Shockwave for conditions below the knee

Amol Saxena, DPM, MPH
FAAPSM, FACFAS, FFPM RCPS(G), Lifetime Honorary Member, German Association for Foot & Ankle Surgery
Palo Alto-Sutter Dept of Sports Medicine
Fellowship Director 1999-2021
Past-President AAPSM, Pacific Region President, ACFAS

www.AmolSaxena.com | HeySax@aol.com

ESWT Family: Gerdesmeyer, Gollwitzer, Galli, Fullem, Novak, Stierle, Bouché, Caminear, Didomenico (STORZ & CuraMedix)

Shockwave

1. Three types of “ESWT”: focused ESWT (fESWT), radial pressure wave (RPW aka “EPAT”) and “EMTT”
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!

Brooks Johnson: multi-Olympian coach, 2014 AAPSM Golden Foot Winner

- "sweat the small stuff & the big stuff will take care of itself"
- "when you tell a coach their athlete has a stress fracture, you just told them that they messed up"

2019

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

Check for updates

Extracorporeal Shockwave Therapy in Lower Limb Sports Injuries

Haylee E. Borgstrom[1] · Amol Saxena[2] · Adam S. Tenforde[1]

Published online: 3 June 2019

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

Need to adjust mindset & set timelines

- **Early intervention** better especially with shockwave
- Athletes no matter what level, want to know when they can return to sport (RTA/S) & downtime

Not just for chronic conditions

- Try evidenced-based non-surgical Tx (not necessarily “conservative”) EARLY
- After a suitable “downtime” including rest, eg 6 mos (for pros, may be 3 mos) for plantar fasciitis, sesamoiditis, some Achilles, then following PROVEN techniques, surgery can be discussed, particularly since compensation injuries can compound disability

“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 coincidently, shockwave research started!)

SHOCK WAVE has more level 1 evidence than most tools in our Pfascia 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) Gollwitzer, Saxena, Galli et al*
- 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)*
- "Platinum-Level of Evidence" for Plantar Fasciitis- Cochrane Reviews

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

- 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**

FDA Trial for Duolith in JBJS

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, Carsten Horn, MD, Ingo J. Banke, MD, Rainer Burgkart, MD, and Ludger Gerdesmeyer, MD

