

Keynote: ESWT: from carpal tunnel syndrome to the brain

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The by far most frequent compressive neuropathy is carpal tunnel syndrome, where the median nerve is entrapped beneath the nine flexor tendons. As early as 2011 Pietro Romeo and colleagues have shown that among patients with failed surgical carpal tunnel release, focused electromagnetic nano-energetic ESWT ($0.03\text{mJ}/\text{mm}^2$, 3000 shots, three sessions) could substantially reduce pain from VAS 6.2 to 2.5 at 6 weeks and to 0.44 at 120 days, which has been reproduced in RCTs in 2019 by Haghighat and in 2021 by Turgut published in the Korean J Pain. A meta-analysis from 2020 by Li et al. showed ESWT being superior to local corticosteroid injection in carpal tunnel syndrome with VAS and Boston Carpal Tunnel Questionnaire (BCTQ) in favour of ESWT. By now, more than 10 RCTs have been published for both, radial pressure wave and focused shockwave therapy in CTS. In my clinical practice combined radial and focused ESWT is the first therapeutic option to offer in CTS in a step-wise approach followed by ultrasound-guided hydrodissection or, if failed, mini-open surgery.

Morton's neuroma of the intermetatarsal nerve can be described as a compressive neuropathy with entrapment under the deep transverse intermetatarsal ligament. By now two studies have been applied focused ESWT starting in 2009 with Weil Jr. and colleagues with a single focused electrohydraulic ESWT session in general anesthesia with a pain reduction from VAS 7.2 to 2.5 in a RCT. Korean colleagues in 2016 applied three sessions of piezoelectric ESWT ($0.12\text{-}0.24\text{mJ}/\text{mm}^2$, 1000 shots from plantar) with a pain reduction from VAS 6.4 to 3.6 at four weeks.

From the peripheral nerves to the central nervous system, spinal cord injury (SCI) is of distinct interest not only after trauma but also in aortic surgery of the descending aorta. Experimental-wise several publications are reporting beneficial results of ESWT especially when applied within 72h after paraplegia. Based on the encouraging experimental results in SCI, a multi-center RCT has started in Aug 2019 in Austria and Berlin, Germany to evaluate the effect of electrohydraulic ESWT ($0.15\text{-}0.23\text{mJ}/\text{mm}^2$, 3-5Hz, 6000 shots) in acute traumatic spinal cord injury on motor and sensory function within 6 months post-injury (Leister I et al., 2022).

The German Henning Lohse-Busch, who for the first reported nano-energetic focused electromagnetic ESWT ($0.01\text{-}0.024\text{mJ}/\text{mm}^2$) in children with cerebral palsy as early as 1996 has set the stage for currently more than 40 original papers verifying the beneficial effects of radial pressure waves and focused ESWT in spasticity, both among children and adults.

The same Lohse-Busch started in 2004 to apply focused electromagnetic ESWT in unresponsive wakefulness coma patients, followed by ataxia and athetosis in 2005 and Alzheimer disease in 2014. In 2018 CE-approval was granted for the Neurolith^(c), a focused electromagnetic ESWT device with MRI-based-navigation in real time. Prof. Beisteiner and Dr. Lohse-Busch have published an early observation of so-called transcranial pulse stimulation (TPS) in Advanced Science in 2019, where 6 TPS sessions in two weeks ($0.25\text{mJ}/\text{mm}^2$, 6000 shots per session) were applied with beneficial and clinically relevant effects on the CERAD score. As of now, TPS is evaluated besides Alzheimer's disease for Parkinson's disease, depression and attention-deficit syndromes.