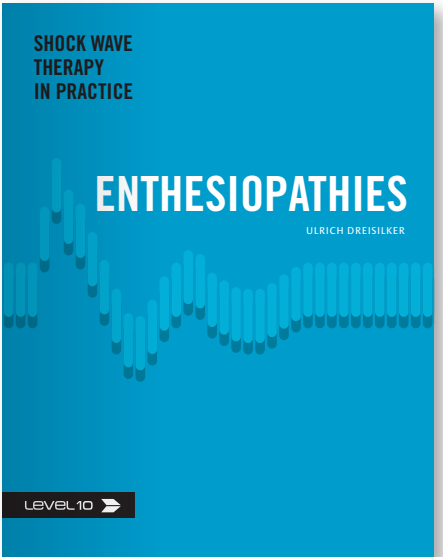
SHOCK WAVE
THERAPY
IN PRACTICE
ENTHESIOPATHIES
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LEVEL10

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SIGNIFICANCE OF ESWT IN PRACTICE

/ Ulrich Dreisilker

Extracorporeal shock wave therapy (ESWT) has been an established medical treatment for quite some time. Orthopaedists and surgeons alike rely on the method and it is part of their range of conservative treatments. Basic research and numerous scientific studies have been conducted on the effects of ESWT on classic indications like calcific tendinitis of the shoulder, epicondylitis, heel spur and pseudarthrosis. Regarding these indications, there is in fact more research on the effects of ESWT than on the effects of any other conservative treatment method.

An alternative to surgery

ESWT is an alternative to surgery. It is important to explain this gentle, non-invasive and outpatient treatment to patients suffering from calcified tendinitis of the shoulder, epicondylitis, heel spur, patellar tendinitis and other enthesiopathies. In this way patients can often avoid stressful and questionable surgeries. In the past it was often claimed that ESWT should only be applied after patients had failed to respond to other conservative treatment methods for six months. This is not comprehensible as there is no scientific proof that other conservative methods work better than ESWT.

ESWT stimulates tissue regeneration

Orthopaedic ESWT has nothing in common with urological lithotripsy – the disintegration of kidney stones (ESWL). ESWT stimulates the regeneration of degenerated tissue. Knowledge regarding the cellular and biomolecular processes of the procedure is necessary in order to further establish ESWT. Preconditions for a successful therapy are the right energy flux density and penetration depth, pulse frequency, number of treatments and intervals between sessions. Biological reaction and recovery cannot occur immediately – improvements are achieved in the medium to long-term. The patient must be informed about these facts. Physicians should be patient as well: if treatments are repeated too frequently at short intervals, this will lead to bad results.

Right dosage

Therapy takes time

No „disintegration"

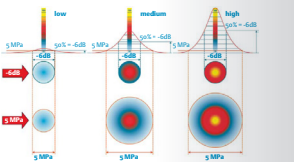
Physicians who are only marginally familiar with ESWT often base their knowledge on the principles of urological ESWT. According to their beliefs, calcified tendinitis of the shoulder or heel spur are being "disintegrated", although it is known that heel spur is the result of an ossified insertion of the fascia. Its disintegration is not possible and not necessary.

The treatment area depends on the adjustment of intensity and is usually larger than the focal zone

5 MPa TREATMENT ZONE

Only by providing information on the energy level does it become possible to give an impression of the area in which the shock wave will unfold its biological effect. In other words: the shock wave treatment area in the body is not described by the size of the -6dB focus. It can be larger or smaller. As a result, an additional parameter has been defined that is more closely related to the therapeutic effect and is not based on relative quantities (relationship to the peak pressure in the centre) but on an absolute quantity, namely the pressure of 5 MPa (50 bar). Consequently, the 5 MPa focus has been defined as the spatial zone in which the shock wave pressure is greater than or equal to 5 MPa. It is assumed that a certain pressure limit exists, below which shock waves have no or only a minimal therapeutic effect. There is no scientific proof for the value of 5 MPa. However, this definition offers the advantage of reflecting the change in the treatment zone with the selected energy setting. The different zones and their changes according to the selected energy levels are schematically represented in fig. 3.1-7. In comparison, the -6dB focus zone remains almost unchanged despite different energy settings.

