Shock wave therapy against piriformis syndrome

The application of shock waves to trigger points (TrPs) is a new therapy procedure that seems to outperform other known treatment options with regard to precision and effectiveness. Focused shock waves in particular enable reliable trigger point diagnosis by triggering referred pain. Dr. med. Danilo Jankovic, Head of the Regional Pain Centre in Hürth/Cologne, Germany, reports about the results he has obtained in the treatment of trigger points in the piriformis muscle.

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The activation of trigger points in the piriformis muscle ("double devil") and in other five small external rotator muscles (superior gemellus, internal obturator, inferior gemellus, external obturator and quadratus femoris muscles) and the resulting irritation of adjacent nerves cause pain with a characteristic radiation pattern [28]. The name of the piriformis muscle is derived from the Latin "pirum" (pear) and "forma" (shape). It was coined by Adrian Spigelius, a late 16th and early 17th century Belgian anatomist.

Anatomy

The piriformis muscle is a thick, fleshy muscle that originates in the pelvis from the anterior sacrum between the sacral pelvic foramina 1-4 and passes through the greater sciatic foramen to insert on the upper edge of the greater trochanter (Fig. 1). The rigid aperture of the greater sciatic foramen is bounded as follows: anteriorly and superiorly by the iliac bone, posteriorly by the sacrotuberous ligament and inferiorly by the sacrospinous ligament. The piriformis muscle acts as external rotator of the thigh and assists in thigh abduction. Innervation of the piriformis muscle is generally from the first and second sacral nerves. The nervous structures in the greater sciatic foramen include the following: superior gluteal nerve, sciatic nerve, pudendal nerve with pudendal vessels, inferior gluteal nerve and posterior femoral cutaneous nerve (Fig. 2). These nerves jointly determine the sensitivity and function of all gluteal muscles as well as the sensory and motor functions in the perineum and in the posterior thigh and calf. Major blood vessels in this region are the superior and inferior gluteal arteries.

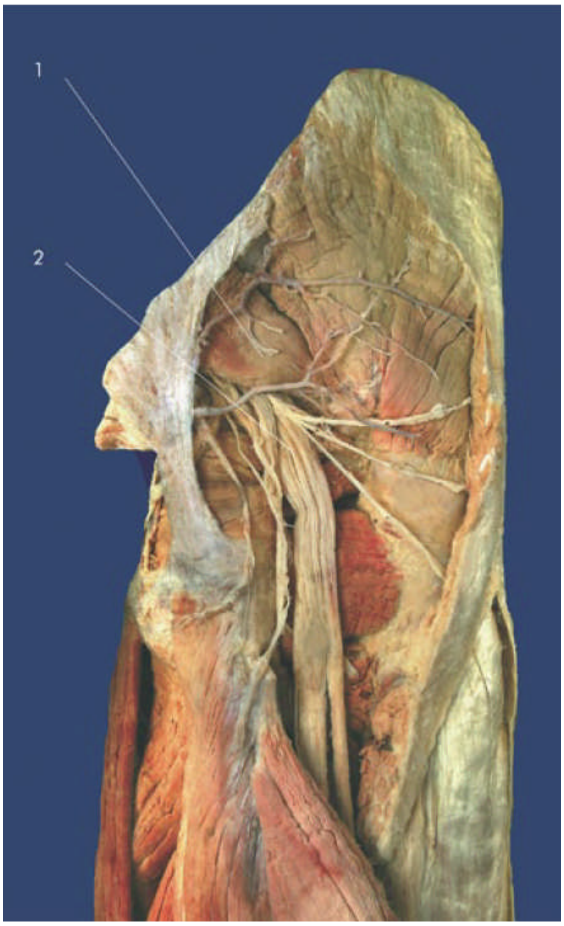

Fig. 1: Anatomic preparation. (1) Piriformis muscle, (2) Sciatic nerve. Most frequent passage; all nerve fibres in front of the piriformis muscle arise between the muscle and the edge of the greater sciatic foramen (reflecting the passage found in 85% of all autopsies).

