

“ESWT” use in Foot and Ankle: 19+ year experience

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Disclosures

- Receive research funding, honorarium, travel and equipment from Curamedix, Storz

ESWT Family



2015 FDA Clinical Trial JBJS

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A commentary by Michael S. Aronow, MD,
is linked to the online version of this article
at jbjs.org.

Clinically Relevant Effectiveness of Focused Extracorporeal Shock Wave Therapy in the Treatment of Chronic Plantar Fasciitis

A Randomized, Controlled Multicenter Study

Hans Gollwitzer, MD, Amol Saxena, DPM, Lawrence A. DiDomenico, DPM, Louis Galli, DPM,
Richard T. Bouché, DPM, David S. Caminear, DPM, Brian Fullem, DPM, Johannes C. Vester,
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Background: The effectiveness of extracorporeal shock wave therapy in the treatment of plantar fasciitis is controversial. The objective of the present study was to test whether focused extracorporeal shock wave therapy is effective in relieving chronic heel pain diagnosed as plantar fasciitis.

Shockwave

1. Two types of “ESWT”: focused ESWT (FSW) and radial pressure wave (RPW aka “EPAT”)
2. The technologies work differently and potentially synergistically by stimulating angiogenesis, stem cells, growth factors
3. Has the highest level of evidence of anything you do for musculoskeletal conditions, many bone conditions, and high potential for wounds
4. Is “non-invasive”, most often no “down-time”. Can use while training even daily & half-time!

SHOCK WAVE HAS MORE LEVEL I EVIDENCE THAN MOST TOOLS IN OUR TOOL BOX

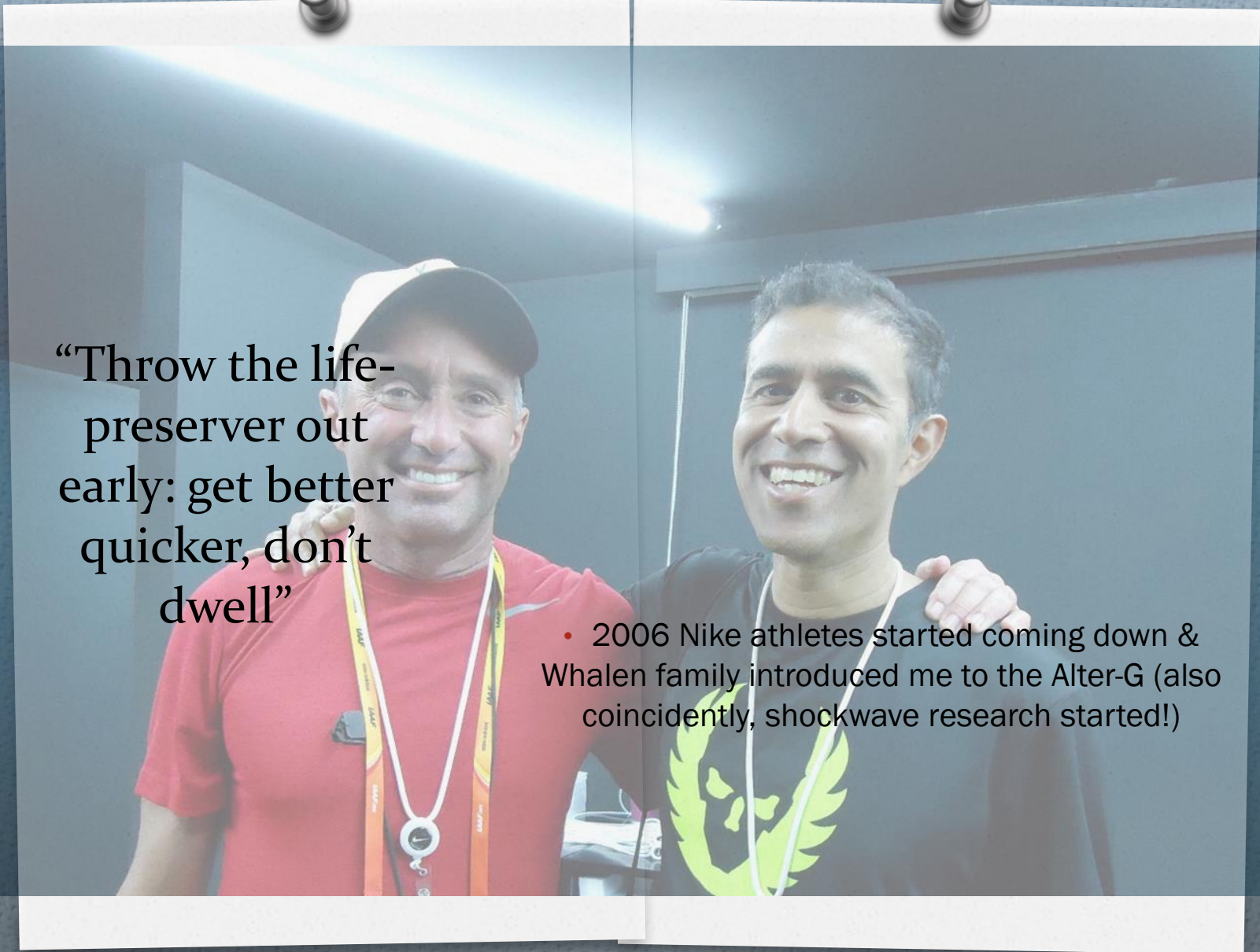
Clinically Relevant Effectiveness Of Focused ESWT In The Treatment Of Chronic Plantar Fasciitis: A Randomized, Controlled Multicenter Study *The Journal of Bone and Joint Surgery* (2015)

Radial ESWT Is Safe And Effective In The Treatment Of Chronic Recalcitrant Plantar Fasciitis: Results Of A Confirmatory Randomized Placebo-Controlled Multicenter Study *American Journal of Sports Medicine* (2008)

Eccentric Loading Versus Eccentric Loading Plus Shock-Wave Treatment For Midportion Achilles Tendinopathy: A Randomized Controlled Trial *American Journal of Sports Medicine* (2009)

Eccentric Loading, Shock-Wave Treatment, Or A Wait-And-See Policy For Tendinopathy Of The Main Body Of Tendon Achillis: A Randomized Controlled Trial *American Journal of Sports Medicine* (2007)

Shock Wave Therapy For Chronic Achilles Tendon Pain: A Randomized Placebo-Controlled Trial *Clinical Orthopedics and Related Research* (2005)



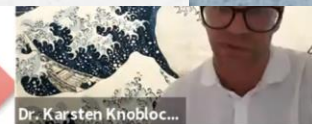
“Throw the life-
preserver out
early: get better
quicker, don’t
dwell”

- 2006 Nike athletes started coming down & Whalen family introduced me to the Alter-G (also coincidentally, shockwave research started!)



Indications

Beginner



1. Approved standard indications

- 1.1. Chronic Tendinopathies
 - 1.1.1. Calcifying tendinopathy of the shoulder
 - 1.1.2. Lateral epicondylopathy of the elbow (tennis elbow)
 - 1.1.3. Greater trochanter pain syndrome
 - 1.1.4. Patellar tendinopathy
 - 1.1.5. Achilles tendinopathy
 - 1.1.6. Plantar fasciitis, with or without heel spur
- 1.2. Bone Pathologies
 - 1.2.1. Delayed bone healing
 - 1.2.2. Bone Non-Union (pseudarthroses)
 - 1.2.3. Stress fracture
 - 1.2.4. Avascular bone necrosis without articular derangement
 - 1.2.5. Osteochondritis Dissecans (OCD) without articular derangement
- 1.3. Skin Pathologies
 - 1.3.1. Delayed or non-healing wounds
 - 1.3.2. Skin ulcers
 - 1.3.3. Non-circumferential burn wounds



