

Comparison of Short-Term Analgesic Effects of Extracorporeal Shock Wave Therapy (ESWT) and Conservative Treatment (CT) In Men With Chronic Heel Spur (HS)



Medical Science

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ABSTRACT

Surgical removal of heel spur (HS) provokes many controversies. An alternative is Extracorporeal Shock Wave Therapy (ESWT), it's a non-invasive method. The aim's to compare ESWT short-term analgesic effects and conservative treatment (CT) in males with chronic HS. Sixty patients (54.9 ± 4.3 years; 42-59 years) with HS pain were examined. The shockwave group (SG) received 1000-2000 impulses a session. These patients took 5 ESWT once a week. The control group (CG) received CT: nonsteroidal anti-inflammatory drugs (NSAIDs), orthotics, a local cortisone injection. We evaluated by Visual Analogue Scale (VAS). The groups were tested before the first, after the last treatment, 3 and 6 months after the treatment. A significant decrease of VAS ($p = 0.000$) in the shockwave group. In the control group no significant decrease of VAS. ESWT reduces pain more effectively than CT in men with chronic HS.

Introduction

Chronic inflammation of the plantar fascia, in the place of its connection to calcaneal tuberosity, can be a major cause of pain in the adults. Due to a visible in X-ray imaging calcification – bone spurs near the heel – is called „heel spur” (HS). Among other causes of the condition, there are: an inflammation of the Achilles tendon associated with inflammation of the Achilles tendon bursitis, inflammation of adipose tissue beneath calcaneal tuberosity by repeated micro damages that cause degeneration of the tissue, fatigue fractures of the calcaneal tuberosity, neuropathy caused by pressure on the plantar branch of the tibial nerve by an overgrown plantar aponeurosis. Risk factors also include excessive body weight, training running and jumping, work that entails standing or lifting heavy objects, flat feet, rheumatic changes.^{1,2,3,4,5}

The treatment of HS and plantar fascia provokes many controversial opinions, many authors point to the need for surgical removal of calcaneal bursitis and resection of HS, but clinical studies show the risk of complication after operation.^{6,7,8,9,10,11,12} An alternative to the surgical treatment of HS is CT that involves the use of physiotherapy treatments, such as ionophoresis, laser, ultrasound, and recently more and more often ESWT is used.^{13,14,15,16}

The most important is that ESWT is a completely non-invasive method. It has not yet been fully explained how it works exactly, but it probably involves micro destructions – the application of ESWT causes micro breaks in avascular or poorly-vascularized tissue thus stimulating appropriate revascularization and stem cell growth. Patients can continue to work or train the next day. Given the significant reduction of activity limitations and short duration of the treatment, ESWT is not only comparable to surgical treatment, but it is also less expensive than a few months of CT.^{17,18}

Objective

The aim of the study is to compare the short-term analgesic effects of ESWT and CT in males with chronic HS.

Methods

Continuous research was carried out in the period from January 2010 to July 2012, and involved sixty patients (54.9 ± 4.3 years; 42-59 years) who had pain associated with HS. The average BMI was 24.29 ± 0.78. None of the men was obese. The study was conducted in Spa in Busko-Zdrój. The patients had unilateral pain. The average duration of pain was 15.2 ± 5.3 months. Inclusion criteria were pain over the X-ray examined HS, unsuccessful iontophoresis, cryotherapy, laser therapy, ultrasound and phonophoresis during the six months before referral to Spa in Busko-Zdrój. Exclusion criteria were: rheumatoid arthritis, spondylarthritis, crystal induced arthropathies, diabetes mellitus, neurological abnormalities, age under 18, infectious or tumorous diseases,

skin ulcerations, and bursitis. All patients were informed about the principles of the treatment, and signed a written permission for treatment and inclusion in the study.

In the SG patients received – during the first treatment 1000 impulses, 1500 impulses in the second, and 2000 impulses in the third, fourth and fifth treatment (the pressure of 2.5 bar, the frequency of 8 Hz, the energy density of 0.4 mJ/mm²). The patients in the SG took a series of 5 ESWT once a week. Apparatus used for the treatment was BTL-5000 SWT. The active engagement between the head of the apparatus with a diameter of 15 mm and skin was gel used in ultrasound scan. The procedure was performed in the area of most intense pain – calcaneal tuberosity. Treatment time did not exceed 10 minutes. Patients in the CG at the same time received CT consisting of NSAIDs, orthotics and a local cortisone injection with 0.5 mL of betamethasone (7 mg/mL).