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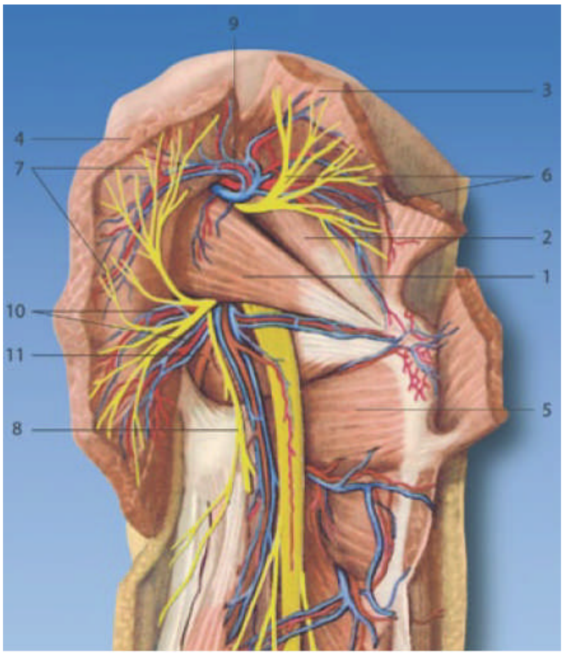

Fig. 2: Anatomy. (1) Piriformis muscle and adjacent muscles, nerves and vessels, (2) Gluteus minimus muscle, (3) Gluteus medius muscle, (4) Gluteus maximus muscle, (5) Quadratus femoris muscle, (6) Superior gluteal nerve, (7) Inferior gluteal nerve, (8) Posterior femoral cutaneous nerve, (9) Superior gluteal artery, (10) Inferior gluteal artery and vein, (11) Internal pudendal artery.

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Pain mechanism

In the past, numerous authors addressed the fact that piriformis muscle contracture may create a potential bottleneck for the nerves and vessels that pass through the greater sciatic foramen. Where this occurs, there is a risk of insufficient blood supply to the muscle, which may result in the accumulation of metabolic waste products which are normally eliminated by the circulating blood. This would cause myofascial referred pain and, in many cases, sacroiliac joint blockage. This syndrome is frequently associated with severe pain. Its development is determined by the following three components:

- Myofascial referred pain, mostly in the deep gluteal region, with pain radiation to the posterior thigh up to the popliteal cavity. Pressure exerted on the sciatic nerve or posterior femoral cutaneous nerve in the greater sciatic foramen may be an additional cause of pain in the posterior thigh (Fig. 2) [28].
- Bottlenecks for nerves and vessels.
- Sacroiliac joint blockage caused by functional disorders within the joint.

Symptoms

Trigger points in the piriformis muscle contribute significantly to complex myofascial pain syndromes in the pelvic and hip region. In many cases, the piriformis syndrome is characterised by bizarre symptoms that may seem unrelated at first sight [24, 28]. Patients complain about pain (and paraesthesia) in the low back, perineum, feet, buttocks, hip, posterior femoral and crural regions, rectum (during bowel movement) and in the coccygeal region. Some authors suspect that piriformis muscle contracture may be the often unidentified cause of coccygodynia [7, 27]. Edwards describes this syndrome as "neuritis of branches of the sciatic nerve" [24, 28].

Te Poorten suggests that the peroneal nerve may be involved in the syndrome [24]. Swelling in the affected leg and sexual disorders (dyspareunia in women and potency disorders in men) are often concomitant with the syndrome.

The activation and stimulation of trigger points in the piriformis muscle may be caused by the following factors: severe strain, trauma, prolonged muscle immobilisation, long journeys, chronic infections (pelvic region, infectious sacroiliitis, coxarthritis), Morton's neuroma, corporeal asymmetry [28], vascular compression of the sciatic nerve by varicosis of the gluteal veins and others [2].

In terms of differential diagnostics, the following disorders must be considered: postlaminectomy syndrome, disk prolapse, coccygodynia, facet syndrome, spinal stenosis (bilateral pain), sacroiliitis, malignant neoplasms, local infections and others.