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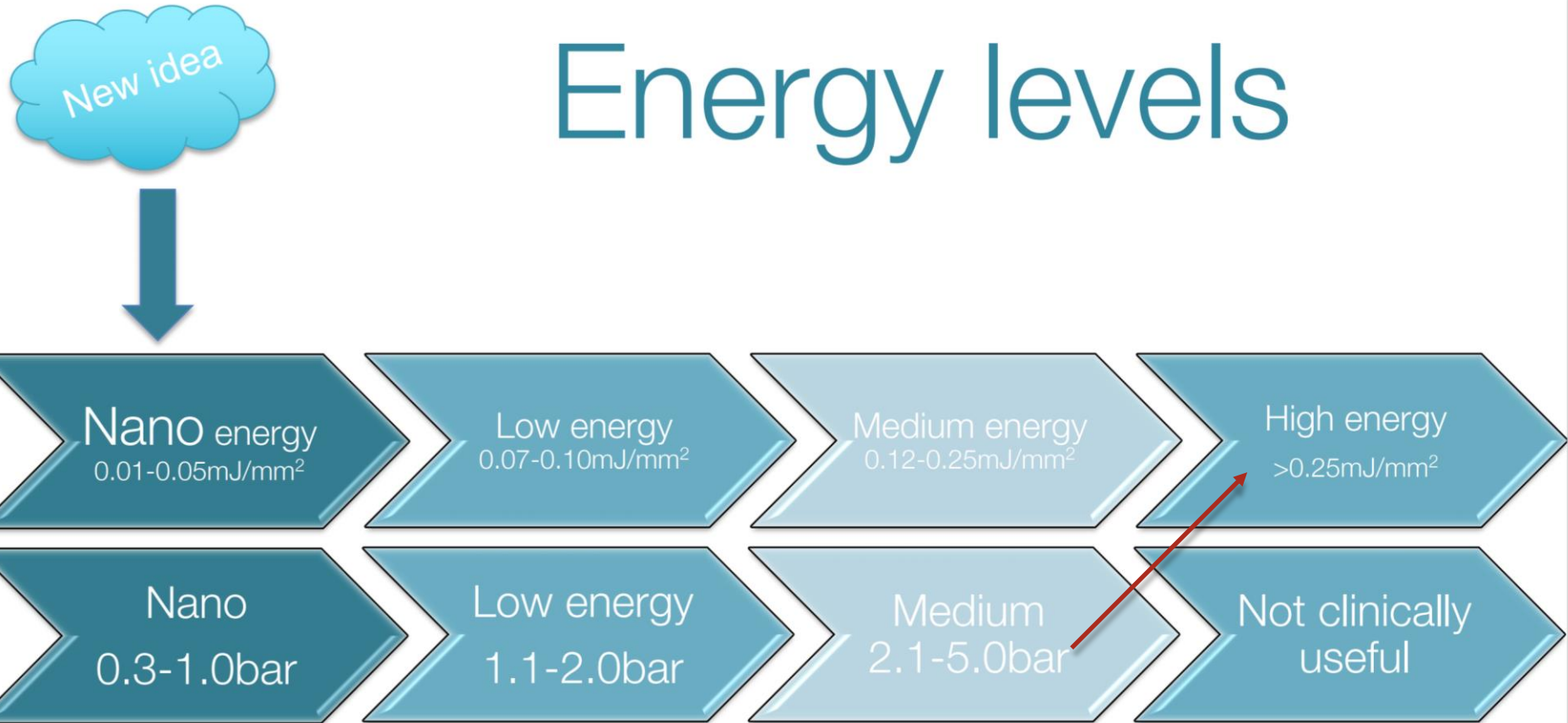
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High-Energy/Low-Energy

- OLD Terminology, Old machines!!!
- **Current Terminology** (since 2006): **Focused** aka “ESWT” (true shockwaves) and **radial** (RSW, SWT,rESWT) “sound/pressure” waves
- Most “shockwave” devices current in US market are radial devices (\$16-26K)
- ESWT (focused) devices are \$55+K (but have more indications beyond musculoskeletal, ie **wounds**, neuro, GU)

Energy levels: both can produce “High”



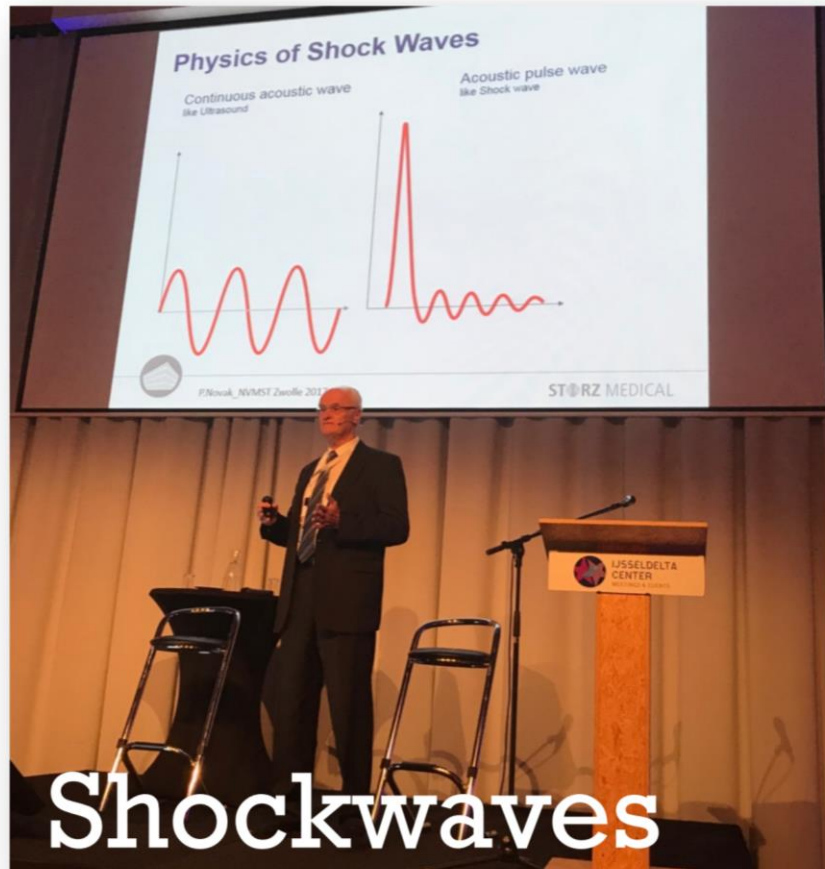
Nano-energetic



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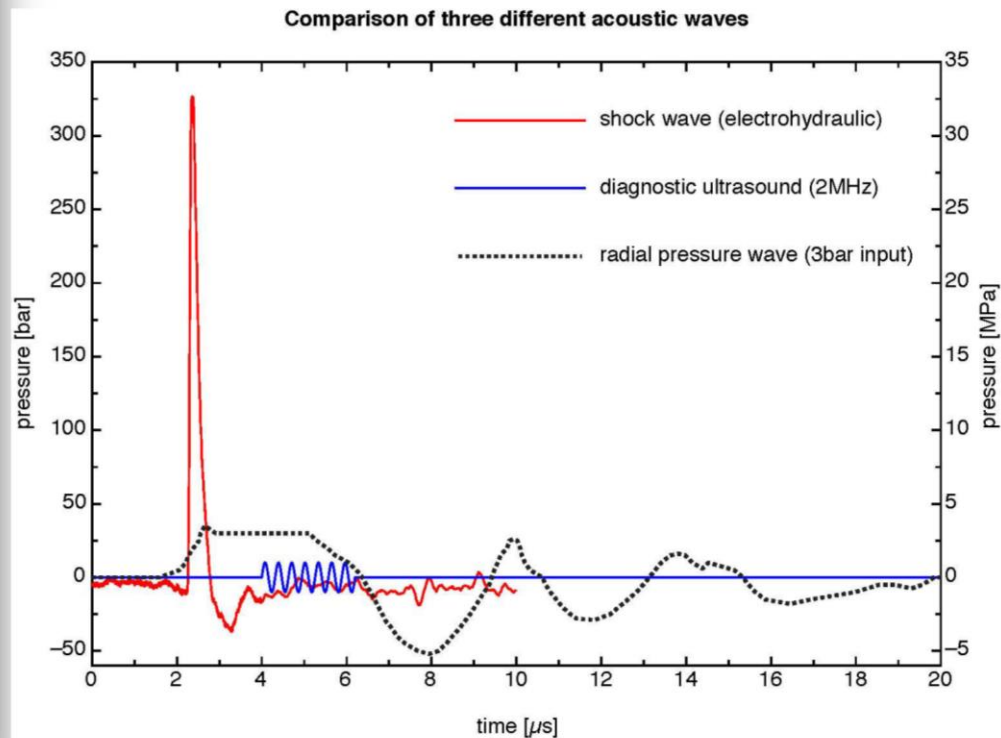
How does it work?