The basic method of research was to evaluate pain according to VAS, where 0 – no pain; 10 – severe (maximum) pain at rest and after normal daily activity. The patients of the two groups were tested before the treatment, at the end of the last treatment. The patients were also examined 3 months and 6 months after the end of treatment. The modifications observed were classified as excellent improvement (a VAS reduction of over 50%), good improvement (a VAS reduction of over 30% to 50%), slight improvement (a VAS reduction of over 15% to 30%).

In order to evaluate the early results of the treatment, the obtained data was subjected to statistical analysis. The statistical distributions of the analyzed characteristics were examined by Kolmogorov-Smirnov's test. It was shown that the tested variables had normal distribution. Basic descriptive statistics was used for the analysis. The mean arithmetic (\bar{x}) and standard deviation (SD) of the studied traits of men in both groups was calculated. In order to evaluate the statistical significance of differences in the intensity of pain before the treatment, after the last treatment and 3 and 6 months later, while at rest and after normal daily activity, one-way analysis of variance (ANOVA) was used in both studied groups. The value of the function F Snedecor was observed in various combinations. The statistical significance of differences in the intensity of pain was assessed at the 0,05 level. Calculations were performed at the Department of Computer Science at Holy Cross University in Kielce with the use of MedCalc software – version 11.4.3.0, licensed to Holy Cross College. The research project was authorized by the Bioethics Committee at Holy Cross College in Kielce as a resolution number 1/10/KB dated on 29.01.2010.

Results

A significant decrease of VAS ($p = 0.000$) was seen in the SG just after the end of ESWT and in the period after the end of ESWT to 3 months later and in the period from 3 months to 6 months

after the end of ESWT at the two reference points – at rest and after normal daily activity. No significant decrease of VAS was seen in the CG just after the end of CT at rest ($p = 0.202$) and after normal daily activity ($p = 0.341$). No significant decrease of VAS was seen in the period after the end of CT to 3 months later at rest ($p = 0.367$) and after normal daily activity ($p = 0.633$). No significant decrease of VAS was seen in the period from 3 months to 6 months after the end of CT at rest ($p = 0.608$) and after normal daily activity ($p = 0.393$). Studies have shown that ESWT reduces pain more effectively than CT in males with chronic HS (Table 1).

Table 1. The Intensity of Pain (VAS) in the following Terms of Research at the Two Reference Points

Shockwaves group				
Two Reference Points	when at rest		after normal daily activity	
Variables	$\bar{x} \pm SD$ P-Value	F-Value	$\bar{x} \pm SD$ P-Value	F-Value
Vas Before the ESWT Vas After the last session ESWT	7.4 ± 0.9 5.8 ± 0.7 0.000	59.077*	8.5 ± 0.9 6.2 ± 0.7 122.077*	0.000
Vas After the last session ESWT Vas 3 months after ESWT	5.8 ± 0.7 3.9 ± 0.8 95.841*	0.000	6.2 ± 0.7 4.6 ± 0.7 78.367*	0.000
Vas 3 months after ESWT Vas 6 months after ESWT	3.9 ± 0.8 2.5 ± 0.7 52.035*	0.000	4.6 ± 0.7 3.5 ± 0.6 42.706*	0.000
Control group				
Vas Before the ESWT Vas After the last session ESWT	8.4 ± 0.9 8.1 ± 0.9 0.202	1.667	8.7 ± 0.9 8.5 ± 0.7 0.923	0.341
Vas After the last session ESWT Vas 3 months after ESWT	8.1 ± 0.9 8.3 ± 0.8 0.367	0.828	8.5 ± 0.7 8.6 ± 0.9 0.231	0.633
Vas 3 months after ESWT Vas 6 months after ESWT	8.3 ± 0.8 8.4 ± 0.7 0.608	0.265	8.6 ± 0.9 8.8 ± 0.9 0.741	0.393

The P values represent result of testing with analysis of variance, F values represent coefficient Snedecor *Significant 0.05

The analgesic efficacy of ESWT is confirmed by the detailed analysis of differences in the frequency of occurrence of pain intensity between groups. In the SG excellent improvement (a VAS reduction of over 50%) was seen in 22/30 (73.3%) patients, good improvement (a VAS reduction of over 30% to 50%) was seen in 6/30 (20%) patients and slight improvement (a VAS reduction of over 15% to 30%) was seen in 2/30 (6.7%) patients at the two reference points – at rest and after normal daily activity. There was no improvement in pain intensity in the CG, as it was unchanged in 24/30 (80%) patients and worsened in 6/30 (20%) patients at these points (Table 2).