Therapy

Treatment of the piriformis syndrome comprises the following procedures:

- Therapeutic injections with local anaesthetics and corticosteroids [8, 11, 12, 14, 23]
- Injection of botulinus toxin [32]
- Osteopathic manipulations [23, 24]
- Intermittent cooling and stretching [28]
- Corrective measures [23, 24, 28]
- Autostretching [28]
- Transrectal or transvaginal muscle massage [27]
- Surgical decompression [2]

Focused shock wave therapy

Focused shock waves have been used with great success in the treatment of typical orthopaedic disorders [6] for about 15 years. Indications include calcified tendinitis [18], radiohumeral and ulnohumeral epicondylopathy, heel spur [9], pseudarthrosis [29] and muscular trigger points. Extracorporeal shock wave therapy (ESWT) was developed 30 years ago for urological applications and is still used for the non-invasive fragmentation of kidney stones. About 10 years ago, the therapy procedure was extended to include radial pressure waves, which provide similarly positive results in many indications. Recently, extracorporeal and mostly planar shock waves have also been used in dermatology. Wound healing disorders as in crural ulcers, burns or diabetic leg ulcers can now be treated with shock waves with remarkable success [15, 20, 25]. One generally distinguishes between focused shock waves and radial pressure waves [30]. Shock waves are characterised by high pressure amplitudes (approx. 1000 bar), short pulse lengths of about 300 ns and extremely short pulse rise times of about 10 ns (Fig. 3).

Treatment with focused shock waves is referred to as ESWT (extracorporeal shock wave therapy). Radial pressure waves are much slower (factor 1000), and their pulse amplitude is generally as low as 10 to 100 bar.

Despite these differences, radial pressure waves have similar physiological effects in the treatment of many conditions as shock waves. This is presumably due to the typical pulsatile and asymmetric pressure profile. Although different from shock waves [3], treatment with radial pressure waves is referred to as RSWT (radial shock wave therapy). The acronym EPAT (extracorporeal pulse activation therapy), which has been increasingly used recently, seems to describe the principle much better [22]. Although its biological mechanisms of action are not yet fully known, shock wave therapy has been used with great success to improve perfusion and metabolic activity. It stimulates biological processes which eventually lead to permanent healing.

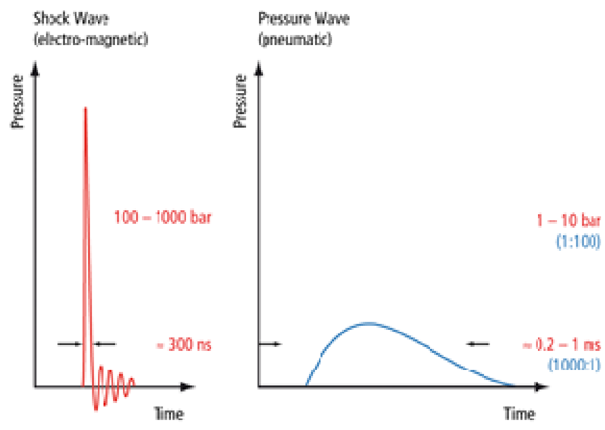

Fig. 3: Typical pressure profile of shock and pressure waves

Model according to Wess, 2005/Storz Medical AG

Mechanisms of action

The mechanisms of action that are known to provide the positive wound healing results we have observed include the following effects:

- Immediate increase in blood flow: when using focused shock waves in particular, this is not attributable to the pulse-massage effect of the shock transmitter vibrations, but to the documented release of nitrogen oxide (ENOS; endothelial nitric oxide synthase) [19]. Nitrogen oxide causes biochemical vasodilation and is a highly versatile messenger substance that is involved in the production of additional tissue factors.
- Increase in cell membrane permeability [5] and, consequently, general improvement of metabolic activity.
- Release of numerous tissue factors among which the VEGF (vascular endothelial growth factor) is of crucial importance in wound healing processes as it promotes neovascularisation [10].
- An additional key effect is the proliferation and differentiation of stem cells which lead to the formation of new healthy tissue without scarring [4, 15].