- Causes pain, release & depletion of Substance P
- Creates micro-trauma, releases growth factors, neovascularization, re-introduces a healing response
- Can induce stem cell release in bony & fatty areas



Shockwaves

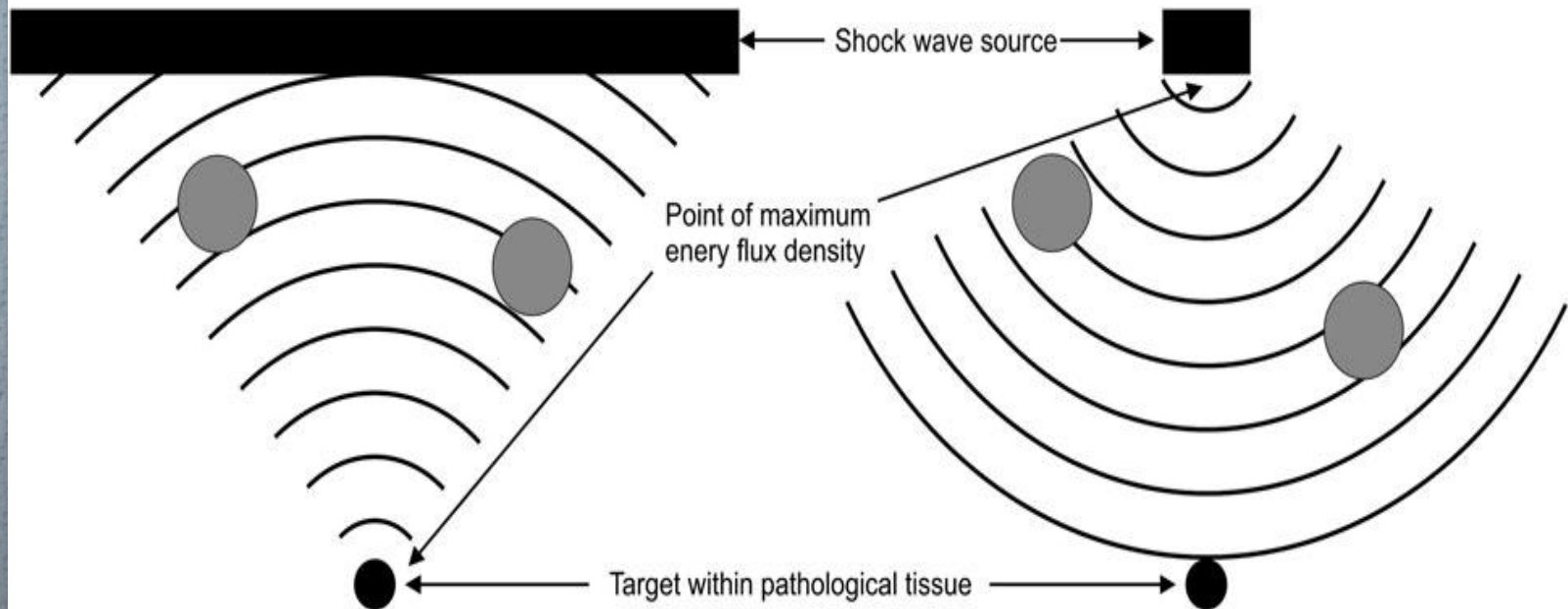
exert high energy for
very short time



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Focused shock waves (fESWT)

Radial shock waves (rESWT)



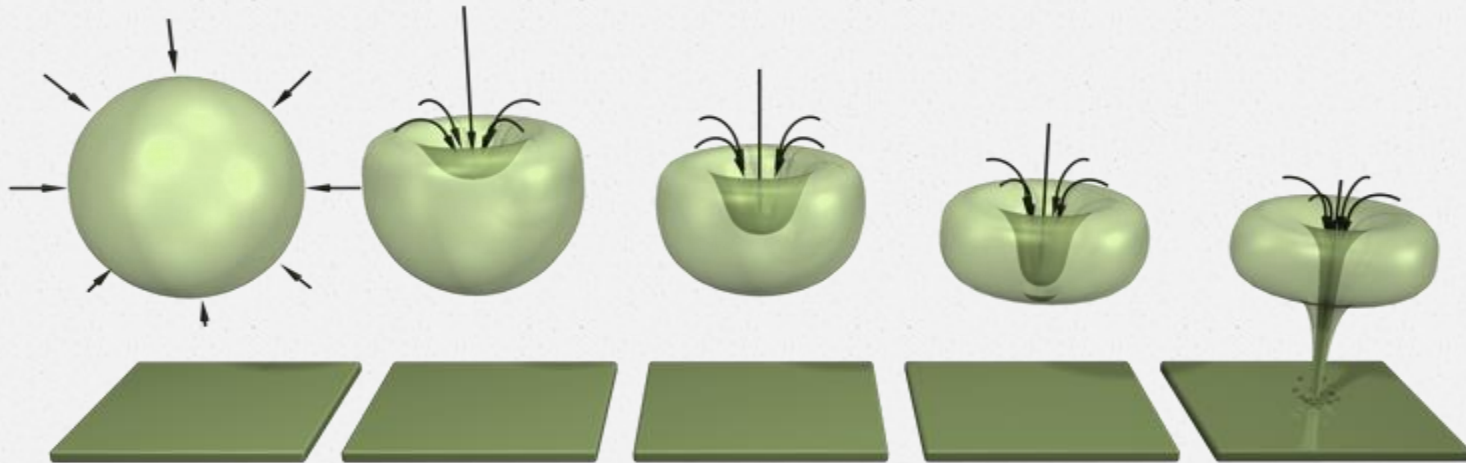
The Effects of SHOCK WAVE

- Reduces/eliminates pain
 - Effect on nociceptors:
→ c-fibres (slow)
 - Inhibited by a-delta-fibres (fast)
 - Analgesic effect
- Increases circulation and metabolism
- Stimulates neovascularization
- Stimulates tissue and bone growth
 - Tissue engineering (mense)
- Biological mechano-transduction
 - Cell proliferation (neuland)
- Dissolves calcium deposits
- Reduces muscle tension
- Antibacterial effects