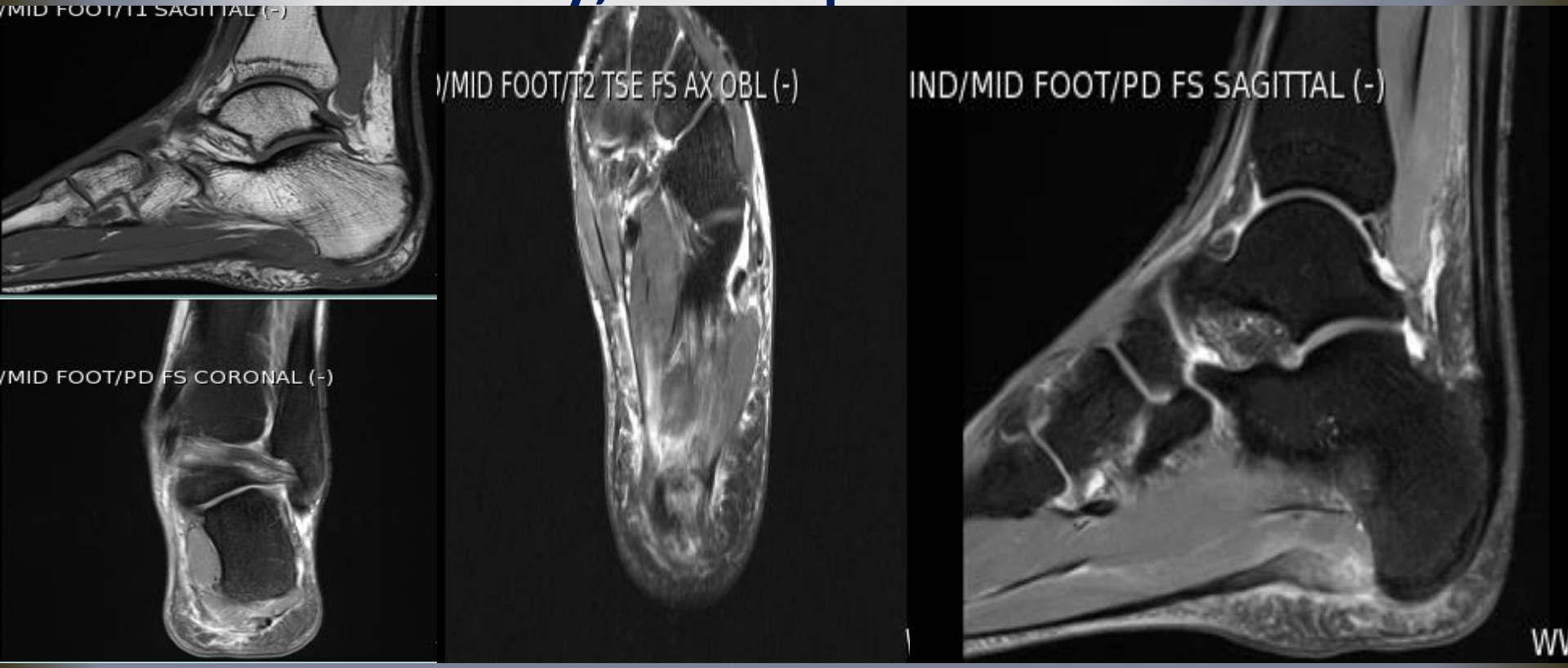
www.AmolSaxena.com | HeySax@aol.com

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.

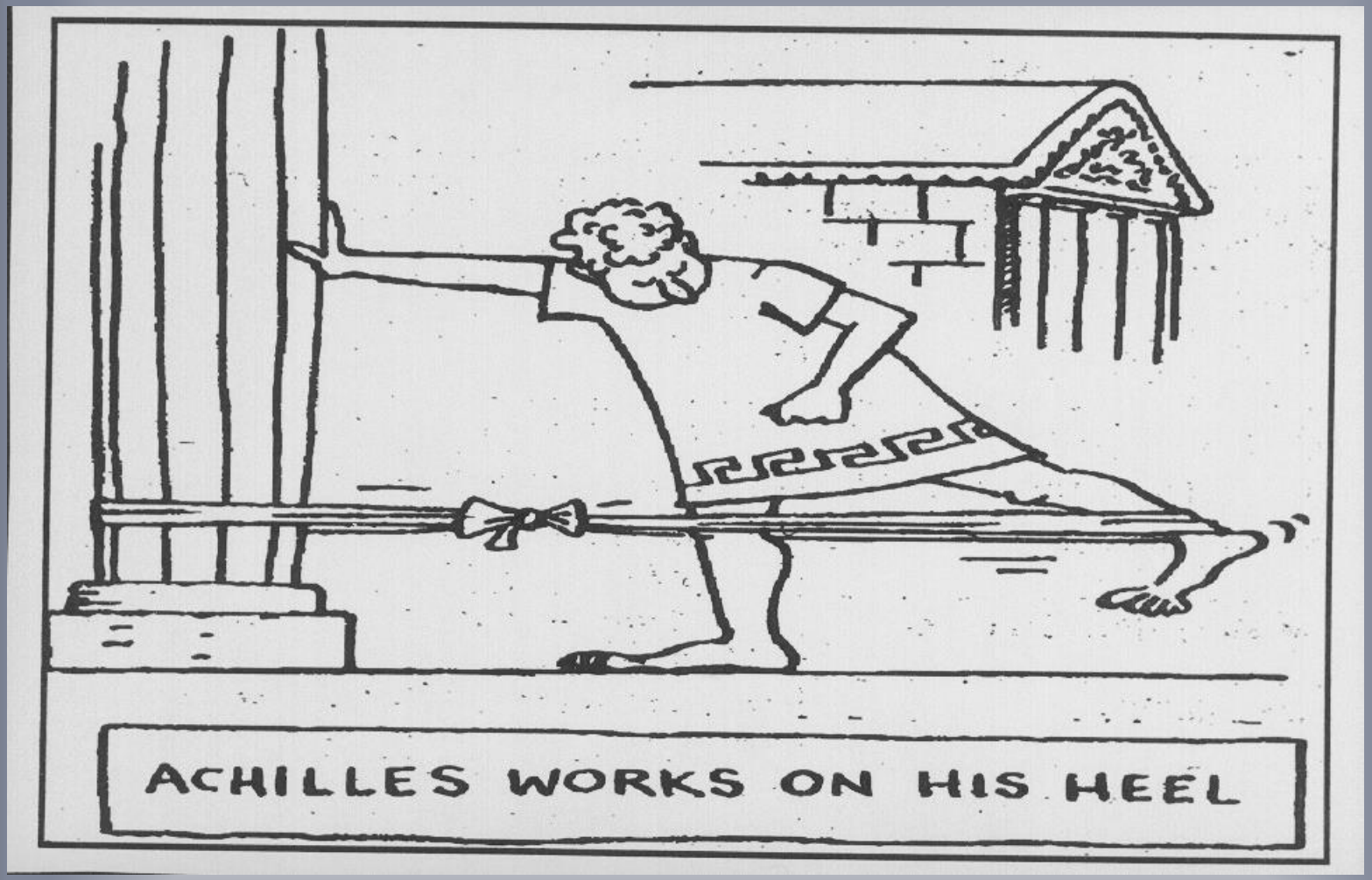
Plantar Fasciitis case

- 31 yo elite Olympic medalist marathoner w 3 mos of PF, tx so far with FSW including 2 days ago just after a race where it “flared”
- MRI says “rupture”
- No pop, no bruising, no pain on single leg heel raise, nor with passive extension of toes = No rupture

MRI: Is it torn? OK to inject? Boston is 2 wks away, MRI post-SW false+



2nd place Boston…Moral: Do not rely on MRI!


