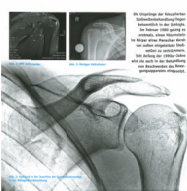


## STOSSWELLEN (ESWT)



# SHOCK WAVES (ESWT)

Mode of Action, Indications, Practical Tips and Supplemental Therapy

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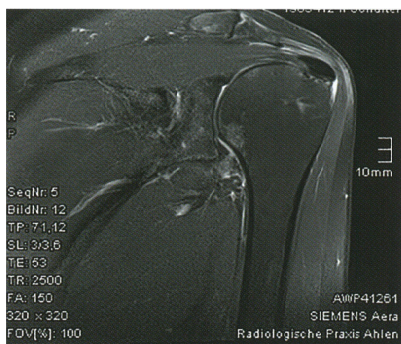


Fig. 1: MRT of calcifying tendinitis of the shoulder



Fig. 2: X-ray of calcifying tendinitis of the shoulder

It is well known that focused shock wave treatment originates from urology. The first successful shattering of a kidney stone in the body of human being using externally applied shock waves took place in February 1980. Starting at the beginning of the 1990s, it has also been used to treat musculoskeletal problems.

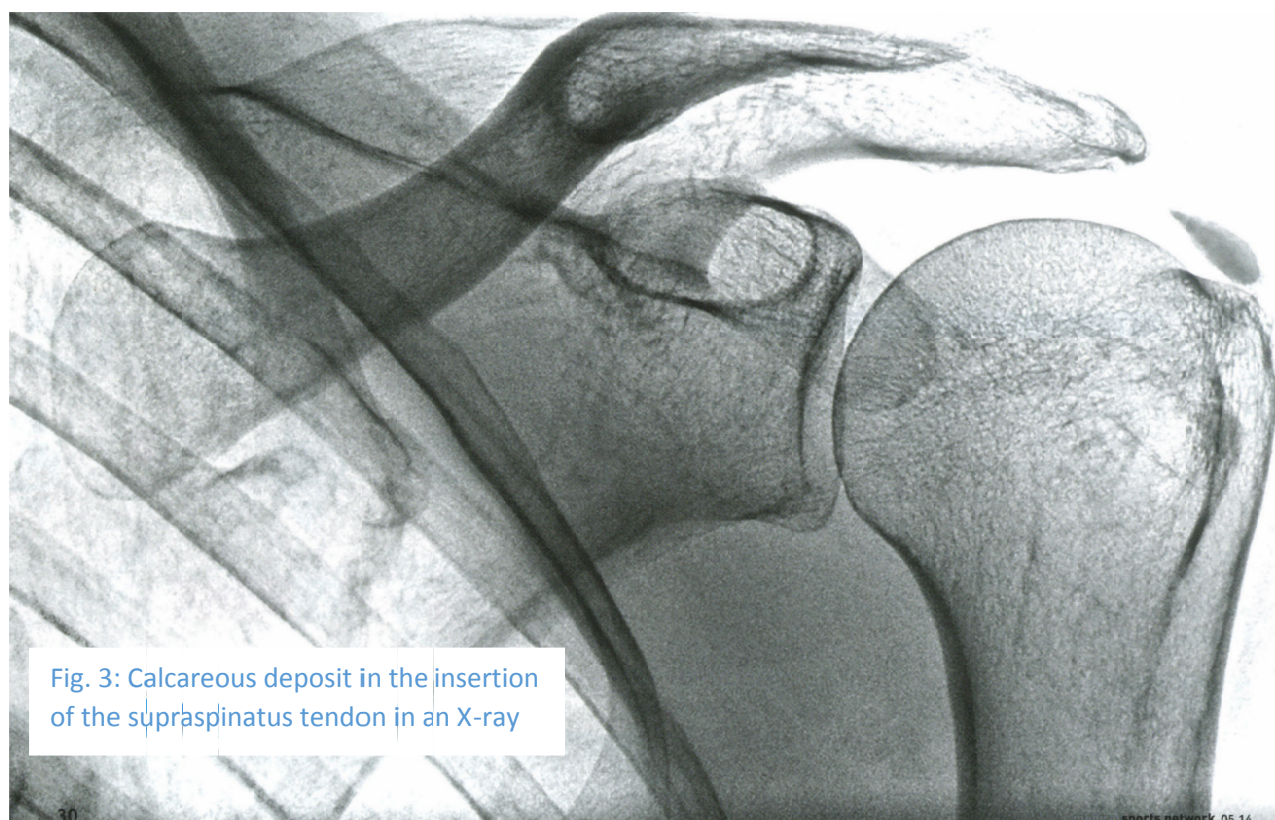


Fig. 3: Calcareous deposit in the insertion of the supraspinatus tendon in an X-ray