Fig. 4: Treatment position (Sims position)
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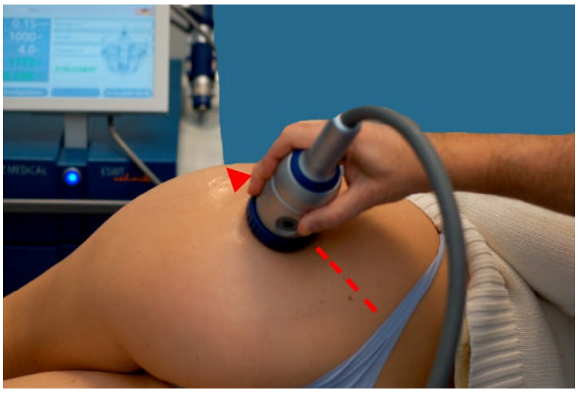

Fig. 5: Treatment with focused shock waves
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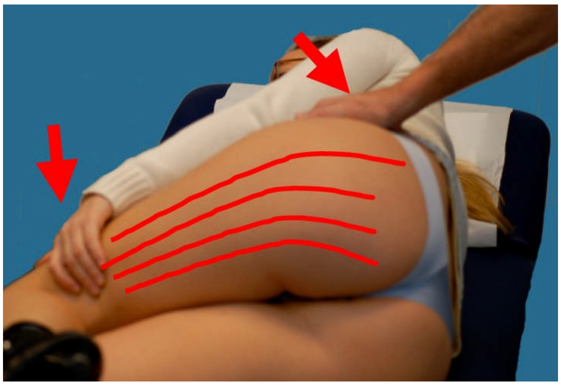

Fig. 6: Muscle smoothing after shock wave treatment – with radial pressure waves or with V-ACTOR® shock wave vibrations (equivalent to stretch and spray technique) [28]
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Treatment

Focused shock waves are used for diagnostic and therapeutic purposes: for the precise localisation of trigger points on the one hand – because the characteristic referred pain can be induced much more accurately than by manual examination – and for the local treatment of individual trigger points on the other hand. Patients are positioned on their side in such a way that the leg to be treated is the upper leg (Sims position, Fig. 4). The upper leg is flexed at the hip and knee; the upper knee lies on the table. The lower leg is stretched [14]. The so-called "piriformis line" is localised (line connecting the greater trochanter with the posterior superior iliac spine and/or sacral hiatus (Fig. 4) [14, 28]. The target areas to which focused shock waves are applied (therapeutic effectiveness up to 125 mm) are the following:

- along the so-called "piriformis line" (Fig. 5),
- iliosacral joint,
- greater trochanter region.

For most patients, an energy flux density of between 0.07 and 0.25 (0.30) mJ/mm² is used at a pulse frequency of 4 Hz. About 3000 shock waves are applied per therapy session. Therapists should make sure that the pain caused by shock waves is well tolerated by the patient. Muscle smoothing after completion of shock wave application is done with the V-ACTOR® (vibration therapy) or with radial pressure waves (approx. 3000 pulses, equivalent to the stretch and spray technique) [28] (Fig. 6).

Recommended treatment frequency: the first three therapy sessions take place at intervals of about seven to ten days. Additional treatments are conducted at intervals of two to three weeks. In general, four to eight therapy sessions are necessary to achieve substantial pain relief. Experience has shown that in most cases the energy level can be increased from session to session because the pain caused by shock wave application decreases gradually if the therapy progresses as expected.

Important factors to consider during treatment

The "piriformis syndrome" hardly ever manifests itself as a pain syndrome that affects only a single muscle. The posterior portion of the gluteus minimus muscle (so-called "pseudo-sciatica" muscle) is almost parallel to the piriformis and inserts directly beside the point of attachment of the piriformis muscle (Fig. 2) [14, 28]. The referred pain of trigger points in the anterior portion of the gluteus minimus muscle spreads over the inferior lateral gluteal region and the outer side of the thigh down to the knee, lower leg and ankle. The trigger points in the posterior portion of the gluteus minimus muscle are characterised by a similar but more posteriorly located pattern which refers pain via the inferior medial gluteal region and the posterior thigh to the calf [28].

The three trigger point areas of the gluteus medius muscle (so-called "lumbago muscle") jointly refer pain and sensitivity primarily along the posterior iliac crest to the sacrum and to the posterior and lateral buttock area and may even reach the upper thigh region [28]. Adjacent to the lower edge of the piriformis muscle are three muscles of the external rotator group: the gemelli muscles and the internal obturator muscle. Moreover, in many cases the levator ani muscle and coccygeus muscle are affected along with the piriformis muscle.

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References available from the author

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