ACHILLES WORKS ON HIS HEEL

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Review

Current evidence of extracorporeal shock wave therapy in chronic Achilles tendinopathy

Ludger Gerdesmeyer [a, e, *], Rainer Mittermayr [b], Martin Fuerst [a], Munjed Al Muderis [c], Richard Thiele [a], Amol Saxena [d], Hans Gollwitzer [e]

[a] Dept. Orthopaedic Surgery and Traumatology, University Schleswig Holstein, Campus Kiel, Arnold Heller Strasse 3, 24105 Kiel, Germany
[b] Stosswellenzentrum-wien.at, AUVA Trauma Center Meidling, Ludwig Boltzmann Institute dir exp. and clin. Traumatology, Austria
[c] Suite G3B, Norwest Private Hospital, 9 Norbrik Drive, Bella Vista, NSW 2153, Australia
[d] Palo Alto Medical Foundation, 795 El Camino Real, Palo Alto, CA 94301, USA
[e] Technical University of Munich, Dept. Orthopedics and Traumatology, Ismaninger Straße 22, D-81675 Munich, Germany

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.

ARTICLE INFO

Article history:
Received 30 June 2015
Accepted 15 July 2015
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.

RPW for 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 tendinopathy[7]. 75% effective **Level III**
- **Rompe et al (2009)**. RCT. RSWT vs. Eccentric + ESWT with favorable outcome for the combined group[8]. **Level I**
- **Rompe et al (2008)**. RCT. RSWT vs. eccentric loading. Better outcome for ESWT[9]. **Level I**
- **Rasmussen et al (2008**). RCT. ESWT vs. Placebo ESWT. Better outcome with the ESWT[10]. **Level I**
- **Furia (2008)**. Case control study. RSWT vs. Control (traditional conservative method). Better outcome with ESWT[11]. **Level III**

2019: Musc Lig Tend Journal: Combined better up to 90% sig improved

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

A. Saxena, L. Shou

Department of Sports Medicine, Palo Alto Medical Foundation-Sutter, Palo Alto, CA

CORRESPONDING AUTHOR:
Amol Saxena
Department of Sports Medicine
Palo Alto Medical Foundation-Sutter
Palo Alto, CA
E-mail: heysax@aol.com

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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±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

fESWT & RPW for Achilles

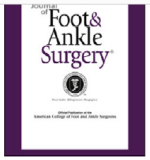
- Saxena et al 2019 Musc Lig Tend J **Combined treatment is better compared to just RSW**
- 38 pts tx w both, 7 had surgery after (1 prior), 7 lost to f/u. 24 all RTA w sig improvement
- Statistical improvement at 3 mos w VAS & RM scores, and sig better at 12+ mos post-tx
- So far, compared to radial studies, **adding ESWT appears better**
- **50% were pain-free & at 100% activity level @ 1+ yr**
- **About 10% of chronic Achilles end up "needing" surgery**
- also see Tenforde et al 2021 JFAS: 85-90% improved

Combined can work better!

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org



Original Research

Functional Gains Using Radial and Combined Shockwave Therapy in the Management of Achilles Tendinopathy

David M. Robinson, MD[1], Can O. Tan, PhD[2,3], Adam S. Tenforde, MD[3]

[1] *Resident, Department of Physical Medicine and Rehabilitation, Spaulding Rehabilitation Hospital/Harvard Medical School, Charlestown, MA*
[2] *Assistant Professor, Spaulding Research Institute, Spaulding Rehabilitation Hospital, Boston, MA*
[3] *Associate Professor, Department of Physical Medicine and Rehabilitation, Spaulding Rehabilitation Hospital/Harvard Medical School, Charlestown, MA*

ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
Achilles tendinopathy
eccentrics
focused shockwave
radial shockwave
sports medicine

ABSTRACT

Achilles tendinopathy is a common condition and many patients have functional limitations after initial conservative treatment. Shockwave therapy has been shown to improve function within patients; however, comparative outcomes for different forms of shockwave are poorly described. In this retrospective cohort study, we describe findings from a quality improvement initiative evaluating safety and functional outcomes after treatment with radial shockwave therapy (n = 58) or combined radial and focused shockwave therapy (n = 29) for patients with Achilles tendinopathy refractory to exercise therapy. All patients were prescribed an eccentric exercise program. We hypothesized both groups would see improvements in function quantified using the Victorian Institute of Sports Assessment-Achilles with similar safety outcomes. Overall, the minimal clinically important difference (defined at 7 for insertional and 12 for noninsertional Achilles tendinopathy) was met in a greater proportion of patients treated with combined shockwave compared to radial shockwave (26 [89.7%] vs 37 [63.8%], $p = .022$). The change in Victorian Institute of Sports Assessment-Achilles from baseline to final treatment was not different between combined and radial-only groups (23.3 ± 12.6 vs 19.9 ± 18.7, $p = .2$). Within group differences from baseline to final follow-up measures (mean duration 17.9 ± 14.8 weeks) demonstrated overall functional improvement for both groups (both $p < .0001$). No serious adverse effects were observed. Our findings suggest combined radial and focused shockwave therapy may provide more predictable functional gains for treatment of Achilles tendinopathy compared to radial shockwave therapy.

