CHAPTER **45**

EXTRACORPOREAL SHOCK WAVE THERAPY: Chronic Plantar Fasciitis

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The use of extracorporeal shock wave therapy (ESWT) for recalcitrant heel pain is becoming increasingly more popular in our profession. The rise in favorability is a result of a number of factors, including the lower rate of complications, the treatment is non-invasive, has a faster recovery time, the public is more technology driven, and the effectiveness of the therapy. Heel pain is a common ailment affecting millions of individuals each year. There are a number of etiologies of heel pain, although ESWT is only approved for plantar fasciitis. It is imperative to rule out such conditions as entrapment neuropathy, tarsal tunnel syndrome, calcaneal bursitis, infectious processes, metabolic disease, inflammatory arthropathies, calcaneal stress fractures, and soft tissue or osseous tumors. The initial evaluation for heel pain should include a thorough history and physical examination with the appropriate diagnostic studies to determine a more accurate diagnosis. The standard conservative measures for heel pain such as strapping and padding, injection therapy, anti-inflammatory medications, stretching exercises, alteration of shoe gear, immobilization with splints, orthotics, and alteration in life style are often times effective in 80-90% of the patients. In the cases of resistant heel pain lasting for six months or more, extracorporeal shock wave therapy is a new, non-invasive treatment option.

Extracorporeal shock wave lithotripsy was approved by the FDA in the early 1980s and now is the standard of care for urinary stone treatment. The use of extracorporeal shock wave therapy for musculoskeletal conditions has been available in many parts of the world for a number of years. The technology gained FDA approval in the United States in 2000 for the treatment of plantar fasciitis and in 2002 for lateral epicondylitis. The effect of the shock wave on soft tissues has not been established, though it has been theorized that the micro disruption caused by the trauma causes vascular in-growth allowing the chronic inflamed tissues to heal. On osseous tissues, the shock wave causes activation of the osteoblasts. The indications and limitations of the technology are still being investigated and have already been expanded to calcific tendonosis, delayed and non-unions, and tendon injuries.

The generation of shock waves is by three methods, electromagnetic, electrohydraulic, and piezoelectric. The electromagnetic type of shock wave has been manufactured by Dornier's Epos Ultra and Siemens' Sonocur. The electrohydraulic method is manufactured by Healthtronics' Ossatron. This article will focus on the electromagnetic technique for producing a shock wave and specifically the Dornier device. A pulsed electrical current passes through a coil with a thin membrane such that when the membrane is repelled by the magnetic field, a shock wave is generated. The shock wave is focused by an acoustic lens at the treatment site. The energy for the Epos Ultra can range from a similar low level (level 1) as the Sonocur to a higher level (level 9) than the Ossatron.

The early ESWT devices relied on the patient to identify the maximum area of tenderness by placing a mark on the foot before the therapy began. The patient was then sedated in order to deliver the treatment without pain. The treatment was focused in the general area that was identified by the patient during the preoperative period. A newer technology has emerged with the Dornier device to direct the treatment with ultrasound (Figure 1). A study by Vohra, et al used ultrasonography to evaluate symptomatic and asymptomatic plantar fascial

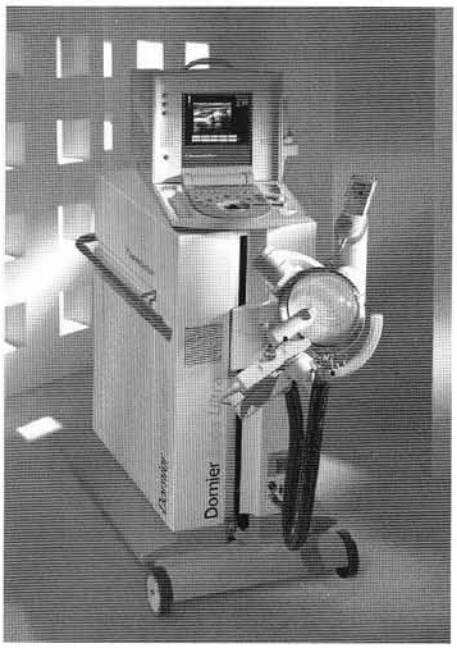

Figure 1. The Dornier device.

bands. They concluded that the average thickness for a band that was symptomatic was 5.35 mm and an asymptomatic band was 2.70 mm. Therefore, the use of the ultrasound unit can better determine the area of maximum inflammation and direct the treatment accordingly.

A number of studies have been performed to better determine the effectiveness of extracorporeal shock wave therapy in chronic plantar fasciitis. The studies have reported a success rate of 56-82% with significant improvement in heel pain from 3-12 months post procedure. In general there are fewer complications encountered with ESWT as compared to traditional plantar fascial surgery. In most cases, postoperative care is drastically different in ESWT versus traditional plantar fascial surgery. The ability of patients undergoing ESWT to return to work and activities within 1-2 weeks is far less debilitating than the traditional 6 weeks of inactivity. All of the current studies discuss the use of stretching exercises and/or orthoses after the procedure is performed. The optimal postoperative plan is yet to be determined.

