATMENT OPTION FOR RUNNERS

Laser helps reduce pain generated from both joints and muscles:

It is common for runners to have stiffness and pain in the lower leg, knee, and hip. Laser has the ability to relieve muscle and joint pain through the process of photobiomodulation.[40] This can help runners return to training when they would otherwise have to take days off due to pain.

For runners that are looking for options to help them to bounce back after intense training sessions, laser has been shown to reduce delayed onset muscle soreness after training (DOMS).[41] This is likely related to lasers' ability to increase local blood circulation at muscle tissue after treatment.

When pain is more chronic in nature, for example when athletes try to run through painful arthritic pain, their muscles can restrict motion due to protective guarding. Laser can be used before or after events to help *reduce muscle spasm, pain and stiffness*.[40] This can be a huge benefit for seniors trying to ready themselves for an event or manage their condition as they prepare for tackling longer distances.

Maximizing performance in shorter periods of time

Many clinics are looking for ways to increase cash revenue in their clinics or through community outreach. This can be done by treating runners on location before their races in a laser safe tent.

LightForce® high power lasers allow proper dosing to be applied to large areas of tissue, like the quadriceps, hamstrings, and lower leg in minutes! This is simply the result of utilizing higher power when treating which inversely impacts the amount of time needed for treatments.

This can be a huge benefit when trying to work with a line of runners looking for treatment before an event or within a busy clinic when multiple patients are in need of laser therapy.

TREATING TENDONITIS VS TENDINOSIS

Manage achilles tendonitis (reactive tendinopathy) by:

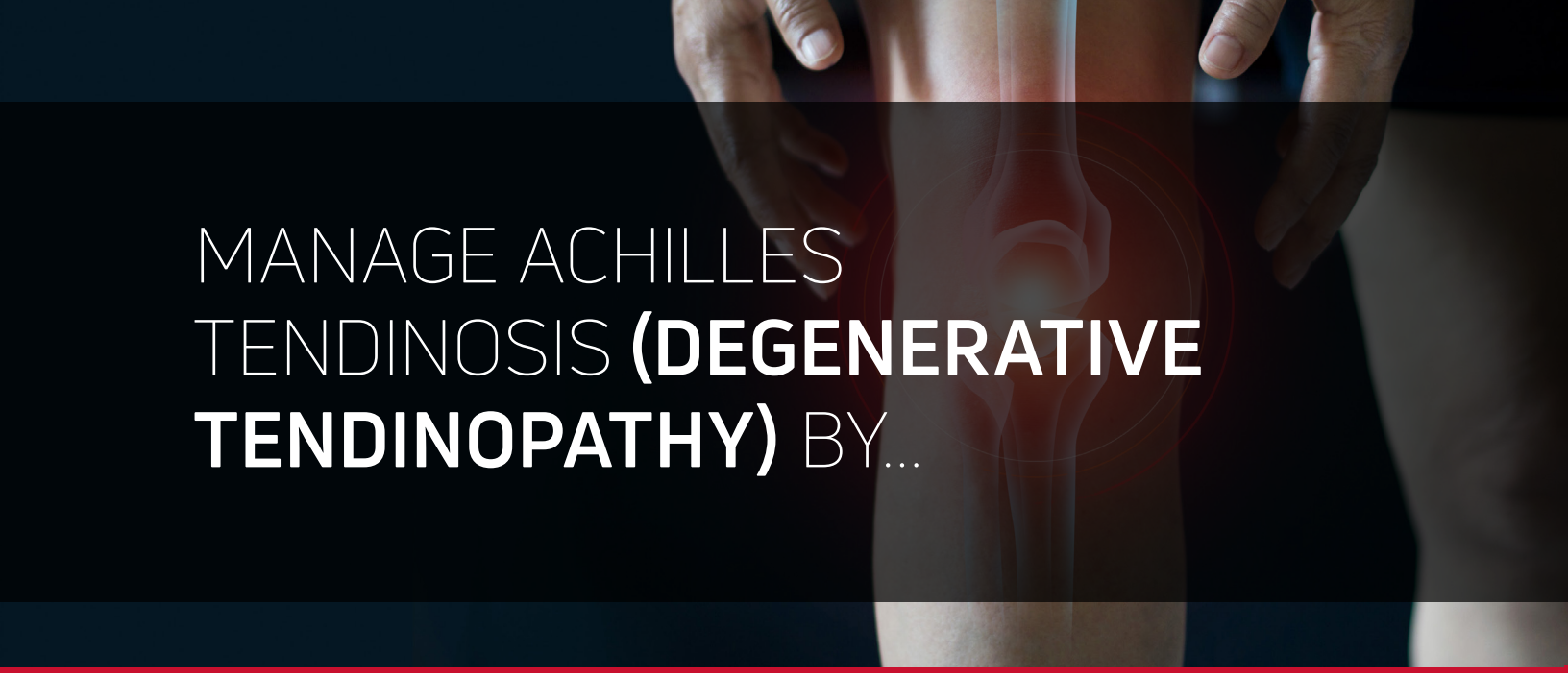
Reducing load/ exercise on the tendon until pain levels subside.