Achilles tendinopathy (AT) is one of the most frequently reported injuries to the foot and ankle amongst a multitude of sporting activities

noninsertional AT (5). This review evaluated short term (<3 months) and longer-term outcomes (3-12 months) for management of mid-por-

EMTT & Achilles

- Cohort study comparing 1cm heel cushion to 8 weekly 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**

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

New study: 55 with surgery alone, 17 with surgery & SW

- Using fESWT &/or RSW peri-operatively revealed patients had a faster RTA and better RM scores than those who underwent surgery alone in the setting of calcific and retrocalcaneal Achilles tendinopathy surgery
- RTA 7.3 mos vs 5.6 faster by 1.7 mos. (CI 95%, 0.99 to 2.4, $P < 0.0001$).
- RM 1.9 vs 1.1 was better by 0.8 (CI 95%, 0.4 to 1.2, $P < 0.0001$).

Matched pair analysis

- Since the control group was statistically older, matched with intervention by sex, diagnosis, activity level & age (within 3 yrs)
- 12 patients in each group & those with ESWT still had a statistically faster RTA by 1.4 mos
- Only needed 17 in each group for power…

Seifu Tura's 2:06:12 beat Galen Rupp by 23 seconds, with Eric Kiptanui another 26 seconds back. (KEVIN MORRIS/BANK OF AMERICA CHICAGO MARATHON)

Lower Extremity fractures and shockwave in athletes

Amol Saxena, DPM, FAAPSM, FACFAS, FFPM RCPS(G), MPH©
Lifetime Honorary Member, German Association for Foot & Ankle Surgery
Palo Alto-Sutter Dept of Sports Medicine
Fellowship Director since 1999
Past-President AAPSM, Pacific Region President, ACFAS

www.AmolSaxena.com | HeySax@aol.com

Bioengineering 2023

Article

Outcomes Using Focused Shockwave for Treatment of Bone Stress Injury in Runners

Alexandra Beling MD,[1] Amol Saxena DPM,[2] Karsten Hollander MD, PhD,[3] and Adam S. Tenforde MD[1, *]

[1] Spaulding Rehabilitation Hospital; Cambridge, Massachusetts
[2] Palo Alto Foundation Medical Group; Palo Alto, California
[3] Medical School Hamburg; Hamburg, Germany
* Correspondence: atenforde@mgh.harvard.edu

Abstract: Bone stress injury (BSI) is a common overuse injury that can result in prolonged time away from sport. Limited studies have characterized the use of extracorporeal shockwave therapy (ESWT) for the treatment of BSI. The purpose of this study was to describe the use of ESWT for management of BSI in runners. A retrospective chart review was performed to identify eligible patients in a single physician's clinic from 8/1/2018 to 9/30/2022. BSI were identified in 40 runners with 41 injuries (28 females; average age and standard deviation: 30±13 years; average pre-injury training 72±40 kilometers per week). Overall, 63% (n=26) met criteria for moderate- or high-risk Female or Male Athlete Triad categories. Runners started ESWT at a median of 36 days (IQR 11 to 95 days; range 3 days to 8 years) from BSI diagnosis. Patients received an average of 5±2 total focused ESWT treatments. Those with acute BSI (ESWT started <3 months from BSI diagnosis) had an average return to run at 12.0±7.5 weeks, while patients with delayed union (>3 months, n=3) or non-union (>6 months, n=9) had longer time for return to running (19.8±14.8 weeks, p=0.032). All runners returned to pain-free running after ESWT except one runner with non-union of a navicular stress fracture who opted for surgery. No complications were observed with ESWT. These findings suggest that high energy focused ESWT may be a safe treatment for the management of BSI in runners.

Keywords: stress fractures; running; athlete; high energy shock waves

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International Journal of Surgery

journal homepage: www.journal-surgery.net

Review

Current concepts of shockwave therapy in stress fractures

Carlos Leal [a, *], Cristina D'Agostino [b], Santiago Gomez Garcia [c], Arnold Fernandez [a]

[a] Fenway Medical Shockwave Medicine Center, Universidad El Bosque, Bogotá, Colombia
[b] Instituto Humanitas, Milan, Italy
[c] Unidad Medica Deportiva, Policia Nacional de Colombia, Bogota, Colombia

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.

ARTICLE INFO

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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.