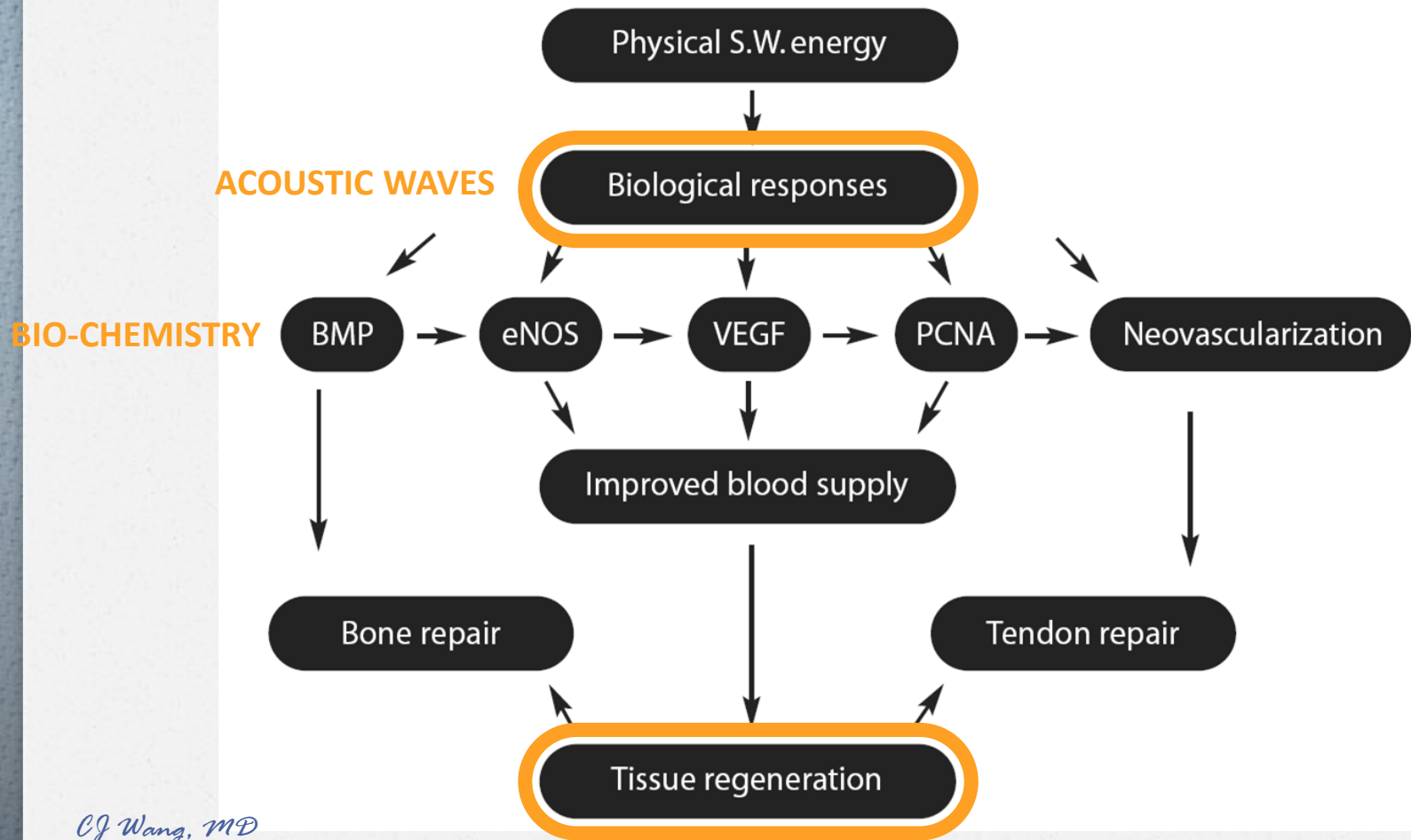
BIOLOGIC EFFECTS OF ACOUSTIC PRESSURE WAVES

- Disruption of cell membranes



- Neovascularization
- Stimulate osteoblasts, chondroblasts, macrophages

Biologic Effects of



Contraindications

- Coagulopathies
- NSAIDS, Gluco-Corticoid tx (wait 6 wks)
- Anti-coagulation therapy (coumadin, etc)?
- Tumors?
- Pregnancy?
- Open growth plates? RSW OK.
- Neurogenic seizure
- Neuropathy/Radiculopathy/Tarsal Tunnel?
My have increased pain

Note:

- ◊ Some devices require gel &/or mineral oil between application area & device
- ◊ Local anesthetic decreases effectiveness
- ◊ Much more indications beyond US borders

Note:

- o Changing a degenerative state to regenerate
- o Creating acute inflammation
- o Some data to show treatment of trigger points can be more helpful

Note:

- Patients' response to pain can be variable but most have some temporary relief after each treatment
- Variable # of pulses/shocks, may need to space out more treatment sessions if not achieving therapeutic range
- Having more pain after treatment is not correlated w a better or worse response
- **Can take 10-12 wks to see improvement after completion of treatment!**

TIP:

- o It's like re-painting a wall...the colors take a while to match!
- o Like painting, may need “touch-up” treatment @ 6 & 12 wks.
- o Some athletes have used RSW during sports competition (half-time), daily, & “annually”

Working principle of focused and radial extracorporeal shock wave technology.

In case of focused shock waves, single acoustic pulses are generated either with a spark-gap (electrohydraulic principle), a technology similar to a loudspeaker (electromagnetic principle) or piezocrystals (piezoelectric principle).

By means of reflectors of certain shape, the acoustic pulses are converted into a focused acoustic **pressure wave/shock wave** with a point of highest pressure at the desired target within pathological tissue.

In case of radial shock waves, a projectile is fired within a guiding tube that strikes a metal applicator placed on the skin. The projectile generates stress waves in the applicator that transmit pressure waves into tissue.

Devices

- ESWT aka “focused”, ultrasonic
- RSW: radial, acoustic sound wave,
“Extracorporeal Pulsed Activation Treatment”
aka “EPAT”, RPW
- “V-actor”-vibration therapy used for muscle
spasm/trigger point therapy
- Different applicator “tips” change depth
penetration
- Getting FDA approved: “EMTT” Electromagnetic
Transduction Therapy

Duolith (fESWT)



Orthopulse: RPW aka “EPAT”



Energy setting based on device

Bar	Duolith(mJ/mm ²)	EnPuls (mJ)	Condition
1	0.7	60	
2	0.12	90	
2.4	0.15	110	Achilles, medial tibial stress syndrome & other superficial areas (tennis elbow, patellar tendon, hip & elbow bursitis)
3	0.2	120	
4	0.25	150	Plantar fascia, hamstring, muscle strains, rotator cuff
5	0.3	185	
0.3-55			Non-union, AVN, stress fractures (may need local anesthesia proximal to area)
Note: contraindication is coagulopathy, nsaids			
Note: tx settings are typical but can be a range, usual session is 2500 pulses, larger areas can adjust up to 5000 pulses			
Note: with Duolith apply mineral oil between head every 3 tx			
Note: with Duolith, D Actor & Orthopulse, use ultrasound gel between applicator tip & patient's skin			
Note: with EnPuls, may need blue cap for superficial areas (eg Achilles)& mineral oil (not US gel) between tip & skin			
Note: radial devices can be used daily, but focused ESWT (Duolith) should be used 2-14 days apart for musculoskeletal & 4-6 wks for bone			

Benefits

- Ideally, **NO “downtime” for most conditions**, no immobilization, (No Boot! -but some protection, ankle brace, orthosis), great for athletic & active patients
- Better not to use NSAIDS concurrently
- Few relative contra-indications (coagulopathies)

Note on study Levels

- Level I: **highest** (blinded, randomized, placebo-controlled)
- Level II- randomized, placebo controlled
- Level III- non-randomized, case-cohort, prospective
- Level IV: retrospective
- Level V: expert opinion

Have to use the best evidence!

1. Need to use facts & data
2. Resist the temptation to use unproven therapies
3. Do not try to gain fame (it's not about you)



2018: 3 Excellent Reviews

- o Moya et al. The Role of Extracorporeal shockwave treatment in musculoskeletal disorders. J Bone Joint Surg Feb 2018
- o Reilly et al. Narrative review on the effect of shockwave treatment for management of upper and lower extremity musculoskeletal conditions. Phys Med Rehab 2018
- o Hao et al. Meta-analysis for osteonecrosis femoral head. J Ortho Surg Res 2018

2019

<https://doi.org/10.1007/s40141-019-00229-4>

SPORTS MEDICINE REHABILITATION (B LIEM AND BJ KRABAK, SECTION EDITORS)



Extracorporeal Shockwave Therapy in Lower Limb Sports Injuries

Haylee E. Borgstrom¹ · Amol Saxena² · Adam S. Tenforde¹

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Abstract

Purpose of Review To outline current evidence on the use of ESWT for the treatment of lower limb sports injuries.

Recent Findings There is growing evidence to support the use of extracorporeal shockwave therapy (ESWT) for a variety of musculoskeletal conditions in the general population. However, research focused on the use of ESWT specifically for lower extremity injuries in the athletic population is more limited. Athletes represent a subgroup of patients that may benefit from ESWT. Compared with injections or surgical interventions, athletes undergoing ESWT often are able to continue sports participation with fewer limitations in activity during treatment.