All exercise should be at low intensity while in painful state. Looking for minimal pain with exercises.[14]

Focus on pain reduction.[14]

Gentle range of motion.[42]

NSAIDs per instruction of medical professional.[14]



MANAGE ACHILLES TENDINOSIS **(DEGENERATIVE TENDINOPATHY)** BY...

Exercising in a moderate pain (0-5/10) window in initial weeks of program.[17, 39]

Eccentric loading should be a key component of exercise regimen, but more concentric activities should be included as pain improves.[17]

Load should be progressed as tolerated: pain staying below 5/10.[17, 39]

Explosive/ high intensity activities are reintroduced in later phases of rehab once pain has subsided and athlete is preparing for return to sporting activities.[17]

Full recovery of symptoms does not ensure full recovery of function or tendon structure.[17]

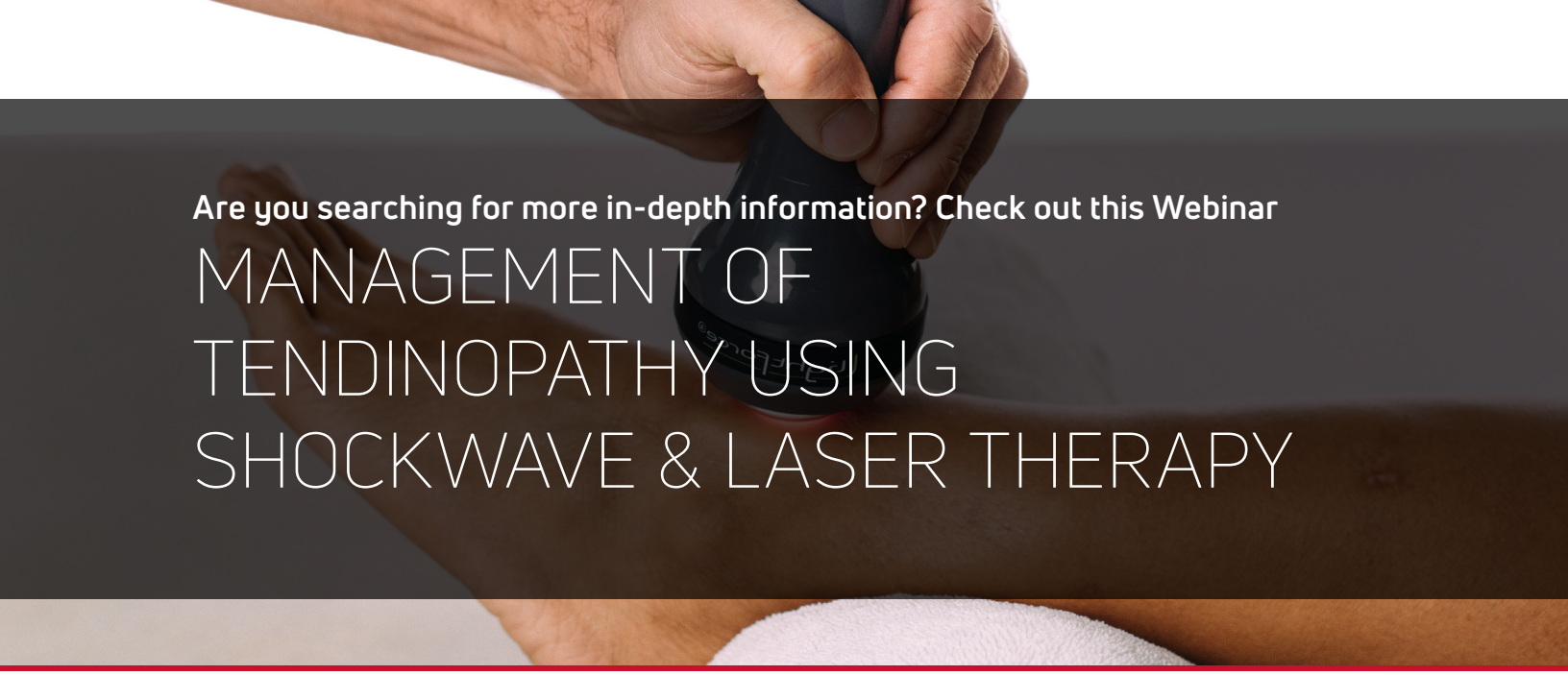
Isometrics may be beneficial early on when pain levels are higher.[17]

