Improvement of active calf muscle extensibility by means of radial shock waves in chronic achillodynia

Dr. med. Markus Gleitz
Orthopädische Praxis
[Orthopedic Surgery]
30, Grand Rue
L-1660 Luxembourg

Tel.: (+352) 22 91 92
Fax: (+352) 22 91 94
E-mail: marklux@mail.anonymizer.com

Summary: The aim of this study was to investigate the possibility of improving active calf muscle extensibility by means of radial shock waves (rESWT) in patients with chronic achillodynia. To this end, radial shock waves were applied to the shortened calf muscles in 102 patients, and active dorsal extension of the affected ankle joint was measured before and after completion of therapy and 3 to 6 months later. The results of the study showed a lasting improvement in active dorsal extension by 9 degrees after 4.4 therapy sessions with 4000 to 6000 shock waves per session. The mode of action of radial shock waves in muscles is consistent with the trigger point theory, but needs to be investigated in more detail by experimental studies.

Key words: rESWT, calf muscle shortening, stretching, muscle extensibility, achillodynia, trigger points.

Introduction: Shortened calf muscles are one of the main risk factors for recurrent achillodynia (McCRORY 1999, KAUFMAN 1999, KRIVICKAS 1997). The anamnestic information provided by patients revealed that many subjects had been suffering from limited mobility for several years (e.g. heel up off the ground when in squat position). The real cause of this muscle shortening is often difficult to identify. In most cases, stretching exercises are not sufficient to provide pain relief and produce a lasting improvement in calf muscle extensibility (ALFREDSON H 2000, HARVEY L 2002, YOUDAS JW 2003). By contrast, the use of heel lifts leads to a rapid improvement of the condition, which demonstrates that the reduction of tension on the Achilles tendon is crucial in curing achillodynia (DAVIS WL 1999). A possible cause of calf muscle shortening may be the presence of trigger points in the calf muscles (TRAVELL JG 1992). The permanent contracture of the actin-myosin filaments caused by trigger points due to the energy crisis of the motor end-plate leads to circumscribed muscle contractures which, in the presence of a sufficient number of trigger points, result in a measurable overall shortening of the affected muscles and in a limited dorsal extension of the ankle joint. The causes of trigger point formation are manifold and range from mechanical overstrain, trauma or poor posture to articular, neurogenic or remote muscular disorders (satellite trigger points).

One of the most effective therapies in use today is the application of strong mechanical pressure to the trigger points. This is generally done by using the friction massage technique, followed by calf muscle stretching. The following reasons for the effectiveness of this treatment method are discussed: resolution of existing permanent actin-myosin contractures and improvement in local circulation along with the elimination of the ischemia-induced energy crisis (MENSE S 2001). Examinations into the effectiveness of classical trigger point therapy in improving calf muscle extensibility are not dealt with in the citable literature. The effectiveness of calf muscle stretching alone is discussed controversially (ALFREDSON H 2000, PORTER D 2002, YOUDAS JW 2003), as this therapy approach is considered to induce only a temporary improvement in mobility (HARVEY L 2002).

In the last few years, the use of low to medium-energy radial shock waves (rESWT) has become increasingly established in the treatment of tendon pathologies. This therapy method uses shock waves at an energy level of up to 0.23 mJ/mm² and a maximum tissue penetration depth of 35 mm. On the basis of the aforementioned pressure application theory in the treatment of trigger points, the question is whether shock waves are able to provide a lasting improvement in the extensibility of shortened calf muscles.

<u>Materials and methods:</u> A retrospective study was conducted on 102 orthopedic practice patients (63 males, 39 females, average age 45.3 years) with unilateral chronic achillodynia (> 6 months) and a history of failed conservative therapy. The inclusion criterion was a soft tissue induced reduction in the active dorsal extension of the ankle joint to less than 20° when examined at 90° knee flexion.

In addition to receiving local Achilles tendon treatment, all patients in the study underwent 4 to 6 radial shock wave therapy sessions at weekly intervals. During each session, 4000 to 6000 radial shock waves were applied to the calf using the Masterpuls MP100 system developed by Storz (Fig. 1) with 15 mm D-Actor shock transmitter. Shock waves were primarily applied to the proximal gastrocnemius muscles where most palpable indurations were found and, by using the smoothing technique, towards the distal end of the muscles. The median part of the soleus muscle had to be treated through the proximal Achilles tendon, whereas the distal lateral muscle portion was freely accessible for shock wave application. The maximum application pressure was determined by the patient's pain threshold and was increased from 2.5 to 4.0 bar during the therapy. Shock waves were applied at a shock frequency of 15 Hz.