SPORTPRAXIS
PROF. DR. MED. K. KNOBLOCH

ISMST 2018
AUCKLAND - NEW ZEALAND

J.LEAGUE

Metarsal 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

SPORTPRAXIS
PROF. DR. MED. K. KNOBLOCH

17 yo HS Male Football player

- Pre-op Tx w fESWT 0.40 mJ/mm² for 2000 pulses
- Post-op fESWT 0.45 mJ/mm² and 6000 Pulses EMTT
- Healed by 4 wk post-op X-ray

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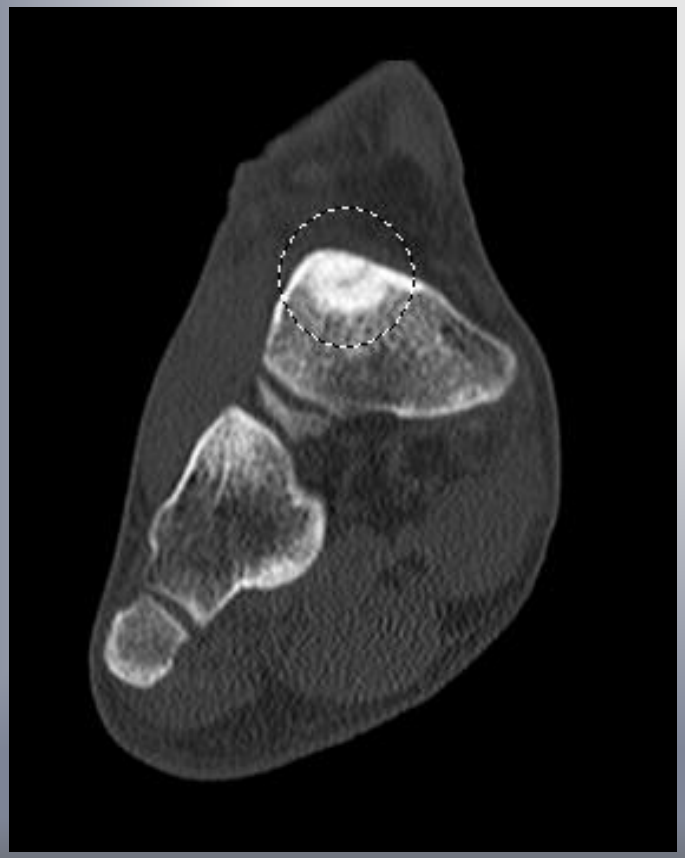
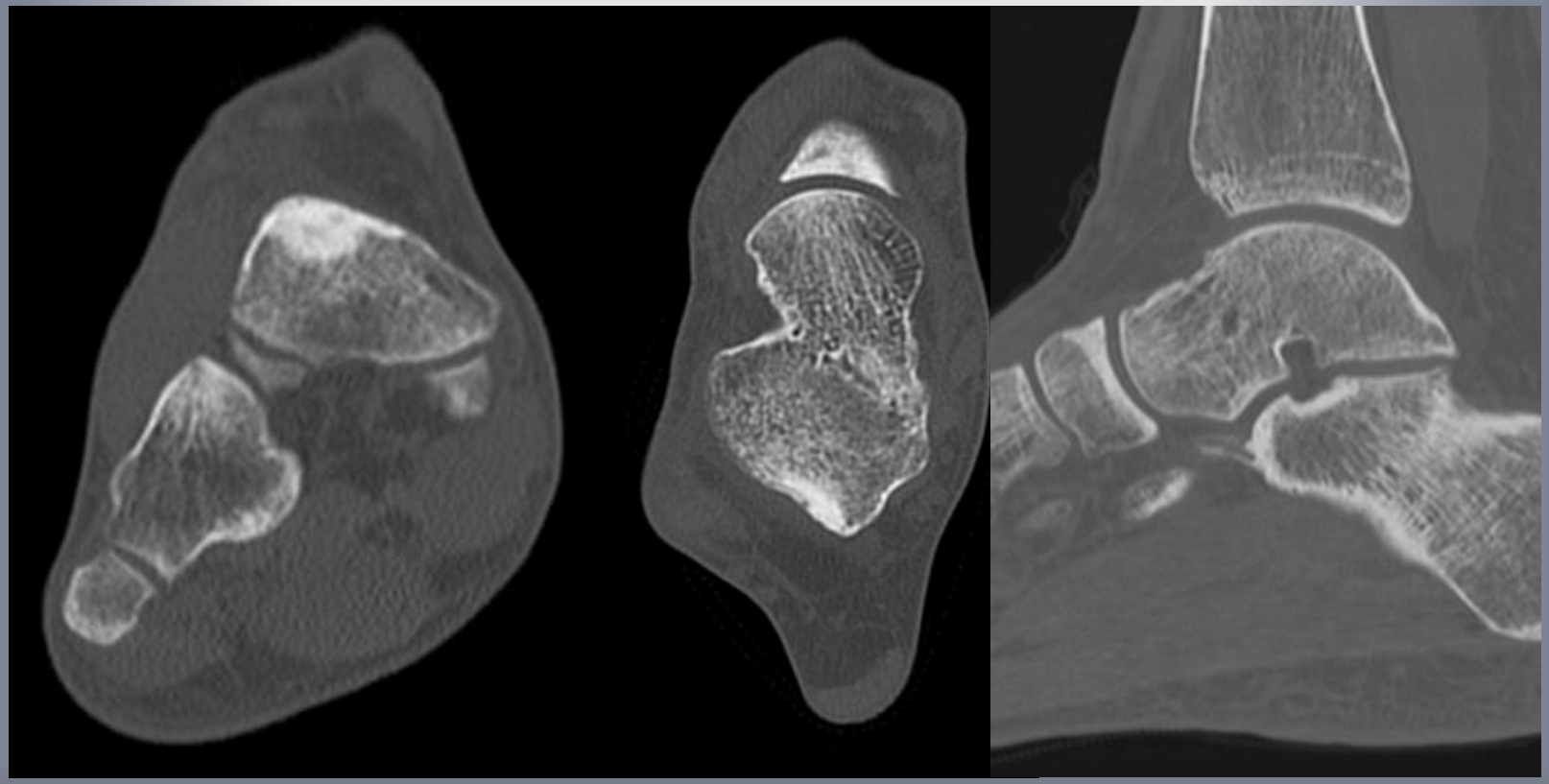
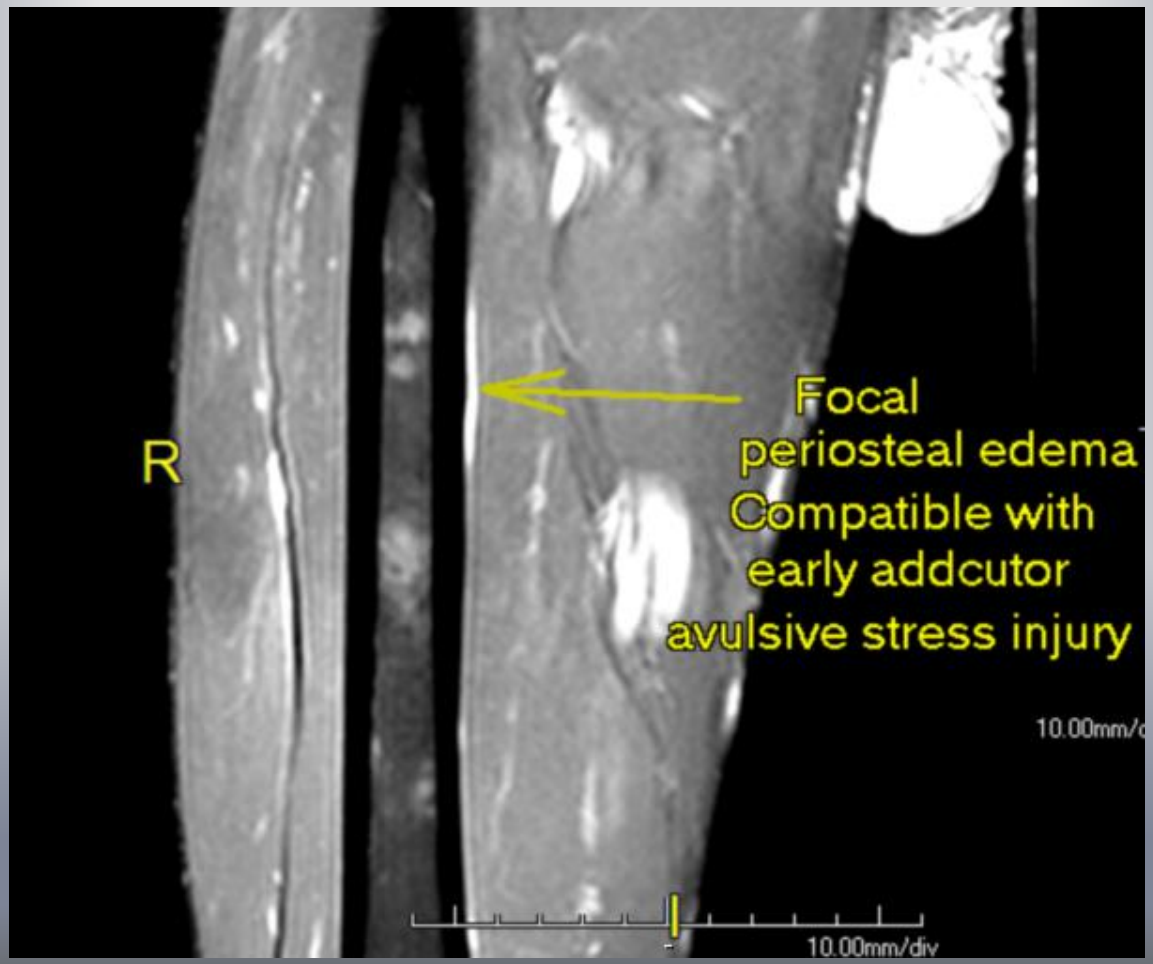
Type 1 NSF x6 mos in elite sprinter(need <1mm cuts)