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### Effect

Its effect is based only to a limited extent on a "shattering" of pathological structures such as calcareous deposits. Instead, shock waves exhibit a very wide spectrum of molecular and cellular effects and influence, inter alia, cell regeneration, the density of pain conducting nerve fibres and the collagen fibre composition of the painful parts of

the tissue. The effects of the shock waves are if nothing else energy-dependent and vary from an increase in cell permeability in the low-energy range up to cell necrosis in the high-energy range. The first evidence of a successful application in sports orthopaedics appeared in the treatment of pseudoarthrosis, for which osteogenesis could be stimulated by shock wave treatment. Soon after that, demonstrable successes could be seen in the treatment of tendon calcifications and tendon insertion problems. Accordingly the first "classic indications" included:

- Tendinosis calcarea, epicondylitis, calcaneal spur/plantar fasciitis and pseudarthroses.

At the end of the 1990s, radial shock wave was introduced, for which a ball-shaped dispersion of the acoustic wave with superficial maximum energy is typical and which is therefore especially suitable for wider-area treatments.

### Successful treatment of sports orthopaedic medical conditions with shock waves

The spectrum of "sports orthopaedic" medical conditions has considerably expanded in the past 20 years and now includes:

- Pseudarthroses and stress fractures
- Plantar fasciitis/calcaneal spurs (plantar and rear upper)
- Tendinosis calcarea (tendon calcifications in the area of the rotator cuff), as well as in other tendons (e.g. patella tendon, Achilles tendon)
- Tendinopathies and insertion tendinopathies (including achillodynia, patellar tip syndrome, epicondylopathia humeri radialis/ulnaris, shin splints, insertion tendinopathy at the tuber ischiadicum, tendinopathy of the tibialis posterior muscle, etc.)
- Ligamentoses
- Persistent muscle tension/myogeloses/triggers/myofascial pain syndromes (focussed/radial)
- Muscle injuries (focussed/radial)

Combination treatment with radial and focussed shock waves is especially advisable for some medical conditions. An example that can be mentioned here is the treatment of myofascial pain syndromes, in which a loosening of the tensioned muscles takes place with radial treatment and a specific treatment of individual deeper trigger points with focussed shock waves.



### Further indications

Some authors have also reported positive experiences in the early phase of osteochondroses and osteonecroses (such as e.g. femoral head necrosis). Outside of sports orthopaedics, therapeutic successes in the treatment of skin disorders are gaining increasing attention. The first ones to be mentioned here are wound healing disorders, e.g. in the case of diabetes, as well as after burns or skin transplants, which probably benefit from ESWT-induced vessel dilatation and angiogenesis.

### What medical conditions should not be treated or only with caution?

No good results have yet been shown for medical conditions in which inflammatory conditions are predominant (e.g. bursitis, tendovaginitis). An example from sports medicine is runner's knee (ITBS), for which we were unable to

discover any beneficial results, although they are frequently described in medical publications. This also seems logical to us, since ITBS is not a tendinopathy but an irritation condition (frequently with accompanying bursitis) between the tractus iliotibialis and the condylus lateralis. Examples of suitable therapeutic measures include injections, insole treatment, stretching exercises for the tensor fasciae latae muscle and gluteus maximus muscle, strength exercises for the gluteus medius muscle, etc. In our opinion, therapy in such cases should not be focussed on shock waves.

In the past few years, mobile yet powerful devices have led to increased use for acute sports-medical indications such as muscular tension or acute overstrain symptoms at tendon insertions, e.g. at training camps. An imperative prerequisite for this treatment is the previous exclusion of severe injuries. In cases of muscle injuries that can be detected

by ultrasound, shock wave treatment in the area of the muscle structure injury should not commence until three to four weeks afterwards. In cases of normal ultrasound monitoring, radial shock wave treatment is then applied in accordance with fibre orientation and (if present) trigger point/myogelosis treatment appropriate to the findings (superficially and possibly radially, with deeper focus).