Table 2. The Analgesic Effects of ESWT

	Shockwave group		Control group	
	N	percent	N	percent
VAS > 50% Reducing	22	73,3%	—	—
VAS >30-50% Reducing	6	20%	—	—
VAS >15-30% Reducing	2	6,7%	—	—
VAS unchanged	—	—	24	80%
VAS worsened	—	—	6	20%

Discussion

The effectiveness of treatments for HS causes many controversial opinions. There is no consensus on how to treat it, conservatively or surgically. Endoscope method is cost-effective, non-invasive, with low risk of post-surgery complications and allows patients for fast return to socio-professional activity after surgery treatment.^{8,19,20,21,22} An alternative is ESWT for treatment of pain in people with chronic heel spur. The dominating opinion about it is highlighting the analgesic efficacy of ESWT in the treatment of chronic HS. The analgesic success of ESWT probably depends on the total dose of energy, not on the density of stream of emitted energy.^{18,23,24,25} Review of subject literature shows that the analgesic efficacy of ESWT with different physical characteristics and over a different period of time concerning was investigated. Hammer et al.¹⁴ assessed the analgesic efficacy of ESWT in patients with painful chronic inflammation of the plantar fascia. Patients treated with ESWT were given 3000 impulses of shocks with energy density of 0.2 mJ/mm² at weekly intervals. Two years after the end of treatment the level of pain on a VAS scale in patients treated with ESWT decreased 94%. In subsequent studies, the authors used medical ultrasonography to assess the effects of ESWT on changes in thickness of plantar fascia that had been affected by chronic inflammation. During the treatment, 3 sessions of 3000 shock wave impulses with the stream density of 0.2 mJ/mm² were applied at weekly intervals. The thickness of plantar fascia was measured 2 cm distally to calcaneal tuberosity. The level of pain was recorded in the VAS scale. The ultrasound scan 6 months after the end of ESWT showed a significant reduction in the thickness of plantar fascia of the affected foot and the level of patients pain was reduced 79% in the VAS scale.²⁶ Metzner et al.¹⁸ used ESWT in patients with chronic plantar fascia. Each patient received 1000 impulses of shock wave, the density of energy stream was 0.35 mJ/mm². The patients were examined 6 weeks, 16 months and 72 months after the end of ESWT. It turned out that pain was reduced in 81% of patients after 6 weeks, in 88% of patients – after 16 months, and in 96% of patients in the last examination – 72 months after the end of ESWT. The authors concluded that the doses of ESWT effectively reduced pain and the therapeutic effects achieved provide satisfactory long-term results. Yalçın et al.²⁷ used ESWT for analgesic purposes in patients with HS and treated them for 5 weeks with 2000 impulses of shock waves, ranging from 0.05 to 0.4 mJ/mm². Clinical results demonstrated excellent results (no pain) in 66.7% of the cases, good results (50% of pain reduced) in 15.7% and unsatisfactory outcome (no reduction in pain) in 17.6%. Moretti et al.²⁸ evaluated the analgesic efficacy of low doses of ESWT for foot plantar fascia inflammation accompanying HS in runners – athletes. The subjects received a weekly shock wave of 1000 impulses, 0.06 mJ/mm² energy density. ESWT continued for four weeks. The patients were examined after the last session of ESWT. Clinical results were excellent in 59%, good in 12%, satisfactory in 21% and clearly unsatisfactory in 8%.