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



Femur Str frx in an elite athlete



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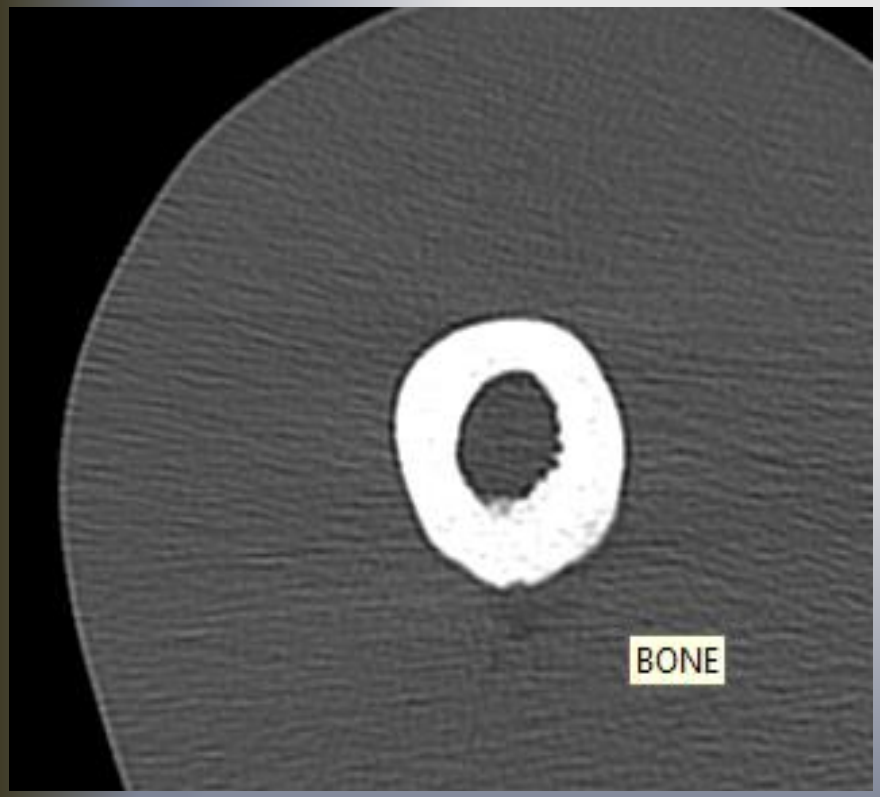
MRI “negative”, CT positive

2 wks after ESWT @ .55 mJ/mm² 2500 pulses anterior & posterior & PRP



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Other Bone conditions: European & ASIAN Experience (PUBLISHED)

1. AVN including Freiberg's
2. Osteochondral injury (OCDs)
3. Bone bruises
4. Improve healing rate pre- & post-op i.e. "Haglunds" (tenodesis), post-1st MPJ arthroplasty sesamoiditis/flexor tendinosis, fusions, fracture & wound healing

Things they don't tell you…

- Radial devices, can treat daily, pre- & during events
- Can use on growth plates (apophysitis)
- Can use more than recommended pulses when you know you patient & device/experience
- Eg: more than 2500 pulses, pre- & post surgery for OCD repair, PRP injection

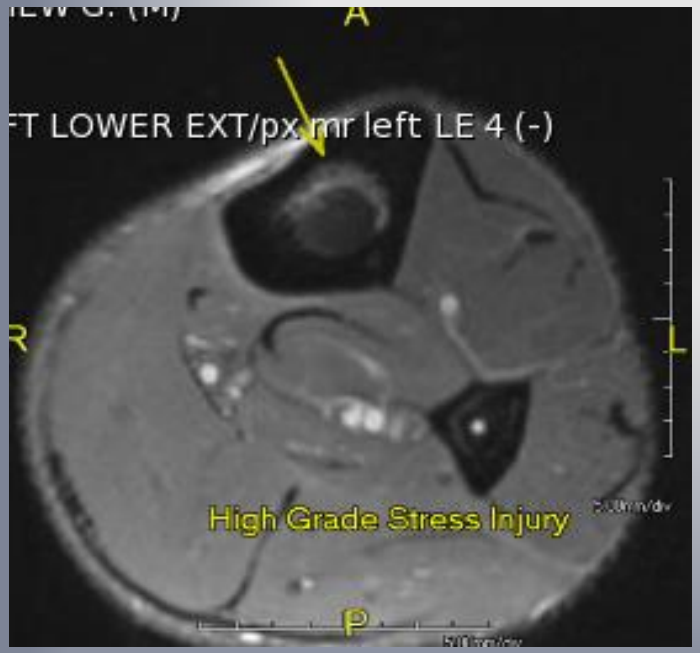
Lesser Metatarsal Stress Fracture

- Typical Tx: Rest from running sports 6+wks with a post-op shoe, “met-pad” (myth!)
- Sports Med Tx:
- 1. off-load w insert & ESWT/RPW
- 2. Cross train, inc run on Anti-gravity treadmill @70%, Elliptical @1-3 wks, bike & pool (no flip-turns)immediately
- 3. Assess imbalances(core), shoes, training, VitD, avoid NSAIDs
- NOTE: this tx not for proximal Met & Jones