The procedure is primarily performed in an office setting, although it can be utilized in an ambulatory surgical facility or hospital. The procedure does not require intravenous sedation or a light general anesthetic, only a local anesthetic. In some instances of performing the treatment with a nervous patient, valium is administered orally. An equal mixture of 1% lidocaine and 0.25% bupivicaine are infiltrated about the posterior tibial and sural nerves. After the foot is anesthetized, the patient is appropriately positioned on a treatment table or chair (Figure 2). The therapy is then administered with a sequential increase in energy and number of shocks, which produces a TENS effect (Table 1). The treatment time is from 15-20 minutes. The patient will then begin ambulating in an air cast walker for 1 week and then progress to a tennis shoe with an orthotic. The patient will sleep in the air cast walker for 2 weeks. An aggressive stretching regimen is continued for 6 weeks. During the postoperative period, the patient may develop some mild pain, ecchymosis, or mild paresthesias. If these side-effects occur, they are very mild and resolve quickly after the procedure. The patient is evaluated after 3 weeks, 6 weeks, and 12 weeks.

Extracorporeal shock wave therapy is a new and exciting technology with a great amount of potential. ESWT can be administered by the technologies of Dornier and Healthtronics for chronic plantar fasciitis. The ultrasound imaging system on the Epos Ultra provides precise localization and excellent imaging quality, allowing the user to continuously observe and control the therapy. The type of energy that is delivered has also caused much debate. There is some skepticism whether the low energy devices will be able to generate enough power to penetrate the thicker heel structures. ESWT is not effective in all patients, although early results of the procedure are very promising with significantly less complications. The next treatment site where the therapy may be used is the posterior heel structures because this condition can be far more debilitating than plantar fasciitis with fewer treatment options. The future ESWT studies should be directed to determine which patients may be more likely to respond to the therapy, and if the therapy should be initiated earlier in the treatment plan.

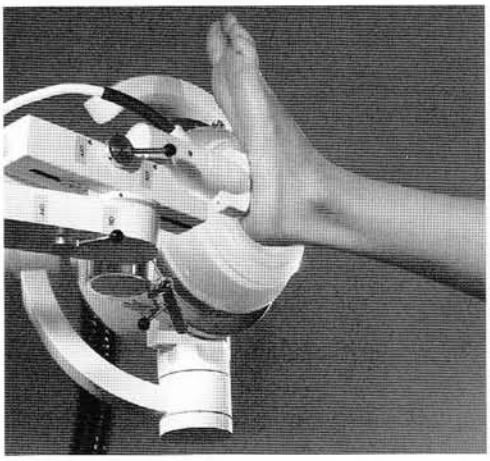

Figure 2. Proper position of the patient.

Table 1

SHOCK WAVE PROTOCOL

Level	Energy	Number of Shocks	Frequency
1	0.03 mJ/mm2	50 (+/- 10)	60 shocks/min
2	0.06 mJ/mm2	50 (+/- 10)	90 shocks/min
3	0.08 mJ/mm2	50 (+/- 10)	120 shocks/min
4	0.15 mJ/mm2	50 (+/- 10)	150 shocks/min
5	0.21 mJ/mm2	50 (+/- 10)	180 shocks/min
6	0.29 mJ/mm2	50 (+/- 10)	210 shocks/min
7	0.36 mJ/mm2	3550 (+/- 10)	240 shocks/min

BIBLIOGRAPHY

Chen HS, Chen LM, Huang TW. Treatment of painful heel syndrome with shock waves. *Clin Orthop Rel Res* 2001;387:41-6.

Hammer DS, Rupp S, Ensslin S, Kohn D, Siel R. Extra-corporeal shockwave therapy in patients with tennis elbow and painful heel. *Arch Orthop Trauma Surg* 2000;120:304-7.

Ogden JA, Alvarez R, Levitt R, Cross GL, Marlow M. Shock wave therapy for chronic proximal plantar fasciitis. *Clin Orthop Rel Res* 2001;387:47-59.

Ogden JA, Alvarez R, Levitt R, Marlow M. Shock wave therapy (orthotripsy) in musculoskeletal disorders. *Clin Orthop Rel Res* 2001;387:22-40.

Ogden JA, Toth-Kischkat A, Schultheiss R. Principles of shock wave therapy. *Clin Orthop Rel Res* 2001;387:8-17.

Peebles CF. Extracorporeal shock wave therapy in chronic plantar fasciitis. In *Update 2002: The Proceeding of the Annual Meeting of the Podiatry Institute* 2002;215-7.

Thiel M. Application of shock waves in medicine. *Clin Orthop Rel Res* 2001;387:18-21.

Vohra PK, Kincaid BR, Japour CJ, Sobel E. Ultrasonographic evaluation of plantar fascia bands. *J Am Pod Med Assoc* 2002;92:444-9.

Weil LS Jr, Roukis TS, Weil LS Sr, Borrelli AH. Extracorporeal shock wave therapy for the treatment of chronic plantar fasciitis: indications, protocol, intermediate results, and a comparison of results to plantar fasciotomy. *J Foot Ankle Surg* 2002;41:166-72.