Cosentino et al.²⁹ evaluated the analgesic efficacy ESWT at patients with calcaneal enthesophytosis. Patients were randomly assigned into two equal groups. The SG received six treatments (one every 7-10 days), each consisting of 1200 shocks with a fre-

quency of 120 shocks/min; the energy density used varied from 0.03 to 0.4 mJ/mm² and the CG went through the identical process but energy density was simulated (0 mJ/mm²). The results revealed significant reduction of pain in the SG. In the CG no significant decrease of VAS was seen.

Wang et al.³⁰ evaluated patients with an established diagnosis of chronic plantar fasciitis, including patients in the shockwave treatment group and patients in the control group. In the SG patients received 1500 impulses of shockwaves at 16 kV to the affected heel in a session. Patients in the CG received orthotics, physical therapy, an exercise program, and/or a local cortisone injection. Before treatment, the groups showed no significant differences in the scores for pain. After treatment, the SG showed significantly better pain scores as compared with the CG. The overall results were 69.1% excellent, 13.6% good, 6.2% fair, and 11.1% poor for the SG and 0% excellent, 55% good, 36% fair, and 9% poor for the CG.

Our study confirmed the results of other authors. The doses used in ESWT gradually decreased pain intensity in the SG and this trend persisted for up to 6 months from the last session of ESWT. The observed differences in this period were statistically significant. In the CG no significant decrease of VAS was seen after the treatment and in the period from 3 to 6 months after the

end of the treatment. In the SG there was a total improvement in the intensity of pain. In the CG, there was no improvement in pain intensity as it was unchanged in 80% patients and worsened in 20%. The results of short-term studies show that ESWT effectively reduces pain, which reduces mental and physical discomfort in patients with chronic HS.

Conclusion

The short-term studies have demonstrated the analgesic effectiveness of ESWT. We achieved a significant reduction in pain, that persisted 6 months in SG. ESWT reduces pain more effectively than CT. ESWT is a repeatable and non-invasive treatment and is a valuable alternative therapeutic option for surgical treatment and other CT in patients suffering from pain due to chronic HS.