Summary The review identifies considerable variability in study design and treatment protocols that affect the overall quality of evidence. Sports participation was allowed in most studies. One case of plantar fascia tear was identified during ESWT treatment; this injury was self-limited. Most studies report pain-relieving and/or functional benefit with the use of ESWT for common lower extremity tendinopathies, plantar fasciitis, and medial tibial stress syndrome. This review highlights the need for further investigations on optimal methods of ESWT use in athletes given the high prevalence of lower extremity injuries and favorable safety profile for treatment.

Keywords Athlete · Sport · Extracorporeal shockwave therapy · ESWT · Lower extremity injury · Tendinopathy

CURRENT CONCEPTS REVIEW

The Role of Extracorporeal Shockwave Treatment in Musculoskeletal Disorders

Daniel Moya, MD, Silvia Ramón, MD, PhD, Wolfgang Schaden, MD, Ching-Jen Wang, MD, Leonardo Guiloff, MD, and Jai-Hong Cheng, MD

- Increasing evidence suggests that extracorporeal shockwave treatment (ESWT) is safe and effective for treating several musculoskeletal disorders.
- Two types of technical principles are usually included in ESWT: focused ESWT (F-ESWT) and radial pressure waves (RPW). These 2 technologies differ with respect to their generation devices, physical characteristics, and mechanism of action but share several indications.
- Strong evidence supports the use of ESWT in calcifying tendinopathy of the shoulder and plantar fasciitis.
- The best evidence for the use of ESWT was obtained with low to medium energy levels for tendon disorders as well as with a high energy level for tendon calcification and bone pathologies in a comprehensive rehabilitation framework.

Acute Plantar Fasciitis (<6 wks)

- Rompe et al (2010) RCT. ESWT vs. Plantar fascia specific stretching for acute plantar fasciitis (<6wks) showed that stretching is superior¹. **Level I**
- Mardani-Kivi et al (2015) RCT. ESWT vs. Corticosteroid for acute plantar fasciitis (<6wks). Corticosteroid injection showed more effectiveness for the acute condition². **Level II**

Plantar Fasciitis tx “early” vs “traditional”)ie 6+mos

- o Saxena et al (2016) Prospective analysis. Early implementation of RSWT on subacute plantar fasciitis (for symptoms <3 months) vs. Standardized implementation of RSWT on chronic (>6months) plantar fasciitis was analyzed. **Better outcomes with early implementation with VAS and RM scores at 12 months, faster RTA & significantly more likely to continue sport/activity 2017 J Foot Ankle Surg Level III**

Chronic Plantar fasciitis (6+ mos)

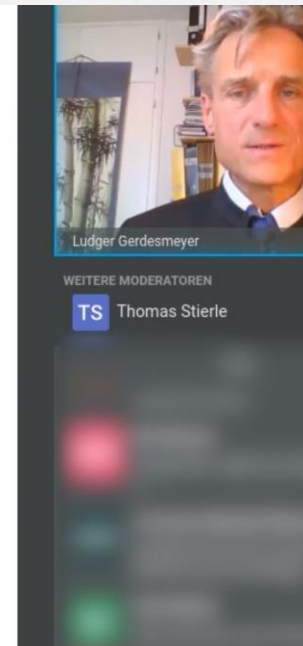
3 Level 1 Studies!!!

- o Gollwitzer et al (2015) Multicenter RCT. Focused ESWT vs. Placebo showed favorable VAS and RM outcome of ESWT³. **Level I**
- o Saxena et al (2013) Case-controlled study on athletes. Comparing endoscopic plantar fasciotomy (EPF) vs. Focused ESWT. EPF with better outcome but ESWT preferable since they can remain active during treatment⁴. **Level II**
- o Gerdesmeyer et al (2008) RCT. Radial ESWT vs. Placebo. Radial ESWT with superior VAS and RM results⁵. **Level I**
- o Malay et al (2006) RCT. ESWT vs. Placebo with better VAS outcome of ESWT⁶. **Level I**

Platinum Evidence!

5 RCT's with positive outcome Ib (Platinum evidence)

- [1] Costa, M. L., Shepstone, L., Donell, S. T., and Thomas, T. L. Shock wave therapy for chronic achilles tendon pain: a randomized placebo-controlled trial. Clin Orthop Relat Res 440 (2005), 199–204.
- [2] Furia, J. P. High-energy extracorporeal shock wave therapy as a treatment for insertional achilles tendinopathy. Am J Sports Med 34, 5 (2006), 733–740.
- [3] Furia, J. P. High-energy extracorporeal shock wave therapy as a treatment for chronic noninsertional achilles tendinopathy. Am J Sports Med 36, 3 (2008), 502–508.
- [4] Rasmussen, S., Christensen, M., Mathiesen, I., and Simonson, O. Shockwave therapy for chronic achilles tendinopathy: a double-blind, randomized clinical trial of efficacy. Acta Orthop 79, 2 (April 2008), 249–256.
- [5] Rompe, J. D., Nafe, B., Furia, J. P., and Maffulli, N. Eccentric loading, shock-wave treatment, or a wait-and-see policy for tendinopathy of the main body of tendo achillis: a randomized controlled trial. Am J Sports Med 35, 3 (2007), 374–383.
- [6] Rompe, J. D., Furia, J., and Maffulli, N. Eccentric loading compared with shock wave treatment for chronic insertional achilles tendinopathy. a randomized, controlled trial. J Bone Joint Surg Am 90, 1 (2008), 52–61



Current protocol

- o Offer earlier after they've tried insoles, stretch, icing, nsaid (stop 6 wks before)
- o ESWT 3-5 sessions
- o Stretching arch
- o **Comfortable** insoles/orthoses
- o Foot & posture strengthening
- o Ice as needed
- o Tape, night splint?

Achilles Tendinopathy:

3 Level 1 studies

- **Saxena et al (2011)**. Prospective study. RSW for para, proximal, and insertional Achilles tendinopathy. Significant improvement in RM score for Achilles tendinopathy⁷. 75% effective **Level III**
- **Rompe et al (2009)**. RCT. RSWT vs. Eccentric + ESWT with favorable outcome for the combined group⁸. **Level I**
- **Rompe et al (2008)**. RCT. RSWT vs. eccentric loading. Better outcome for ESWT⁹. **Level I**
- **Rasmussen et al (2008)**. RCT. ESWT vs. Placebo ESWT. Better outcome with the ESWT¹⁰. **Level I**
- **Furia (2008)**. Case control study. RSWT vs. Control (traditional conservative method). Better outcome with ESWT¹¹. **Level III**



Review

Current evidence of extracorporeal shock wave therapy in chronic Achilles tendinopathy



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HIGHLIGHTS

- This review shows efficacy of extracorporeal shock wave therapy.
- Focused and radial shock waves both show efficacy in chronic Achilles tendinopathy.
- All treatments should be done without local anesthesia.

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Available online 29 August 2015

ABSTRACT

Chronic Achilles tendinopathy has been described as the most common overuse injury in sports medicine. Several treatment modalities such as activity modification, heel lifts, arch supports, stretching exercises, nonsteroidal anti-inflammatories, and eccentric loading are known as standard treatment mostly without proven evidence. After failed conservative therapy, invasive treatment may be considered. Extracorporeal shock wave therapy (ESWT) has been successfully used in soft-tissue pathologies like lateral epicondylitis, plantar fasciitis, tendinopathy of the shoulder and also in bone and skin disorders. Conclusive evidence recommending ESWT as a treatment for Achilles tendinopathy is still lacking. In plantar fasciitis as well as in calcific shoulder tendinopathy shock wave therapy is recently the best evaluated treatment option. This article analysis the evidence based literature of ESWT in chronic Achilles tendinopathy. Recently published data have shown the efficacy of focused and radial extracorporeal shock wave therapy.

