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Visualize the invisible: Redefining shockwave therapy training by merging computational physics and virtual reality in a comprehensive education platform

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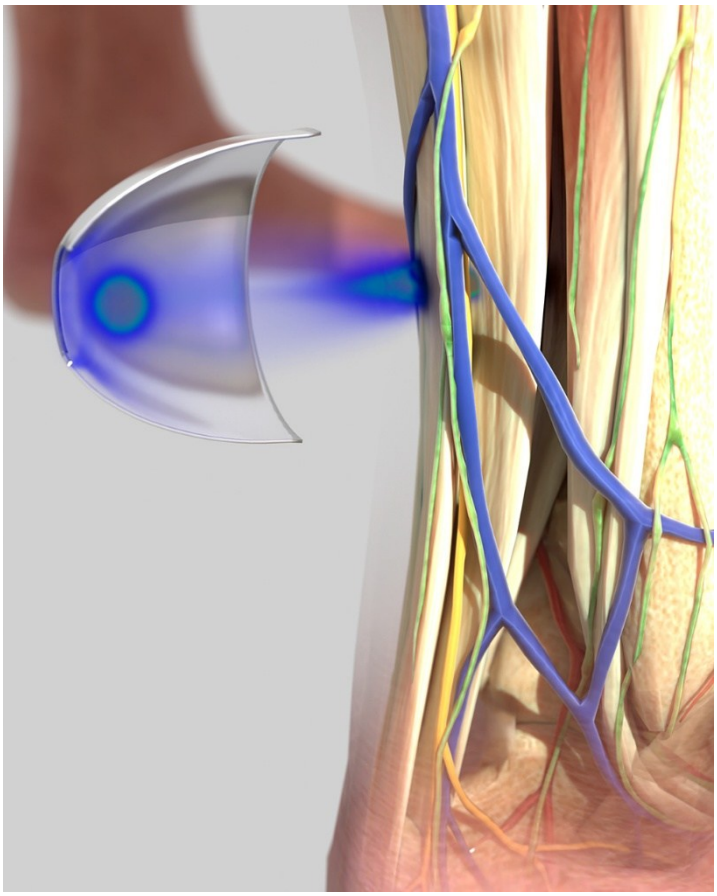
Introduction
Extracorporeal Shockwave Therapy (ESWT) has established itself as a viable non-invasive treatment modality for many musculoskeletal and other constantly expanding indications. Despite its growing adoption, one of the core limitations remains the invisibility of the treatment's acoustic field, and limited training capabilities for the ever increasing international user base. This can significantly impede therapy outcomes or even lead to adverse effects, especially when sensitive tissues are affected.

Material & Methods
In an interdisciplinary effort of ESWT researchers, computational physicists, Virtual Reality (VR) developer, and didactic experts we developed a custom tailored training and visualization platform based on VR and Augmented Reality (AR) technologies for shockwave treatments. The platform leverages high-precision computational patient and device models to simulate acoustic shockwaves and magnetic treatment fields in full 3D. These models allow for real-time visualization of treatments and energy distribution across different clinical scenarios in a fully interactive online experience including multiuser support to deliver a truly international, user centered approach. All of this is facilitated by an easily accessible online learning platform which provides effective, state of the art training to a broad audience in a convenient way.

Results
The developed system successfully integrates interactive VR/AR modules into an online practitioner education program. Computational simulations accurately represent the variable ESWT field geometries and intensities in 3 dimensions and in true sizes. Collaborating with the International Society for Medical Shockwave Treatment (ISMST), the platform ensures alignment with the latest clinical standards and educational guidelines.

Sample of a shockwave treatment simulation in full 3D:



Discussion
This novel platform addresses a critical gap in ESWT application and education by making the acoustic treatment fields visible and understandable through immersive and interactive simulation. It provides convenient online education for international practitioners on the one hand, as well as an interactive VR environment to refine application techniques for early adopters and ESWT specialists on the other. Ultimately, the platform promises better training outcomes, fosters safer and more effective treatments, as well as a continually well-informed ESWT community.