REFERENCE

- Agostinelli J & Ross JA. (1997). Infracalcaneal heel pain in the athlete. *Clin Podiatr Med Surg*, 14, 503-509.
- Aquino W & Payne C. (1999). Function of the plantar fascia. *Foot*, 9, 73-78.
- Kim W & Voloshin AS. (1995). Role of plantar fascia in the load bearing capacity of the human foot. *J Biomech*, 28, 1025-1033.
- Puttaswamaiah R. (2005). Massive calcaneal enthesopathy in non-healing leg ulcer: a case report. *J Orthop Surg*, 13, 211-213.
- Tu P & Bytomski JR. (2011). Diagnosis of heel pain. *Am Fam Phys*, 84, 909-916.
- Blanco CE, Leon HO & Guthrie TB. (2001). Endoscopic treatment of calcaneal spur syndrome: A comprehensive technique. *Arthroscopy*, 17, 517-522.
- Jarde O, Diebold P, Havet E, Boulu G & Vernois J. (2003). Degenerative lesions of the plantar fascia: surgical treatment by fasciectomy and excision of the heel spur. A report on 38 cases. *Acta Orthop Belg*, 69, 267-274.
- Jerosch J, Schunck J & Sokkar SH. (2007). Endoscopic calcaneoplasty (ECP) as a surgical treatment of Haglund's syndrome. *Knee Surg. Sports. Traumatol Arthrosc*, 15, 927-934.
- Leitze Z, Sella EJ & Aversa JM. (2003). Endoscopic decompression of the retrocalcaneal space. *J Bone Joint Surg Am*, 85-A, 1488-1496.
- Malerba F & De Marchi F. (2005). Calcaneal osteotomies. *Foot Ankle Clin*, 10, 523-540.
- Smith WK, Noriega JA & Smith WK Jr. (2001). Resection of plantar calcaneal spur using the holmium: yttrium-aluminum-garnet (Ho: YAG) laser. *J Am Podiatr Med Assoc*, 91, 142-146.
- Stropek S & Dvorák M. (2008). Arthroscopic treatment for calcaneal spur syndrome. *Acta Chir Orthop Traumatol Cech*, 75, 363-368.
- Chuckpaiwong B, Berkson EM & Theodore GH. (2009). Extracorporeal shock wave for chronic proximal plantar fasciitis: 225 patients with results and outcome predictors. *J Foot Ankle Surg*, 48, 148-155.
- Hammar DS, Adam F, Kreutz A, Kohn D & Seil R. (2003). Extracorporeal shock wave therapy (ESWT) in patients with chronic proximal plantar fasciitis: a 2-year follow-up. *Foot Ankle Int*, 24, 823-828.
- Lukowicz M, Weber-Rajek M, Ciechanowska K & Włodarkiewicz A. (2009). The evaluation of the efficacy of low level laser therapy and phonophoresis in calcaneal spur symptoms treatment. *Acta Bio-Optica Info Med*, 15, 339-343.
- Robertson V & Baker K. (2001). A review of therapeutic ultrasound: effectiveness studies. *Phys Ther*, 81, 1339-1350.
- Marks W, Lasek J, Jackiewicz A, Lisieska-Tyszko S, Gwoździewicz J & Stasiak M. (2005). Treatment of chronic inflammatory soft tissue around the bone structures using extracorporeal source, low-energy shock waves of a new generation-a prospective study. *Orthop Quarter*, 3, 216-221.
- Metzner G, Dohnalek C & Aigner E. (2010). High-energy Extracorporeal Shock-Wave Therapy (ESWT) for the treatment of chronic plantar fasciitis. *Foot Ankle Int*, 31, 790-796.
- Komatsu F, Takao M, Innami K, Miyamoto W & Matsushita T. (2011). Endoscopic surgery for plantar fasciitis: application of a deep-fascial paproch. *Arthroscopy*, 27, 1105-1109.
- Marks W, Lasek J, Jackiewicz A, Witkowski Z, Stasiak M & Dawid S. (2008). Extracorporeal source of low-energy shock waves in the treatment of a new generation of heel spurs - a randomized double blind trial. *Orthop Quarter*, 2, 219-226.
- Morafko C. (2007). Endoscopic partial fasciotomy as a treatment alternative in plantar fasciitis. *Acta Chir Orthop Traumatol Cech*, 74, 406-409.
- Othman AM & Ragab EM. (2010). Endoscopic plantar fasciotomy versus extracorporeal shock wave therapy for treatment of chronic plantar fasciitis. *Arch Orthop Trauma Surg*, 130, 1343-1347.
- Gerdesmeyer L, Maier M, Haake M & Schmitz C. (2002). Physical and technical principles of shock wave therapy. *Orthopaede*, 31, 610-617.
- Gollwitzer H, Diehl P, von Korff A, Rahlfs VW & Gerdesmeyer L. (2007). Extracorporeal shock wave therapy for chronic painful heel syndrome: a prospective; double blind; randomized trial assessing the efficacy of a new electromagnetic shock wave device. *J Foot Ankle Surg*, 46, 348-357.
- Ogden JA, Alvarez R, Levitt R, Cross GI & Marlow M. (2001). Shock wave therapy for chronic proximal plantar fasciitis. *Clin Orthop Relat Res*, 387, 47-59.
- Hammar DS, Adam F, Kreutz A, Rupp S, Kohn D & Seil R. (2005). Ultrasonographic evaluation at 6-month follow-up of plantar fasciitis after extracorporeal shock wave therapy. *Arch Orthop Trauma Surg*, 125, 6-9.
- Yalçın E, Keskin Akca A, Selcuk B, Kurtaran A & Akyuz M. (2012). Effects of extracorporeal shock wave therapy on symptomatic heel spurs: a correlation between clinical outcome and radiologic changes. *Rheumatol Int*, 32, 343-347.
- Moretti B, Garofalo R, Patella V, Sisti GL, Corrado M & Moulhies E. (2006). Extracorporeal shock wave therapy in runners with a symptomatic heel spur. *Knee Surg Sports Traumatol Arthrosc*, 14, 1029-32.
- Cosentino R, Falsetti P, Manca S, De Stefano R, Frati E & Frediani B. (2001). Efficacy of extracorporeal shock wave treatment in calcaneal enthesophytosis. *Ann Rheum Dis*, 60, 1064-1067.
- Wang CJ, Wang FS, Yang KD, Weng LH & Ko JY. (2006). Long-term Results of Extracorporeal Shockwave Treatment for Plantar Fasciitis. *Am J Sports Med*, 34, 592-596.