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2019: Musc Lig Tend Journal

Combined ESWT & RSW Therapy for Achilles Tendinopathy: A Prospective Study

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DOI:

10.32098/mltj.04.2019.10

LEVEL OF EVIDENCE:

SUMMARY

Achilles tendinopathy is one of the most common overuse injuries of the foot and ankle in the active population. Many studies have shown radial sound wave therapy (RSW) or extra-corporeal shockwave therapy (ESWT) to be a safe and effective conservative treatment options when used independently. In this prospective study, we examined the outcomes of treatment on Achilles tendinopathy combining these two modalities. We hypothesize improved results with the combination therapy and compare this with previous studies. The current study observes a cohort of 24 patients, who received the both treatments with mean age of 47.2 ± 12.8 years at the time of study. Each patient received three treatments initially and then subsequent treatments at 6 and/or 12 week follow up. Pre-treatment VAS score was 6.3 ± 1.3 and RM score was 3.5 ± 0.5 . Ultimately, these were reduced to 1.2 ± 1.6 ($P=0.00001$) and 1.6 ± 0.9 ($P=0.00001$) respectively at 17 \pm 4.5 month follow-up. Patients with paratendinosis had better outcomes than insertional Achilles pathology. Our results show a significant improvement in outcome measures in patients treated with ESWT and RSW, as compared to other studies. We conclude that the dual treatment method is a safe and improved method of treatment for Achilles tendinopathy compared to isolated use of ESWT or RSW.

KEY WORDS

Achilles; radial soundwave; extra-corporeal; shockwave

ESWT & RSW for Achilles

- Saxena et al 2019 Musc Lig Tend J **Combined treatment is better compared to just RSW**
- 38 pts tx w both, 7 had surgery after (1 prior), 7 lost to f/u. 24 all RTA w sig improvement
- Statistical improvement at 3 mos w VAS & RM scores, and sig better at 12+ mos post-tx
- So far, compared to radial studies, **adding ESWT appears better**
- 50% were pain-free & at 100% activity level @ 1+ yr

Medial Tibial Stress Syndrome (Shin Splints)

- Rompe et al (2010) Retrospective cohort study. Radial ESWT + home training program vs. Home training program only. ESWT combined group out-performed the other group¹². **Level II**
- Moen et al (2012) Prospective study comparing ESWT w a gradual RTRunning program. RTA sig faster ($P=.008$, 60 vs 92days)¹⁵ **Level II**

Medial Tibial Stress Fracture: 17 Wks later, Olympic Gold





Contents lists available at [ScienceDirect](#)

International Journal of Surgery

journal homepage: www.journal-surgery.net



Review

Current concepts of shockwave therapy in stress fractures



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HIGHLIGHTS

- Extracorporeal shockwave treatments (ESWT) stimulate bone turnover and neovascularization in delayed unions and avascular necrosis.
- ESWT is a safe and effective non-invasive outpatient procedure.
- Medium and high energy focused ESWT has shown excellent results in treating stress fractures, with faster return to competition and athletic activity.

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Keywords:

Shockwave therapy

Stress fractures

Bone turnover

Bone overuse

Mechanotransduction

ABSTRACT

Stress fractures are common painful conditions in athletes, usually associated to biomechanical overloads. Low risk stress fractures usually respond well to conservative treatments, but up to one third of the athletes may not respond, and evolve into high-risk stress fractures. Surgical stabilization may be the final treatment, but it is a highly invasive procedure with known complications. Shockwave treatments (ESWT), based upon the stimulation of bone turnover, osteoblast stimulation and neovascularization by mechanotransduction, have been successfully used to treat delayed unions and avascular necrosis. Since 1999 it has also been proposed in the treatment of stress fractures with excellent results and no complications. We have used focused shockwave treatments in professional athletes and military personnel with a high rate of recovery, return to competition and pain control. We present the current concepts of shockwave treatments for stress fractures, and recommend it as the primary standard of care in low risk patients with poor response to conventional treatments.

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Metatarsal 5 fx in soccer athletes

Metatarsale 5 stress fx	N	Bony healing	Return to sport
Screw only	13	10,4 weeks	11,7 weeks
Screw + 3x fok. ESWT	5	7,8 weeks	8,0 weeks
Difference		2,6 weeks	3,7 weeks

18days 26days



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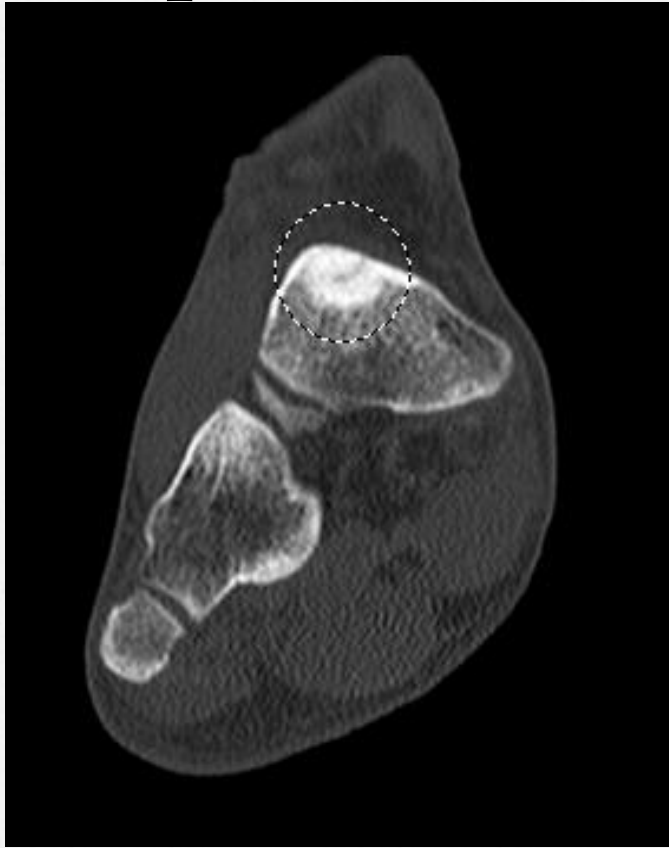
17 yo HS football player re-frx
Sept of Sr yr Tx 3x 0.30mJ/mm²



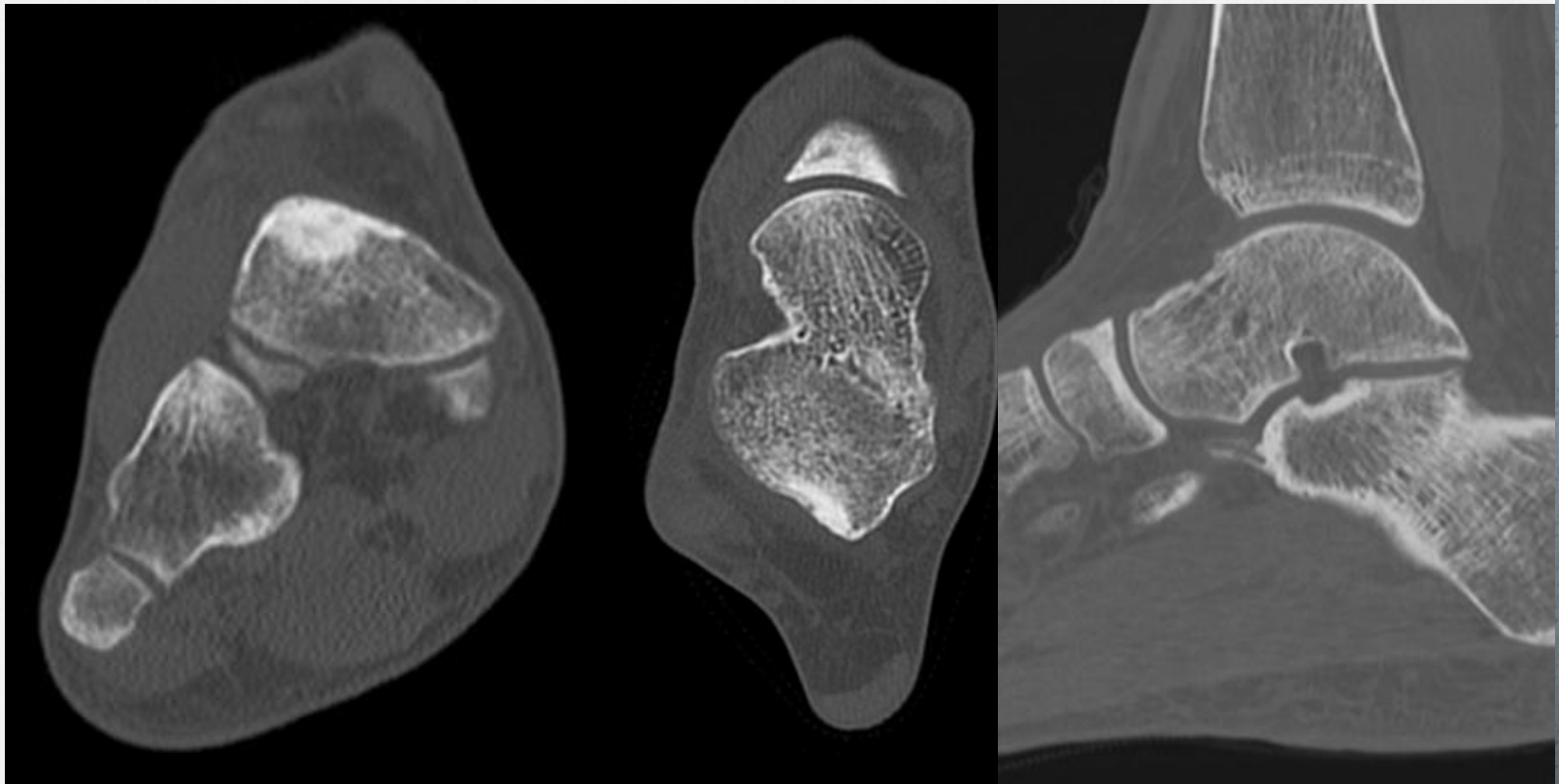
RTA Bootx2 wks, Practice in 6 wk,
played 6 games inc state champs



