27th World Congress
ISMST 2025
Bogotá

ISMST25-0026

Guidelines for RPW transmitter selection

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Introduction
Radial Shockwaves Treatment (RSWT), or Radial Pressure Waves Treatment (RPWT) respectively is well established for the treatment of chronic pain, especially for tendinopathies. Radial pressure waves are typically generated pneumatically. Compressed air driven projectile hits a stationary transmitter and generates internal and external vibrations which propagate radially into the tissue. The type of resulting tissue stimulation depends on the physical properties of the transmitter.

Material & Methods
The internal and external transmitter vibrations have been investigated using pressure measurements with hydrophone and LRT (Light Refractive Tomography), transmitter speed and displacement with LRF (Laser Range Finder), force transducer, and BOS (Background Oriented Schlieren). For the establishment of the selection guidelines a representative collection of typical transducers, assembling the important physical properties has been selected: steel transmitter (R15), titanium transmitter (DI15), ceramic transmitter (C15) and steel transmitter (D20-S) with larger diameter and softer suspension.

Results
RPW transmitters generate two types of vibrations. High frequency (HF) pressure waves are internal longitudinal vibration in the range of 50-200kHz, low frequency (LF) pressure waves are external, microscopic longitudinal vibrations in the range of 100Hz-10kHz. They are accompanied by transversal vibrations (shear or elastic waves). HF vibrations have low penetration depths of 5-10mm. The intensity and frequency depend mainly on the elasticity of the material used. Further on length and diameter. LF vibrations have larger penetration depths, the longitudinal component 10-20mm and the transversal ones up 100mm. Their intensity depends mainly on mass and the elasticity of the suspension.

Discussion
Despite the long-term experience with RPW there is no consensus with respect to the best parameter for describing its healing power. The intensity is usually specified by the projectile driving pressure. This is not a parameter describing the intensity, or efficacy within the tissue. Therefore, the quantification of the HF vibrations intensity is better expressed by EFD (Energy Flux Density). In the case of LF vibrations, pulse energy is the choice. A transmitter generates, depending on its physical parameters, a combination of HF and LF vibrations. For the optimal selection, the knowledge of the differences of the biological mode of action of the HF and LF vibrations would be crucial.

References
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