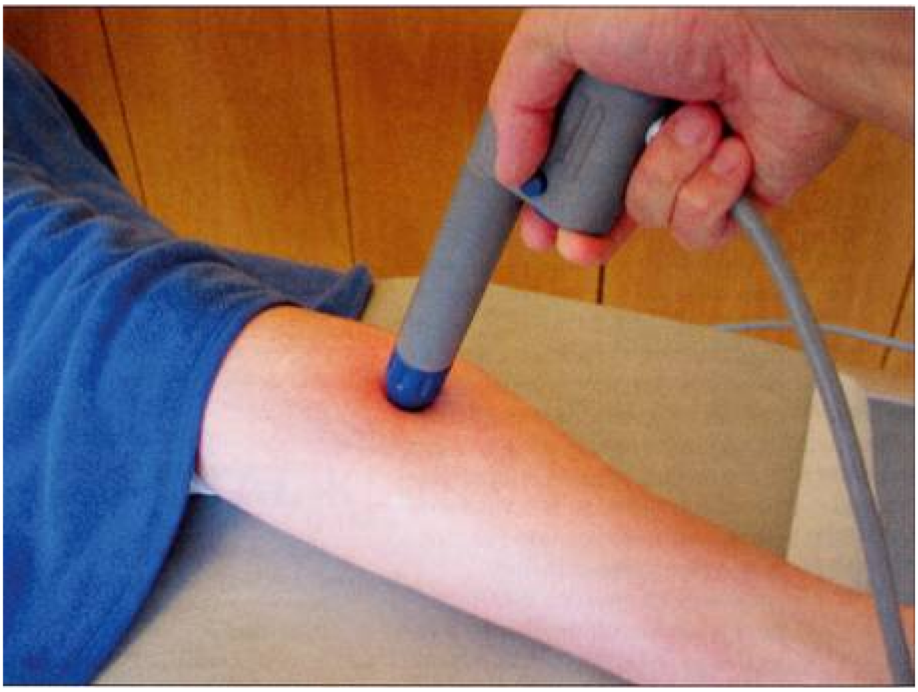

Fig. 1: Calf muscle treatment with pulse transmitter (MP100, Storz Medical AG)

Exclusion criteria were osseous or post-operative induced restriction in ankle joint range of motion, neurological primary diseases, previous thromboembolic events and anticoagulant medication therapy.

The active dorsal extension of the ankle joints was measured by means of a gravity goniometer before and after completion of shock wave therapy and 3 to 6 months later (1 examiner).

The statistical evaluation was performed using the SPSS software. The statistical significance level was set at $p<0.05$.

Results: The average active dorsal extension measured prior to shock wave therapy was 16.7° (12°-19°) (Fig. 2). A significant improvement in the active dorsal extension to 25.8° (21°-32°) was achieved after an average of 4.4 shock wave therapy sessions. Follow-up examinations conducted after an average of 4.6 months (3-6 months) showed that the active dorsal extension had increased to 26.2° (significant improvement from pre-treatment situation but only modest increase from the value measured upon completion of therapy).
Side effects included small subcutaneous hematomas. Sonographic examinations proved that no deeper-sited hematomas had occurred in the muscles as a result of shock wave therapy.

Treatment could be continued at weekly intervals. None of the patients required early termination of the therapy.

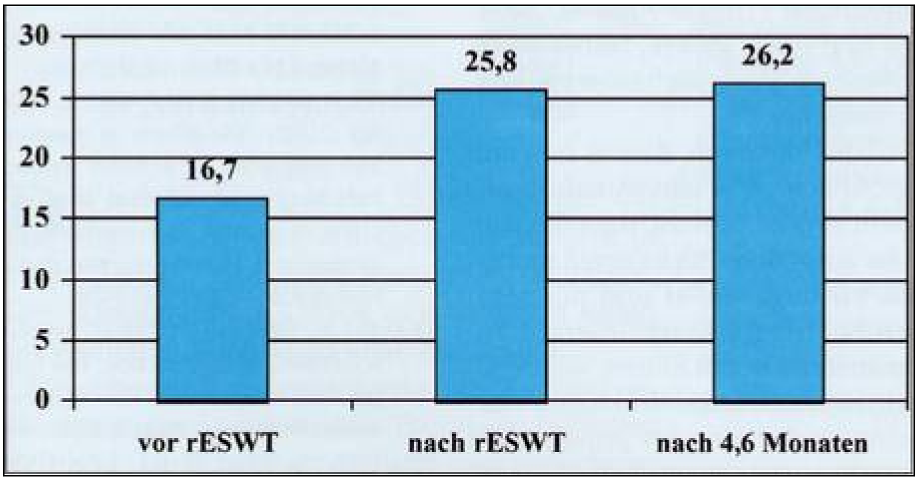

Fig. 2: Active dorsal extension of ankle joints (in degrees)