Type 1 NSF x6 mos in elite
sprinter(need $<1\text{mm}$ cuts)



Healed in 3 mos, 6wks NWB BK boot & 3
Tx w ESWT @ .40mJ/mm², 2500 pulses



Sesamoiditis

- One series reported in the literature.
- Saxena et al (2017) JFAS “prospective” analysis-pilot study. ESWT treatment for sesamoidopathy with failed other conservative treatments. 90% RTA. Stat sig improvements in both VAS and RM score. Mean return to activity 10.1 ± 15.6 weeks (biased by 1 pt who waited a year to RTA!- really only 5wks). **Level III**



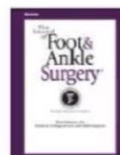
ESWT in Sesamoiditis

The Journal of Foot & Ankle Surgery xxx (2016) 1–3

Contents lists available at [ScienceDirect](#)

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org



and Series

Undwave for Sesamoidopathy in Athletes: A Pilot Study

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Ludger Gerdesmeyer

WEITERE MODERATOREN

TS

Thomas Stierle

Non-Unions

- Furia et al (2010) Retrospective cohort. ESWT vs. Intramedullary screw for 5th metatarsal metaphyseal-diaphyseal fracture non-union treatment. ESWT showed comparable results¹³. **Level I**
- Cacchio et al (2009) Prospective, randomized, multicenter trial. ESWT vs. surgical treatment for long-bone non-unions. Found comparable results¹⁴. **Level I**

EBM : non union

Literature in Peer Reviewed Journals (127):

25 Publication: basic science

55 Publication: animal trials

47 Publication: clinical trials



JBJS:

Extracorporeal Shock-Wave Therapy Compared With Surgery For Hypertrophic Long-Bone Nonunions

A. Cacchio, L. Giordano, O. Colafarina, J. D. Rompe, E. Tavernese, F. Ioppolo, S. Flamini, G. Spacca, V. Santilli

Shock Wave Therapy as a Treatment for Nonunion of the Proximal Fifth Metatarsal Metaphyseal Diaphyseal (Jones) Fracture

J. Furia, P. Juliano, A. Wade, R. Mittermayr, W. Schaden



Ludger Gerdesmeyer

WEITERE MODERATOREN

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ESWT versus surgery „Golden Standard“

ESWT

Group 1: n:42 (Dornier Epos Ultra 0.40 mJ/mm²)

Group 2: n:42 (Storz Modulith; 0,70 mJ/mm²)

- 4 Tx, 1 weeks interval, LA
- cast immobilization 6 weeks

surgery

Group 3: n:42

- Implantat removal
- Decortication
- Resection of interface
- Re-opening of the IM canal
- Reposition
- Re-osteosynthesis (10x plate; 25x IM nail, 7x Fix. ext.)
- Spongiosaplasty
- Partial WB 6 – 12 weeks



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ESWT versus surgery „Golden Standard“

The primary end point of this study was healing of the nonunion as determined with an independent and blinded radiographic assessment **at six months**.

A nonunion was judged to be healed when callus bridged the nonunion site on all **four cortices** (X-ray or CT scan).

TABLE II Healing of the Nonunions in the Shock-Wave and Surgical Groups at the Four Time Periods*

	3 Mo	6 Mo	12 Mo	24 Mo
Group 1	40	37	37	36
Healed	22 (55)	26 (70)	31 (84)	34 (94)
Not healed	18 (45)	11 (30)	6 (16)	2 (6)
Group 2	39	38	38	38
Healed	21 (54)	27 (71)	31 (82)	35 (92)
Not healed	18 (46)	11 (29)	7 (18)	3 (8)
Group 3	40	38	38	37
Healed	21 (52)	28 (74)	33 (87)	35 (95)
Not healed	19 (48)	10 (26)	5 (13)	2 (5)

After 6 month: 70%, 71%, and 74% healt

after 12 month: 84%, 82%, and 87% healt

After 24 month: 94%, 92%, and 95% healt



Ludger Gerdesmeyer

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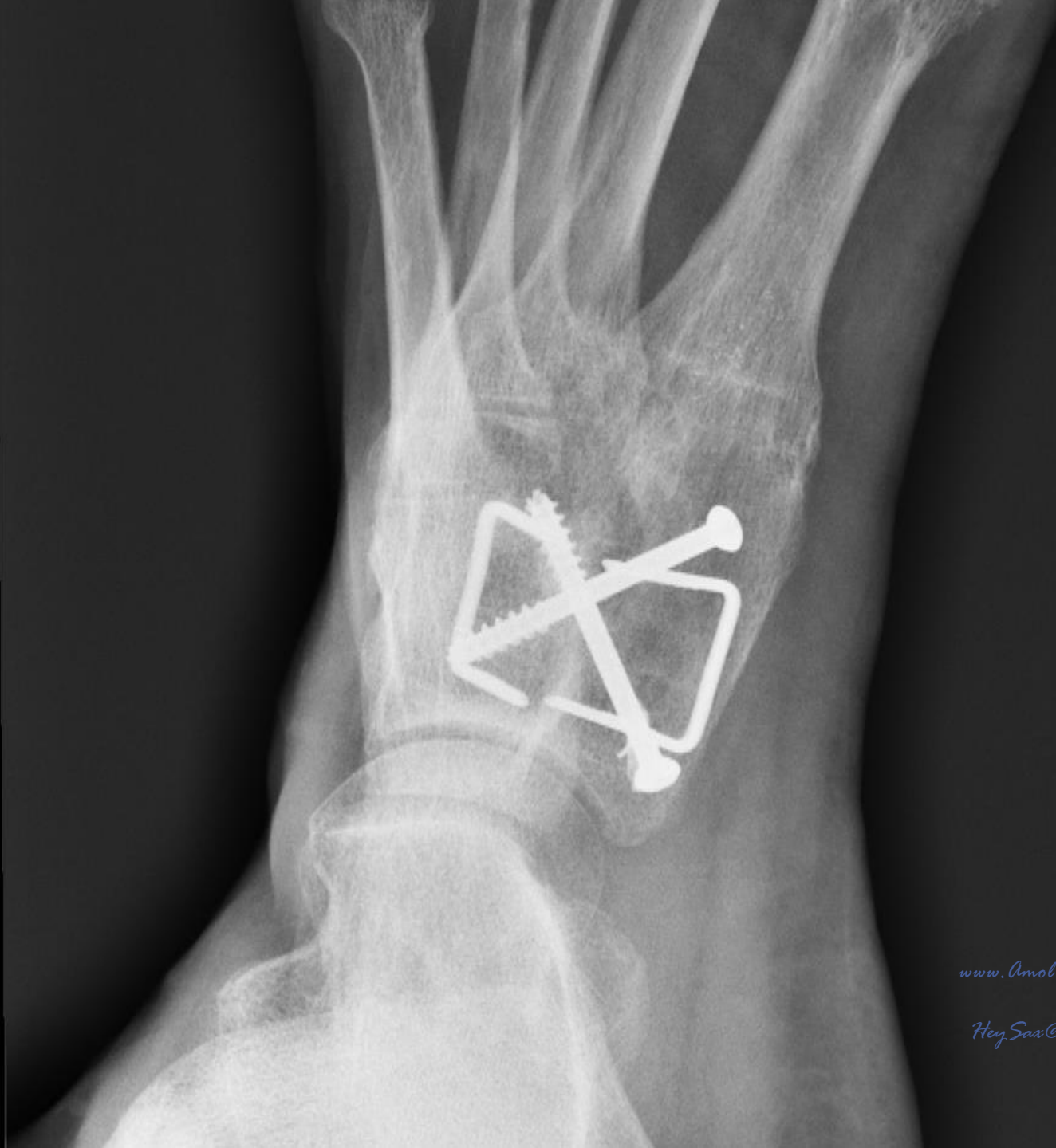
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9 mos non-union: Tx 2x @ .40mJ/mm²

