

Extracorporeal Shockwave Therapy for Non-Unions and Delayed Healing Fractures

Author:

W. Schaden, A. Fischer, A. Sailer, A. Menschik, N. Haffner

Institution:

Trauma Centre Meidling, Vienna, Austria

The objective of every fracture treatment is to reunite the fracture fragments in an anatomical position and completely restore the function of the injured portion of the skeleton as quickly as possible. Despite today's sophisticated technologies and good primary treatment, 1-3% of all bone fractures develop into pseudarthrosis. Surgical treatment with debridement of the pseudoarthrotic tissue, cleaning of the fragment edges, insertion of autologous spongiosa and stabilization with osteosynthesis material is considered the "gold standard" for the treatment of pseudarthrosis. However, these surgical procedures are extremely traumatic for the patient. They are also costly, time-consuming, and associated with a high rate of complications. Therefore in December 1998, after successful pilot studies, the Trauma Centre Meidling commenced a large-scale prospective study using shockwave therapy to treat non-unions.

To date, more than 1,100 non-unions have been treated with shockwave therapy in the Trauma Centre Meidling. We have used different electrohydraulic devices (Orthowave 280, MTS; OssaTron, HMT) and have even compared different technologies by also using an electromagnetic device (Modulith, Storz Medical) from April 2004 until January 2005.

From the start of the study, more than 50 patient-specific data items were stored in a database developed especially to permit the combination of a broad range of parameters. This database structure serves as the basis for quality assurance measures and enables the researchers to determine the optimal treatment parameters and other important criteria. This database containing a documentation of the treatment of pseudarthrosis with ESWT is made available to all interested parties free of charge; it can be ordered from the authors.

Treatment was basically envisaged as a single treatment. Depending on the region to be treated, shockwave therapy is administered under general, regional or local anaesthesia. The patients are positioned such that the pseudarthrosis gap is clearly visualized in the anterior-posterior projection. The shockwave focus is positioned on the pseudarthrosis gap and between 2,000 and 4,000 pulses are applied (1,000 pulses per treatment location). We use an energy flow density (EFD) of 0.3 to 0.4 ml/mm² for all bone treatments.

Following shockwave therapy the pseudarthrosis is immobilized like a fresh fracture. This is usually done with a plaster cast or plastic splint; in 7 patients with especially mobile tibia non-unions, an external fixator was used. Fixation is not necessary when the pseudarthrosis has been treated with appropriate osteosynthesis material and this material exhibits no signs of loosening upon clinical or radiological examination. It can be assumed that the healing process is initially accompanied by neovascularization; for this reason, we try to prevent micro-movements of the non-union during the first 3-4 weeks after treatment to preclude tearing of the new capillaries. It may be necessary, in some cases, for the patient to avoid full weight bearing on the affected extremity during this period. The patient's cooperation must be elicited by a detailed briefing since most patients are asymptomatic directly after the treatment, owing to the analgesic effects of the shockwaves, and want to put their full weight on the affected extremity again.

If the cardinal symptoms (i.e. pain upon bending or compression, swelling, reddening and hyperthermia) subside during the early post-treatment phase (i.e. the first 2-3 months after ESWT), the physician can afford to take a "wait and see" attitude. This applies even if the x-ray findings are ambiguous, since the clinical findings constitute a more reliable measure of therapeutic success at this stage.

A pseudarthrosis gap with a width greater than 5 mm shows a poor prognosis.

In cases where bony remodelling of the non-union could not be demonstrated after 3 to 6 months, patients were given the option of surgical repair. Numerous patients, especially those who had undergone multiple operations previously, refused this option. This led to a relatively high number (18%) of repeat treatments.

In exceptional cases, a third or fourth (and in one instance, even a fifth) treatment was performed. The group of patients undergoing repeat ESWT included patients for whom a complicated pseudarthrosis operation was contraindicated for internal reasons or could have been done only at considerable risk to the patient.

Osseous union was achieved in 67% to 75% (depending on the device) of the pseudarthroses. As expected, the best therapeutic results were obtained in patients with delayed osseous union – in this group, ESWT was administered 3-6 months after the injury or the last operation on bone – and healing was achieved in 75%

to 85% of these patients. Of the patients with pseudoarthrosis with an onset more than six months previous, 60% to 70% experienced osseous union.

Among the more than 1,100 patients treated at the Trauma Center Meidling, no complications occurred other than the adverse reactions that have already been observed following shockwave therapy (i.e. local swelling, petechial bleeding, haematoma). Even though the mechanism of action of shockwave therapy has not yet been fully explored, we are convinced that ESWT is an effective, inexpensive and time-saving therapeutic modality with an almost zero rate of complications. Therefore we consider ESWT as the first choice therapy for non-unions and delayed unions that do not require surgical realignment.