Discussion: Radial shock wave therapy of chronically shortened calf muscles results in an over 9° increase in the active dorsal extension of the ankle joint. The effects achieved last at least for several months. Consequently, this therapy approach is far superior to conventional stretching therapy, both in terms of the degree of improvement and in terms of the duration of its effectiveness. Compared to the otherwise recommended daily stretching exercises, which need to be performed over a period of several weeks, shock wave therapy requires relatively little time as 4 to 5 therapy sessions of 7 minutes duration each are sufficient to achieve the desired results. Except for the pain perceived during treatment, shock wave therapy has only minimal side effects and is thus indicated for almost all patients.

Thanks to the improvement in calf muscle extensibility, which lasts at least for several months, radial shock wave therapy is a viable alternative to heel lifts in the treatment of chronic achillodynia since it allows the tension on the Achilles tendon to be reduced without running the risk of additional muscle shortening by heel elevation.
Moreover, the additional treatment of a shortened muscle in an overuse pathology of the related tendon represents a causal and more functional approach than the hitherto performed local shock wave therapy of the affected tendon alone.

The mode of action of radial shock waves in muscles is still unclear. Although the assumption that muscle shortening is caused by trigger points and that it can be treated with radial shock waves seems logical when considering the theories it is based on, it is not fully consistent with practical experience. In fact, the increase in the range of motion achieved by an exclusively local treatment of the palpated hardened muscle bellies of the gastrocnemius and soleus muscles remains far behind the improvement provided by the combined treatment of both individual spots and larger areas described above.

This means that the trigger point theory needs to be extended to also include muscle fiber alterations over large areas (trigger point areas) rather than merely the defined spot-like muscle knots, or that hitherto unknown other mechanisms are involved.

The assumption that large trigger point areas may be present is underpinned by the fact that the diagnosis by palpation we performed is not accurate enough and that only very large trigger point conglomerates produce palpable knots, while individual fiber contractures merely lead to muscle shortening in the micron region and cannot be identified by palpation.

In conclusion, the results of this practical study are very promising, but need to be verified by means of methodically more valid studies and by conducting experimental examinations of the specific mode of action.

Literature:

ALFREDSON H, LORENTZON R (2000) Chronic Achilles tendinosis: recommendations for treatment and prevention.
Sports Med. 29(2): 135-46

DAVIS WL, SINGERMAN R, LABROPOULOS PA, VICTOROFF B (1999) Effect of ankle and knee position on tension in the Achilles tendon.
Foot Ankle Int. 20(2): 126-31

HARVEY L, HERBERT R, CROSBIE J (2002) Does stretching induce lasting increases in joint ROM? A systematic review.
Physiother. Res. Int. 7(1): 1-13

KAUFMAN KR, BRODINE SK, SHAFFER SA, JOHNSON CW, CULLISON TR (1999) The effect of foot structure and range of motion on musculoskeletal overuse injuries.
Am. J. Sports Med. 27(5): 585-93

KRIVICKAS LS (1997) Anatomical factors associated with overuse sports injuries.
Sports Med. 24(2): 132-46

MENSE S, SIMONS DG, RUSSELL IJ (2001) Muscle Pain. Understanding its Nature, Diagnosis and Treatment.
Lippincott Williams and Wilkins, Philadelphia

McCRORY JL, MARTIN DF, LOWERY RB, CANNON DW, CURL WW, READ HM, HUNTER DM, CRAVEN T, MESSIER SP (1999) Etiologic factors associated with Achilles tendinitis in runners.
Med. Sci. Sports Exerc. 31(10): 1374-81

PORTER D, BARRILL E, ONEACRE K, MAY BD (2002) The effects of duration and frequency of Achilles tendon stretching on dorsiflexion and outcome in painful heel syndrome: a randomized, blinded, control study.
Foot Ankle Int. 23(7): 619-24

TRAVELL JG, SIMONS DG (1992) Myofascial Pain and Dysfunction: The Trigger Point Manual Vol II (Lower extremities).
Williams & Wilkins, Baltimore

YOUDAS JW, KRAUSE DA, EGAN KS, THERNEAU TM, LASKOWSKI ER (2003) The effect of static stretching of the calf muscle-tendon unit on active ankle dorsiflexion range of motion. J. Orthop. Sports Phys. Ther. 33(7): 408-17

Source: Translated from: “Verbesserung der aktiven Wadenmuskeldehnfähigkeit mittels radialer Stosswellen bei chronischen Achillodynien”; In: Orthopädie-Report Sonderheft 2008; pp. 176-178