### Practical tips

The use of shock wave treatment in sports orthopaedics has many parallels with athletic training. As with training, the biological reaction and the desired healing occur in the period between the therapy sessions and within the required time. Analogous to training, treatments that are repeated too frequently and in intervals that are too short can lead to poor results.

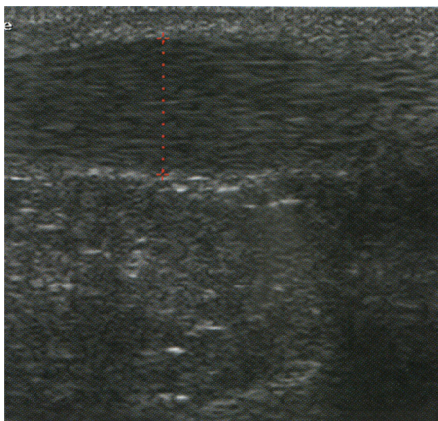


Fig. 4: Tendinopathy of the Achilles tendon



Fig. 5: MRT of plantar fasciitis



Fig. 6: Calcaneal spur

The "how" should therefore never be underestimated. The basic prerequisite is the precise localisation of the tissue to be treated with high-resolution ultrasound devices and an adjustment of the penetration depth using the stand-off devices. The first treatments in the "early history of ESWT" were done with large-scale urological devices using large energy flux densities. However, the results of basic research showed that sometimes considerably lower energies should be used in the area of the musculoskeletal system than was initially assumed.

In cases of acute medical conditions, a lower energy flux density than is used to treat chronic medical conditions is selected as a matter of principle. Current studies indicate that treatment with different energy flux densities leads to significantly different results. This could be the reason why studies on the effectiveness of shock wave treatment sometimes lead to very different results for the same medical conditions.

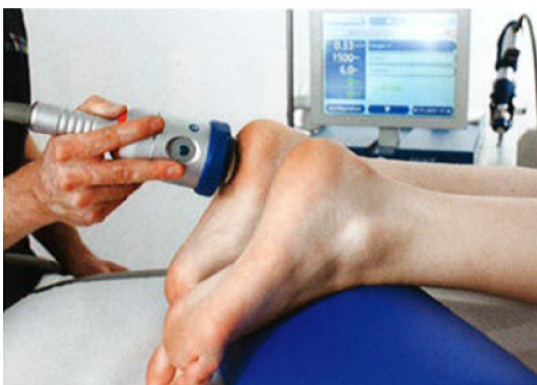
According to experience at our practice, we have found that the results improve when the person providing treatment has more experience, and that the level of energy should be selected according to the sports-orthopaedic condition present. The energy selected for

tennis elbow, for example, should be relatively low, whereas it should be relatively high for chronic mid-portion achillodynia with sonographically measured sagittal diameters of  $> 10$  mm. A low energy flux density is usually used at the beginning of treatment and then increased over the course of therapy. Within one session, it is advisable to start at the point of maximum discomfort, and then to scan for painful points over the entire pain area during the subsequent treatment. One interesting phenomenon involves points for which the patient reports a "memory pain", i.e. the pain induced during the treatment of a point resembles the basic complaint. The dialogue with the patient should therefore not be underestimated.

The length of the break between therapy units is one to two weeks for most indications for focussed shock waves, but should not be less than one week. The total number of treatments for tendon and tendon insertion symptoms is frequently around five, although acute medical conditions require considerably fewer and extremely chronic cases sometimes also require considerably more treatments.

The number of relapses decreases noticeably when shock waves are used until complete healing has

occurred, which is especially important in competitive sports, in which several absences normally have a far greater effect on performance than does one single, somewhat prolonged therapy phase. In order to reduce the number of therapy units needed for this, it can be worthwhile to extend the length of the breaks as the therapy nears its end. Tendon insertions should preferably be treated with focussed shock waves, and in cases of painful tension in the corresponding muscles, it is helpful to relieve this subsequently with radial shock waves. Treatment with radial shock waves is given here if it is tolerated, usually with an energy of 2 to 3.5 bar. Superficial painful trigger points are treated radially, usually with a frequency of 12 to 15 Hz (focussed 2 – 4 Hz). Muscles are stretched and smoothed with 18 to 21 Hz, whereby the stretching and smoothing motion should take place according to the orientation of the fibres. With the so-called punch technique, deeper-lying muscular pain areas are treated by pressing the handpiece down with more force. The tendon insertion itself is treated with focussed shock waves with an initial energy flux density of usually 0.15 to 0.35  $\text{mJ}/\text{mm}^2$  over 1500 – 2000 pulses.



