SHOCK WAVE
THERAPY
IN PRACTICE

MYOFASCIAL SYNDROMES & TRIGGER POINTS

MARKUS GLEITZ

LEVEL10

CONTENTS

Physical basics 16

- Focused shock waves 17
- Radial pressure waves 28
- Clinical comparison of shock waves and pressure waves 33

The muscle as organ of pain 34

- Pathophysiology of muscle pain 38
- Causes of local muscle pain 40
- Referred pain 43
- Muscular trigger point (MTrP) 47
- Extramuscular trigger points 59
- Duration of myofascial pain treatment 59
- Errors in the treatment of myofascial pain 61

Shock wave application to muscles 63

- Mechanism of action 65
- Benefits of shock waves 67
- Indications and contraindications 67
- Diagnosis prior to shock wave therapy 69
- Differential diagnosis of myofascial pain 71
- Focused, planar or radial shock waves? 73
- Shock wave diagnosis of muscular trigger points/painful muscle spots 75
- Therapy planning 79
- Systematic methodology 81
- Treatment routine 84
- Treatment parameters 86
- Treatment frequency 89
- Treatment documentation 90
- Therapy progress: improvement and side effects 90
- Therapy success 93
- Concomitant therapies 95

Orthopaedic indications for successful shock wave therapy 97

- Introduction 99
- Cervical syndrome with brachialgia, dorsalgia and cephalalgia 102
- Periarticular shoulder pain 117
- Tendomyopathy of forearm extensors and flexors with and without epicondylopathy 131
- Dorsalgia 135
- Lumbago and glutealgia with and without pseudoradicular sciatica 145
- Adductor tendinopathy 164
- Shortened thigh extensors and flexors 167
- Peroneus muscle syndrome 171
- Anterior tibial stress syndrome 172
- Medial tibial stress syndrome (shin splint) 173
- Calf muscle shortening with and without achillodynia 174
- Plantar heel and foot arch pain 179
- Metatarsalgia 184

Summary 186

List of abbreviations 190

Reference list 192

PHYSICAL BASICS

/ Pavel Novak

In modern medical practice, both focused shock waves and radial pressure waves are used. Though not correct in physical terms, radial pressure waves are often referred to as radial shock waves. Shock waves and pressure waves differ not only with regard to their physical properties and mode of generation, but also in terms of the magnitude of the standard parameters used and the therapeutic tissue penetration depths achieved. Planar shock waves, also referred to as defocused shock waves, are a special type of focused shock wave. They act superficially, similarly to radial pressure waves, but cause only very little pain and their mechanism of action is similar to focused shock waves.

Focused and defocused shock waves and radial pressure waves are not identical

FOCUSED SHOCK WAVES

WHAT ARE SHOCK WAVES?

Shock waves occur in the atmosphere during explosive events, for example during lightning strokes, or when aeroplanes break through the sound barrier. Shock waves are acoustic pulses characterised by high positive pressure amplitudes and a steep pressure increase compared to the ambient pressure [1].

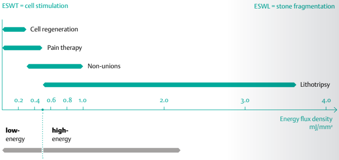
They are capable of temporarily transmitting energy from the point of generation to remote regions to cause window panes to shatter, for instance. Despite their similarity to ultrasound, shock waves have substantially higher pressure amplitudes than ultrasound waves. For this reason, steepening effects resulting from non-linearities in the propagation medium (water, human tissue) have to be taken into consideration. In addition, ultrasound waves are periodic oscillations with limited bandwidth (Fig. 1.1-1). Shock waves, on the other hand, are characterised by a single, mostly positive pressure pulse, which is followed by a comparatively small tensile wave component (negative pressure pulse) (Fig. 1.1-2). Such a pulse contains frequencies that may range from a few kilohertz to over 10 megahertz.

Shock and pressure waves are pulses, while ultrasound is a continuous oscillation waves is determined, among other factors, by a forward-directed dynamic effect (in the direction of shock wave propagation), which causes a pulse to be transmitted to the interface that can be increased to such an extent that even kidney stones can be destroyed [3-4]. In general, these dynamic effects only occur at interfaces with a jump in the acoustic resistance (e.g. bone trabeculae [5]), but hardly ever in homogeneous media (tissue, water).