“Shin splints”

- Typical Tx: rest, “PT”, orthoses?
- Sports Med TX:
- 1. Is the Dx Str Frx, Periostitis, CECS etc?
- 2. External Oblique(Durkin) tib-fib X-ray
- 3. Orthoses include correction for forefoot!
- 4. Pneumatic Leg brace for impact sports
- 5. RPW aka “shockwave” for periostitis (EB)
- 6. Assess imbalances(core), shoes, training, VitD, avoid NSAIDs

MRI of MTSS


A
FT LOWER EXT/px mr left LE 4 (-)
R
L
High Grade Stress Injury
P


EXT/T1 CORONAL (-)
EXT/PD FAT SAT CORONAL (-)

Leg Brace

- Pneumatic Long Leg Brace
- For Tibial & Fibular Injuries
- Anterior Panel for Ant. Tib. Lesions
- **Also consider RPW/FSW**

Medial Tibial Stress Fracture: 17 Wks later, Olympic Gold

Medial Distal Tibial Syndrome (Shin Splints)

Table
Treatment recommendations for elite athletes with MTSS

1. Pneumatic leg brace for weightbearing activity until pain free
2. Avoidance of nonsteroidal antiinflamtory drugs
3. Use of cryotherapy for control of pain and swelling
4. Foot orthoses with varus wedge, rearfoot to forefoot to sulcus, as appropriate
5. Radial soundwave therapy and/or focused extracorporeal shockwave therapy to affected area
6. Relative rest (decreased impact; i.e., aqua jogging, cycling, elliptical machine)
7. Use of AlterG™ treadmill
8. Assessment of vitamin D_3, nutrition status (i.e., disordered eating, relative energy deficiency in sports)
9. Assess shoes and sport surface
10. Assess core strength, limb length, and muscle imbalances

From Saxena et al, Journal of Foot & Ankle Surgery 2017

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Sesamoiditis

- One series reported in the literature.
- Saxena et al (2017) JFAS “prospective” analysis-pilot study. RPW 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

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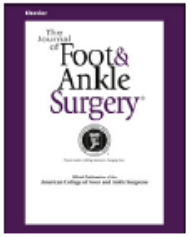

Case Reports and Series

Radial Soundwave for Sesamoidopathy in Athletes: A Pilot Study

Amol Saxena, DPM, FACFAS [1], Andrew Yun, DPM [2], Rajan Patel, DPM [3], Ludger Gerdesmeyer, MD, PhD [4], Nicola Maffulli, MD, MS, PhD, FRCS(Orth) [5]

[1] *Director, Department of Sports Medicine, Palo Alto Medical Foundation, Palo Alto, CA*
[2] *Care Provider, Kaiser Permanente Hawaii, Oahu, HI*
[3] *Foot Care Specialist, Central Jersey Ankle and Foot Care Specialists, Aberdeen, NJ*
[4] *Professor, Department of Orthopedics, University Schleswig-Holstein, Kiel, Germany*
[5] *Professor, Department of Musculoskeletal Disorders, Faculty of Medicine and Surgery, University of Salerno, Salerno, Italy*

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

Can EMTT & ESWT speed up surgical healing?

- Adding EMTT/ESWT to post-op protocol
- No financial bias
- Match procedure & age within 8 yrs
- Compare VAS, RTA & radiographic healing of controls (only surgery) to intervention
- Post-op: two sessions of EMTT (6K Pulses, Level 8)& one of ESWT(0.35mJ/mm^2)

The Future is here! Talar OCDS, Osteotomies, Fusions & Fractures

- Matched Pairs analysis using **EMTT/ESWT(n=12)** vs controls**(n=12):** 14 Females, 10 Males, no diff in age, P=0.49
- Sig diff in VAS score @ weightbearing **P=0.0001 (0.3/10 vs 2.8/10)**
- Sig diff in RTA (**14.8 vs 21.0 wks**) **P=.04**
- Sig diff in healing @ 4 wks via X-ray **P=0.04**
- **(Student's-T test, 95% Confidence Interval & Fisher's Exact P<0.05)**

Have to use the best evidence!

1. Need to use facts & data **(Registries?)**
2. Resist the temptation to use unproven therapies
3. Do not need to sell

(it's not about you)

Get lucky with who your patients & friends are: get training & learn