- o Still healed @ 6 mos
- o Ongoing study of midfoot non-unions in Seattle, WA . R Bouché, DPM (86% healed)



**The Sports
Medicine Clinic**

- o IRB @ PAMF: 188 Lisfranc's fusions: Non-union 9.6% 1st TMT, 2nd TMT 5.6%, 3rd TMT 2.1%, NC 15.9%

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Current Studies on wounds

- Hitchman LH, Totty JP, Raza A, Cai P, Smith GE, Carradice D, Wallace T, Harwood AE, Chetter IC. **Extracorporeal Shockwave Therapy for Diabetic Foot Ulcers: A Systematic Review and Meta-Analysis. Ann Vasc Surg. 2019 Apr;56:330-339.**
- Galiano R, Snyder R, Mayer P, Rogers LC, Alvarez O. **Focused shockwave therapy in diabetic foot ulcers: secondary endpoints of two multicentre randomised controlled trials. J Wound Care. 2019 Jun 2;28(6):383-395**

55 yo F, 3
cm wound
non-smoker
S/p BCC
excision
4/19, non-
healing after
wide-
excision 1/20

- o Re-bx of wound negative
- o Small peroneal artery
blockage re-vascularized
2/20
- o Hx of VV ligation
- o Lymphedema
- o Normal BMI
- o Not Diabetic!



Start of ESWT:
lateral ankle



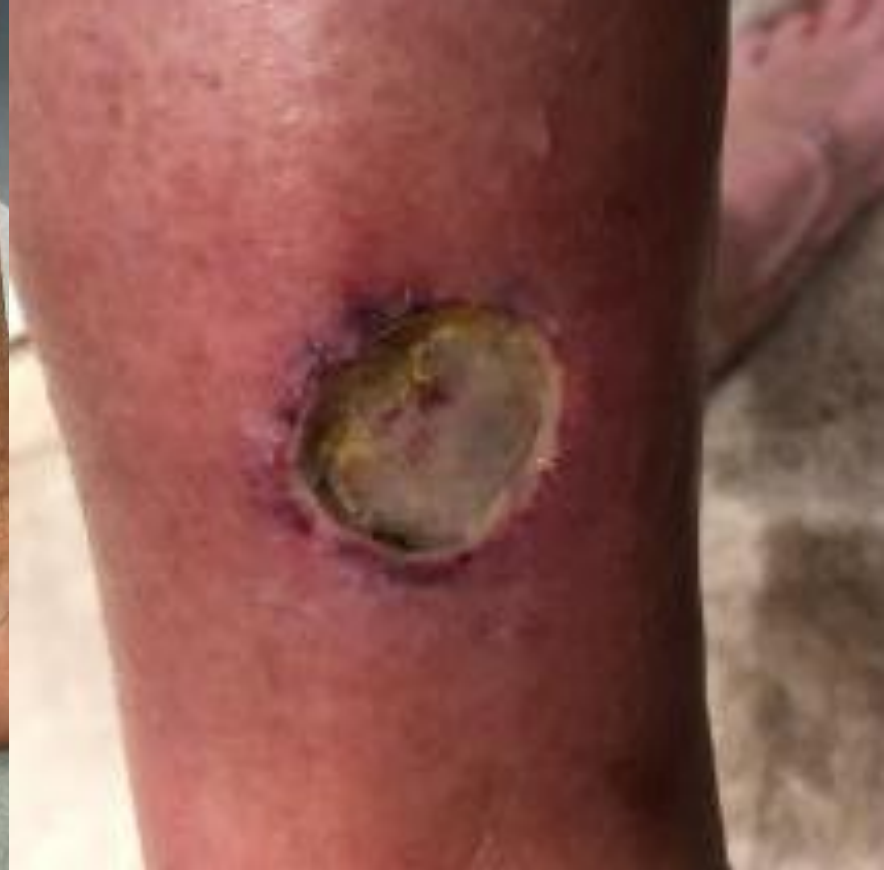
After 6
ESWT 1000
pulses@.10
mJ/mm² &
RSW 1500 @
1.0 Bar, 4-
8Hz



Initial PICO @
1wk

2 wks after
PICO & Grafix
Use VAC codes
& new CPT
tracking codes





PLATINUM LEVEL OF EVIDENCE

- With so many positive Level I-III studies, Cochrane Reviews has designated “Platinum Standard” beyond “Gold Standard”
- Nothing else this rigidly studied in musculoskeletal medicine
- At least 9 Level I, 4 Level II & 4 Level III Foot & Ankle studies...what are people waiting for?

The Future:

- ESWT, RPW & EMTT, plus appropriate eccentrics (avoid negative for insertional) and heel cushions/insoles
- Other tendinopathies such as Post Tib (JFAS 2020 Tenforde et al) & Peroneal(underway)

The Future: “EMTT” (Electromagnetic Transduction Therapy aka PEMF)



MAGNETOLITH®

2017 J Foot Ankle Surg



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Original Research

Electromagnetic Transduction Therapy for Achilles Tendinopathy: A Preliminary Report on a New Technology

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ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
electromagnetic
extracorporeal shockwave therapy
pulsed electromagnetic field
tendinopathy
radial soundwave therapy

ABSTRACT

A parallel prospective feasibility study was performed on 53 patients with chronic mid-portion Achilles tendinopathy (age 44.7 ± 9.1 years). Of the 53 patients, 28 (active group) were treated using a new electromagnetic (pulsed electromagnetic field) transduction therapy device (Cellactor[®] MT1) and heel cushions. The device produces an electromagnetic field of 80 millitesla; a total of 8 treatments was performed within 8 weeks in an outpatient setting, without anesthesia, immobilization, or rest. A control group of 25 patients with a similar duration of symptoms was treated with heel cushions only. At the 12-week assessment point, the visual analog scale scores in both groups had significantly decreased, although the active group had significantly improved visual analog scale scores compared with those of the controls. The Role-Maudsley scores had also significantly improved in both the active and the control groups ($p < .00001$ and $p = .0002$, respectively). Electromagnetic transduction therapy could potentially be a useful modality for the treatment of Achilles tendinopathy. It should be compared with the current reference standard of extracorporeal shockwave therapy/radial soundwave therapy with similar level I, II, and III studies.

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EMTT & Achilles

- Cohort study comparing 1cm heel cushion to 8 sessions of EMTT plus heel cushion
- Gerdesmeyer et al 2017 JFAS
- Eval @ 12 wks, no increase in activity level
- Significant improvement in both groups with VAS & RM, but **significantly better with adding EMTT**
- **FDA approval**
- **Other studies published on shoulder, knee & back pain**

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THANK YOU

