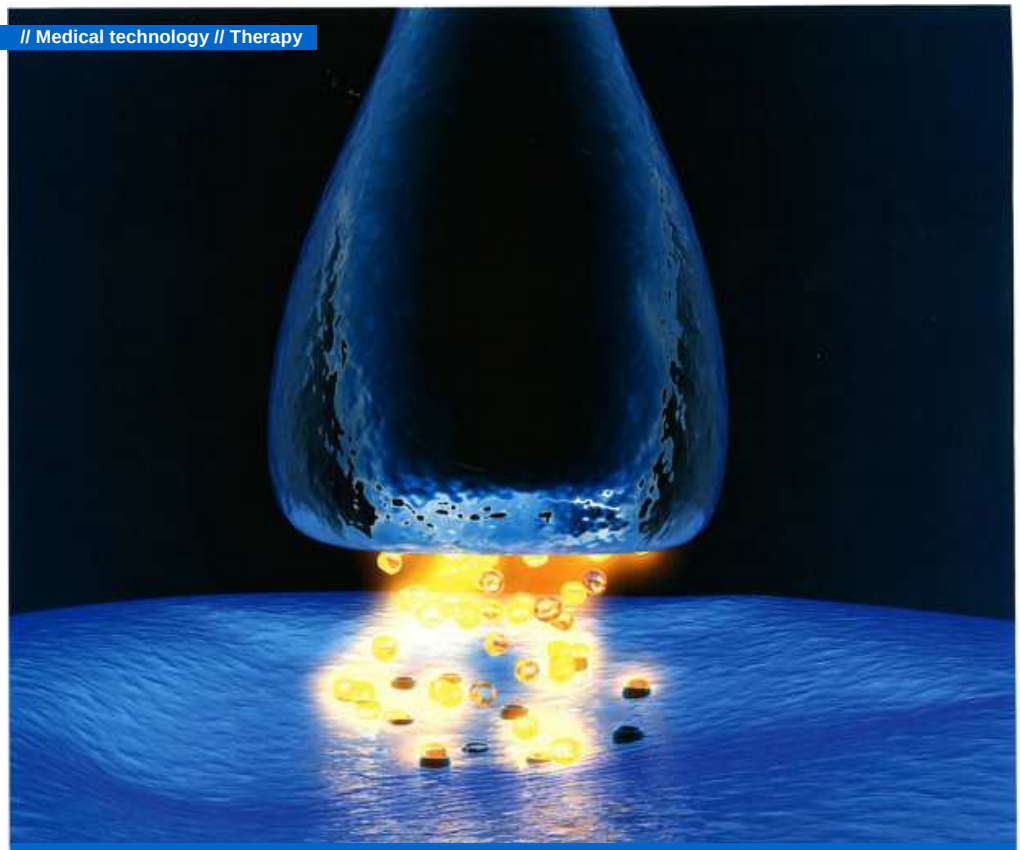

Shock wave therapy

Applications in top-class sports

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Technological progress in extracorporeal shock wave therapy during the last few years has significantly enhanced treatment options for top-class athletes. As early as in 2008, a field report by Professor Lohrer on the use of shock wave therapy at the Frankfurt Olympic Training Centre was published in this journal (medicalsports network 03.08). The report also covered the use of shock waves in the treatment of athletes during Olympic competitions such as the Sydney Olympic Games.

Shock wave therapy was first used in the 1980s for contactless fragmentation of kidney stones. In the 1990s, orthopaedists started to incorporate this therapy modality into their practice, initially for the treatment of bone non-union or delayed union and tendon problems.

Radial and focused shock wave therapy
Shock waves are high-energy sound waves created when jet fighters break the sound barrier, for instance. In physical terms, one speaks of a shock wave when the pressure changes abruptly within an extremely short distance (less than one forth of the pulse length). Typical features of shock waves are:

// steep pressure rise within 10 ns and at ambient pressure up to 100 MPa;
// followed by a negative pressure tensile wave component up to 10 MPa.