Range of motion (ROM) stretches.[42]

Use of modalities that address pain appropriately:
(Ice, ESWT, iontophoresis, instrument assisted soft tissue work).[17]

Extracorporeal Shockwave Therapy (ESWT) is more effective than eccentrics alone.[17]

High power laser can help reduce pain at the tendon and improve circulation. Lasers allow for reduction in overall volume of exercise needed to improve functional levels.[39]



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MANAGEMENT OF TENDINOPATHY USING SHOCKWAVE & LASER THERAPY

[ON-DEMAND WEBINAR]

Chattanooga® Director of Clinical Education, Mark Callanen, PT, DPT, OCS, sits down with special guest and DJO Global Clinical Specialist, Cliff Eaton, MSc, MCSP, to discuss the use of shockwave and laser therapy in treating various types of tendinopathies. Eaton brings with him a wealth of knowledge from his experience in both the professional sports and private practice settings.

His extensive background in sports medicine will provide an exciting perspective on the wide scope of treatment options available using shockwave and laser therapy. During this webinar, we will discuss:

- Treating acute and chronic tendinopathy
- Choosing the proper modality for different types of tendinopathy
- How shockwave and laser therapy can help improve patient outcomes

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SUPPORTIVE EVIDENCE FOR LOWER LEG RUNNING INJURIES

Research shows that radial shockwave treatment is most effective when included as part of comprehensive plans of care that include stretching and exercise.[43] Read the full study: Radial shock wave treatment alone is less efficient than radial shock wave treatment combined with tissue-specific plantar fascia-stretching in patients with chronic plantar heel pain.

Learn More at *pubmed.ncbi.nlm.nih.gov/25940060/*

Management of plantar heel pain: a best practice guide informed by a systematic review, expert clinical reasoning and patient values provides best practices to include conservative treatment in the first 4-6 weeks of plantar fasciitis (outlined below). When pain persists beyond 6 weeks, the evidence supports ESWT as the next best course of treatment followed by custom orthotics.[44] This research included feedback from both the clinician and the patient.

Learn More at *bjsm.bmj.com/content/55/19/1106*

The review revealed the following best practices guidelines for ESWT:

- The core approach (taping, stretching, exercising, and educating) should be used for approximately 4-6 weeks before consideration of adjunctive interventions such as ESWT or orthoses.
- ESWT had the best evidence of any adjunctive treatment, including dry needling, if the core approach was unsuccessful at 4-6 weeks.
- ESWT had minimal documented adverse events and positive efficacy in the short term, medium term, and long term for the most patient-reported outcomes.

Utilizing Extracorporeal Shockwave Therapy for in-Season Athletes reviews the use of ESWT to address sports-related injuries for in-season athletes to accelerate return to play.[45]

Learn More at *www.mdpi.com/2227-9032/11/7/1006*

Patient compliance, the role of modalities

Exercise is often uncomfortable but needed for patients suffering from Achilles tendinopathy and plantar fasciitis.[17] Adding modalities such as shockwave and laser therapy can help manage pain in the clinic which can open doors to more advanced loading exercises. Keeping pain in check can help promote steady progress over the 3-4 week course of treatment commonly needed to restore higher levels of function when adding ESWT to a plan of care (POC).

Quick review of how to use shockwave for runners:

- ESWT is a trusted treatment option for clinicians treating pain associated with a variety of tendinopathies, with unique advantages relative to other interventional treatments.
- RPW technology is the most commonly used ESWT device globally. This is partially due to the lower costs associated with these devices which makes them an attractive entry point into shockwave technology. While cost is one factor, RPW popularity is primarily due to its effectiveness in helping to treat tendon disorders. A 2015 systematic review showed that RPW treatments were 88.5% effective when compared to other treatments for common musculoskeletal pathologies. FSW was found to be 81.5% effective in the same study.[3] While the physical properties of the RPW differ from the FSW, RPW has been repeatedly shown to be as effective in treating soft tissue pathologies in the extremities as FSW where tendons are relatively superficial.[3]
- FSW can provide higher energy treatments at depths of up to 12.5 cm. While potent, FSW has the ability to be more precise with the energy it delivers and at specified depths. This is ideal for clinicians that utilize diagnostic ultrasound to identify the depth and degree of soft tissue lesions they are treating. FSW is very simple to use as it allows clinicians to apply specific energy levels (mJ/mm^2) at precise depths by dialing in the desired energy flux density (EFD) on the screen and then setting the treatment depth of the focal area by choosing the correct stand-off that fits on the handpiece.