Direct effects in tissue – mechanotransduction > While passing through tissue, shock waves cause high pressure gradients (approx. 160 MPa/mm) and pressure, tension and shear forces that lead to the irritation and stimulation of cells and cell matrix due to mechanical deformation of the cytoskeleton [6,7]. This triggers various biochemical processes which support the body's intrinsic healing mechanism. This phenomenon is particularly evident in orthopaedic applications, for instance. Focusing of shock waves allows the desired effect to be confined to the target area, so that side effects outside the treatment zone can be reduced or even avoided.

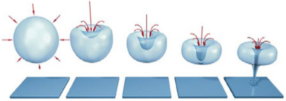
Shock wave focusing enables targeted treatment of a confined area

TYPICAL FIELDS OF APPLICATION OF SHOCK WAVES IN MEDICINE AND RELATIVE ENERGY LEVELS | *Fig. 1.1-8*



Indirect effect – cavitation > In addition to the direct dynamic effect of shock waves on interfaces, a phenomenon referred to as cavitation [8] occurs in specific media such as water and, to a certain extent, tissue. The microjets formed by the collapse of cavitation bubbles [9] (Fig. 1.1-9) contain a high amount of energy and penetration power, so that they not only erode the hard interfaces of stones but can also penetrate the walls of small vessels. This causes micro-bleeding or membrane perforation. Cavitation is not limited to the focal zone, but it is especially pronounced there.

MICROJET FORMATION BY CAVITATION BUBBLE COLLAPSE | *Fig. 1.1-9*

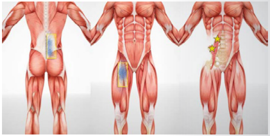


Targeted application of focused shock waves > The targeted application of shock waves requires that the focal zone of the shock wave system be directed at the treatment area within the body. When treating calculi (lithotripsy), bones and specific tissue structures, X-ray or ultrasound systems can be used for this purpose. In pain therapy, effective communication with the patient is necessary to identify the point of maximum pain. This biofeedback method allows many superficial and deep treatment points to be localised.

Attention > Any risk of injury to the intestines must be strictly avoided. Radial shock waves must not be applied to the iliac crest.
Pain referral pattern (Fig. 4.6-7) > In dorsal direction to the iliosacral joint, gluteal region and lumbar paravertebral region; in ventral direction to the inguinal region, ventral thigh region and adductors
Differential diagnosis > Lumbar root irritation, local bone diseases of the spine, sacroiliitis, vertebral blockage, hip joint disorders, inguinal hernia, diseases of abdominal organs and kidneys

Fig. 4.6-6
Iliacus muscle: treatment with radial shock waves; application direction towards the wing of ilium; laterally to abdominal soft tissue

Fig. 4.6-7
ESW-induced pain referral from the iliopsoas muscle (iliacus muscle located laterally in the wing of ilium; paravertebral psoas muscle): mostly in dorsal direction to the iliosacral joint, gluteal region and lumbar paravertebral region; additional pain referral in ventral direction to the inguinal region, ventral thigh region and adductors



Dorsal and ventral pain, primarily in vertical direction

PSOAS MUSCLE

The psoas muscle is a hidden paravertebral muscle (Fig. 4.6-9) which causes dorsal and ventral pain symptoms. It is generally affected along with the iliacus muscle. Treatment of the psoas muscle must be performed by experienced therapists only!

Location of trigger points > In the paravertebral region along the entire muscle
Type of shock wave used > Radial; no focused shock waves to be used!
Patient positioning > In supine position with slightly bent hip
Treatment technique (Fig. 4.6-8) > Transabdominal shock wave application from the ventrolateral side to the paravertebral region in the direction of the palpable muscle belly. Local treatment with stamping technique, no sliding technique to be used.

No use of focused shock waves to avoid risk of haemorrhage

Shock transmitter r-ESWT:	20 mm, 15 mm
Pressure r-ESWT:	2.6 - 5.0 bar
Number of shock waves for large-area r-ESWT:	1,000 - 1,500

Attention > Risk of ureter bleeding! Do not direct shock waves at the bladder. Extreme caution is advised when treatment is performed on the left side in the presence of aortic calcifications
Pain referral pattern (Fig. 4.6-7) > To the lumbar paravertebral region in vertical direction and ventrally to the inguinal region and the ventral aspect of the thigh
Differential diagnosis > Lumbar root irritation, local bone diseases of the spine, vertebral blockage, sacroiliitis, hip joint disorders, inguinal hernia, diseases of abdominal and intrapelvic organs and kidneys

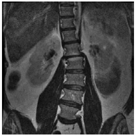


Fig. 4.6-8 (left)
Psoas muscle: treatment with radial shock waves, deep shock transmitter coupling by compression

Fig. 4.6-9 (right)
Psoas muscle MRI: directly beside the vertical column (paravertebral location)