The following shock wave therapy modalities should be distinguished because they differ in their effectiveness, in the equipment costs and with respect to their classification in the medical fee schedule:

// radial shock wave therapy;
// focused shock wave therapy.

Radial shock wave therapy – pressure waves
Radial shock waves are produced mechanically by means of compressed air. Using a pistol-shaped handpiece, a projectile is accelerated to a speed of several metres per second until it strikes an impact body. The projectile transmits its kinetic energy to the impact body which then passes it on to the coupled tissue. The energy produced with this ballistic method of pressure wave generation is not equivalent to the energy level and physical characteristics of focused shock waves.

Focused shock wave therapy
Contrary to radial pressure wave generation, focused shock wave systems use electrohydraulic, piezoelectric or electromagnetic generators to produce the shock waves. The energy flux density of focused shock waves is ten times higher than that of radial shock waves, which means that a significantly higher amount of energy can be applied to the tissue.

Shock wave therapy of tendon injuries
The US Food and Drug Administration approved shock wave therapy for the treatment of plantar fasciitis and lateral epicondylitis in 2000 and 2002,

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Fig. 1: Focused shock wave therapy for piriformis syndrome treatment

respectively. In the treatment of calcific supraspinatus tendinopathy, shock wave therapy with 0.2 mJ/mm² is more effective than the 0.1 mJ/mm² energy flux density used in a randomized controlled design. In the management of Achilles tendon problems, three treatments with focused shock waves can significantly reduce pain and improve function scores. This is confirmed by other studies conducted on 105 patients with Achilles tendon problems who received 3 to 5 treatment sessions with energy flux densities of up to 0.4 mJ/mm² and 1500 – 2000 shocks per session. In the treatment of Achilles tendon disorders, shock wave therapy is able to provide sustained pain relief after an average of four treatments. This can also be confirmed in a randomized controlled study design.

Shock wave therapy in the treatment of bone bruises and stress fractures

Stress reactions of the bone or even stress fractures involving cortical interruption increase as a result of overuse when athletes prepare for the new season. Bone bruises, too, cause MRI signal alteration and present a therapeutic challenge. Being a non-invasive treatment modality, shock wave therapy offers interesting opportunities in the management of stress reactions, stress fractures and bone bruises. In fact, in a case series of ten athletes with metatarsal or tibial stress fractures three to four treatments with low- to medium-energy shock waves resulted in rapid healing, enabling the athletes to resume sports.

Shock wave therapy in the treatment of bone necrosis

In the treatment of aseptic bone necrosis of the femoral head, shock wave therapy with 2400 shocks per session at an energy flux density of 0.5 mJ/mm² is able to halt the progression of the disease after four treatment sessions, especially when performed in the early and intermediate stages of the pathology (ARCO stages I and II). Shock wave therapy obviously stimulates NO and other pro-angiogenic and pro-osteogenic mediators. In a direct comparison between hip endoprosthesis implantation and shock wave therapy, 13 out of 17 patients considered shock wave treatment to be better than total hip replacement surgery in cases of bilateral femoral head necrosis. The remaining four patients considered both methods to be comparable.

Pseudarthrosis, shin splints and Osgood-Schlatter syndrome

In animal experiments, shock wave therapy has shown to induce bone reformation. Especially the periosteal cells seem to be responsible for orthotopic bone regeneration by shock wave therapy. In a cohort study, low-energy radial shock wave therapy of 47 patients with medial shin splints provided better pain reduction and a higher rate of resumption of sports than in the control group. Shock wave therapy shortens the duration of symptoms in patients suffering from medial tibial pain. The skeleton of adolescent football players and jumpers is frequently affected by an ossification disorder manifesting as Osgood-Schlatter syndrome at the tibial ossification centre of the patellar tendon. In 14 young athletes with a mean age of 14 years, radial shock wave therapy resulted in a significant improvement in pain symptoms and subjective knee function.

Conclusion

In the treatment of a number of tendon and bone diseases, shock wave therapy is able to accelerate the healing process, thus enabling athletes to resume sports. A potential effect on stem cell response cannot be excluded.

A list of references can be obtained from the author.

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