The effect of high-intensity versus low-level laser therapy in the management of plantar fasciitis: *a randomized clinical trial*[38]

Banu Ordahan, Ali Yavuz Karahan, Ercan Kaydok

Published in: Lasers in Medical Science, 2018
https://doi.org/10.1007/s10103-018-2497-6

This clinical trial compared high-intensity laser therapy (HILT) to low-level laser therapy (LLLT) in treating plantar fasciitis symptoms.

Seventy-five patients with plantar fasciitis unresponsive to conservative treatment were enrolled in the trial. Patients were randomized to receive HILT or LLLT. Both groups completed 3 treatment sessions per week for 3 weeks.

- **HILT group:** Patients received treatment with a 12 W laser. The first 3 sessions used pulsed wave therapy for 75 seconds, 8 W, 6 J/cm^2. The following 6 sessions used continuous wave therapy for 30 seconds, 6 W, 120-150 J/cm^2.
- **LLLT group:** Patients received treatment from a laser with an output power of 240 mW. Treatment was given over the tendon insertion at 0.16 W/cm^2 and over the medial border of the fascia at 0.08 W/cm^2. Each treatment session was for 157.5 seconds.

In addition to laser therapy, both groups were instructed to wear an insole and to complete home exercises twice daily.

Patients were assessed for pain using the visual analogue scale (VAS) and Heel Tenderness Index (HTI). They were evaluated for function and quality of life using the Foot and Ankle Outcomes Score (FAOS).

After 3 weeks of treatment, both the HILT and LLLT groups showed significant improvement in all of the outcome measures. **However, the HILT group improved significantly more than the LLLT group. For example, VAS scores decreased by 33.4% for the LLLT group but the HILT group scores decreased by 69%.**

It can be concluded from the study that HILT and LLLT improve patient pain, function, and quality of life. However, HILT gives plantar fasciitis patients even better outcomes than LLLT.

Clinical effectiveness of multi-wavelength photobiomodulation therapy as an adjunct to extracorporeal shock wave therapy in the management of plantar fasciitis: *a randomized controlled trial*[46]

Mary Kamal Nassif Takla and Soheir Shethata Rezk-Allah Rezk

Published in: Lasers in Medical Science, 2019
https://doi.org/10.1007/s10103-018-2632-4

This clinical trial evaluated the effectiveness of combining extracorporeal shockwave therapy (ESWT) with photobiomodulation therapy (PBMT) to treat pain and disability in patients with plantar fasciitis.

One hundred twenty patients with plantar fasciitis for more than 6 months and unresponsive to conservative treatment were enrolled in the trial. Patients were randomized to one of the following groups:

- **ESWT:** Patients in this group were treated with the Chattanooga® Intelect® Focus Shockwave. Treatment sessions were completed once a week for 3 weeks and consisted of 2000 pulses at an energy level between 0.22 and 0.28 mJ/mm^2.
- **PBMT:** Patients in this group received photobiomodulation therapy at a dose of 2.8 J/cm^2 for 60 seconds at each session. Treatments were completed 3 times a week for 3 weeks.
- **ESWT + PBMT:** Treatment parameters for this group were the same as described for each of the single therapy groups. Patients received one ESWT and 3 PBMT treatments per week. Once per week, ESWT and PBMT were given consecutively with ESWT being administered prior to PBMT.
- **Sham PBMT:** Patients in this group received sham PBMT 3 times a week for 3 weeks where no power was emitted from the device.

Study outcomes included pressure pain threshold (PPT), VAS pain score, and the functional foot index disability subscale (FFI-d). The ESWT, PBMT, and ESWT + PMBT groups showed improvement in all outcome scores after 3 weeks of treatment, with further improvement at the 12 week follow-up. The ESWT + PBMT group was superior to either treatment alone in reducing pain and disability.

VAS pain scores for the ESWT + PBMT group decreased by 90.5% at the 12 week follow-up and the FFI-d scores decreased by 56.2%! In comparison, the Sham PBMT group VAS pain scores increased by 3.8% and the FFI-d scores increased by 0.6%.

The authors concluded that both ESWT and PBMT are effective treatments for reducing pain and improving function in patients with plantar fasciitis. However, combining the two treatments gives the best results.

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