**Fig. 7: Focussed shock wave treatment for plantar fasciitis**



**Fig. 8: Achillodynia of runners: Good indication for focussed shock waves**

In our experience, an athletic rest period due to the shock wave treatment itself can be kept short (24 – 36 hours). Of course, it can also be necessary to modify or reduce stresses for longer periods due to the medical condition. If this is not the case, however, the performance of the shock wave treatment itself does not require any longer-term additional rest periods. In some cases, the treatment can lead to initial exacerbation effects, which seldom last longer than one or two days and which normally respond well to NSAR. Since the triggering of an acute inflammatory action is interpreted by some authors as part of the healing process, the use of anti-inflammatory medication is understandably the subject of controversy. In our experience, initial exacerbation effects do not adversely influence the later course of therapy.

Local anaesthetics, which were frequently used in the initial years to reduce pain during the shock wave treatment, seem to inhibit positive molecular and cellular effects of the shock waves and should therefore no longer be used with ESWT. In our experience, corticosteroid injections in the treatment area beforehand lead to a considerable reduction in the response to the shock wave treatment, which is why we wait six weeks before starting with a shock wave treatment in such cases.

Shock waves are of particular importance in treating overstrain injuries in sports. A careful determination of the cause should be emphasised here, since this can help to identify relationships and considerably reduce the rate of relapse.

### Supplemental therapy

It is particularly noteworthy that shock waves can be combined very well with eccentric training in the treatment of tendinopathies and insertion tendinopathies. In our practice, we also frequently combine shock wave therapy with acupuncture. Trigger points and acupuncture points often overlap (some studies show an overlap of approx. 70% with respect to the localisation of acupuncture and trigger points). These therapies mutually support and influence each other. Ah shi points scanned during the shock wave treatment can for example be acupunctured (e.g. dry needling). Conversely, knowledge of

local acupuncture points in a pain area helps with the search for suitable therapy points for treatment with focussed shock waves.

### Short digression on trigger point treatment with ESWT

Gleitz and Hornig (2012) define trigger points as follows:

- "Trigger points are hyper-irritable, painful areas in the muscle, usually in the form of a palpable local hardening that lies in a contracture band.

They are a special form of ischaemic local muscular pain and are often associated with referred pain.

Unlike most muscular pain, muscular trigger points are characterised by insufficient self-healing."

The information on the length of the break and the total number of treatments given in the text refer to the treatment of the main indications (usually tendinopathies) with focussed shock waves. These differ from the recommendations for trigger point treatment. In this case, the treatment frequency is one to two times a week for chronic pathologies and up to every day for acute ones. Usually four to ten treatments are required for one muscle region.

### Summary

Although mechanical effects such as the gentle "shattering" of structures were the central focus of observation in the early phase of treatment with shock waves, current study results and experience in sports orthopaedic practice are increasingly shifting interest to molecular and cellular effects. Here, different energy flux densities show different effects. The question of "how" and the experience of the person providing the treatment is becoming more important, also in combination with other treatment methods. The spectrum of indications outside of sports orthopaedics (dermatology, cardiology) will increase in the future as well. In conservative sports orthopaedics, shock wave treatment (with special emphasis on focussed shock wave treatment) is and shall remain a major treatment option, particularly in the treatment of overstrain symptoms. This is of interest to athletes primarily because of the almost complete absence of relevant side effects and the very low relapse rate after successful therapy (providing that the cause is determined).

### Links to associations:

**DIGEST e. V. Deutschsprachige Internationale Gesellschaft für Extrakorporale Stoßwellentherapie (German-language international society for extracorporeal shock wave therapy), [www.digest-ev.de](http://www.digest-ev.de)**

**ISMST International Society for Medical Shockwave Treatment: [www.ismst.com](http://www.ismst.com)**