REPRESENTATION OF THE -6DB FOCUS ZONE AND THE 5 MPa TREATMENT ZONE AT DIFFERENT ENERGY SETTINGS. *| Fig. 3.1-7*



ENERGY (E)

The energy of the applied shock waves is an important parameter for practical applications, although energy flux density is even more important today. It can be assumed that shock waves only have an effect on tissue when certain energy thresholds are exceeded. Using the run of the pressure curve p(t) and the acoustic impedance (Z), the following energy equation is obtained:

$$E = \frac{A}{Z} \int p^2(t)dt$$

A distinction is made as to whether integrating the pressure over time only includes the positive pressure components (E+) or whether it also covers the negative (tensile) components (E_{total}). The total energy is usually given with E (without index). The acoustic energy of a shock wave pulse is given in millijoules (mJ). As a rule, several hundreds or thousands of shock wave pulses are emitted per treatment, so that the total energy applied is obtained through multiplication by the number of pulses.

ENERGY FLUX DENSITY (ED)

As previously mentioned, the therapeutic effect of shock waves depends on whether the shock wave energy is distributed over a large area or concentrated on a locally confined treatment zone (focus zone). A measure of the energy concentration is obtained by calculating the energy per area (E / A):

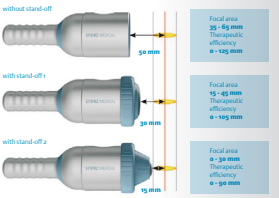
$$ED = E / A = \frac{1}{Z} \int p^2(t)dt$$

The energy flux density ED is given in millijoules per square millimetre (mJ / mm²). Here again, one distinguishes between integration over the positive part of the pressure curve alone on the one hand, and inclusion of the negative part on the other hand. Without index (ED), the pressure curve is usually considered to include the negative (tensile) components (total energy flux density).

The first shock wave systems worked according to the electro-hydraulic principle. Energy levels were usually not given in mJ / mm² but in voltage values (kV).

Fig. 5.1-2
F35V hand piece (Storz Medical AG) with electromagnetic coil and different adapters for different penetration depths

Focus penetration depth



F35V energy

Application energy > At the start of the therapy, an energy dose of 0.10 mJ / mm² is used to localize the point of pain. As soon as patients report pain relief (after approx. 200 pulses), the energy is slowly increased according to the individual patient's perception of pain. Treatment energy should be between 0.10 to 0.35 mJ / mm². The best results are achieved in dialogue with the patient and by using "biofeedback" (patient recognizes pain / referred pain). Patients with acute indications (in contrast to chronic problems) should be treated with lower energies.

F35V frequency

Frequency > For the treatment of pain points with focused shock waves, the highest possible frequency can be used, depending on the energy level (2 - 5 Hz). The experiences of the last few years have shown that when performing trigger point treatment, the best results are achieved with a frequency of 2 to 4 Hz.

COMBINED TREATMENT WITH RADIAL AND FOCUSED SHOCK WAVES

The combination of radial and focused shock waves unites the advantages of both technologies. Radial shock waves relax the muscles and the connective tissue (extracellular matrix). With focused shock waves, it is possible to localize and treat the individual painful muscle hardenings (trigger points) and tendon irritations in different layers.

Application of R15W

Radial shock waves are suitable for >

- Smoothing of musculature
- Relaxation of muscle tension (taut bands)
- Localization and treatment of superficial trigger points
- Treatment of large areas
- Activation of connective tissue (ECM, extracellular matrix)

Application of F35V

Focused shock waves are suitable for >

- Insertion tendopathies, enthesiopathies
- Disintegration of calcium deposits
- Localization of trigger points and points of pain, eliciting "referred pain",
- Superficial and deep trigger points / points of pain

Fig. 5.1-4
DUOLITH® SD1 T Tower, Combined shock wave system (Storz Medical AG)