

Pulse Wave focused ESWT employs an **electromagnetic impulse generator** (coil-membrane system with stepped parabolic reflector) to produce true focused shockwaves. A high-voltage pulse drives the membrane, generating a pressure wave that steepens into a shock front only at the focal zone.

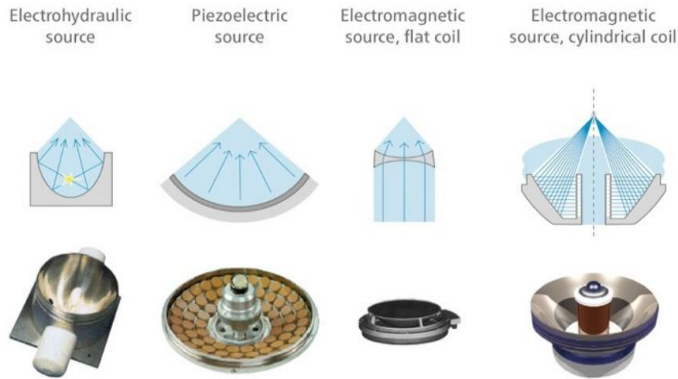
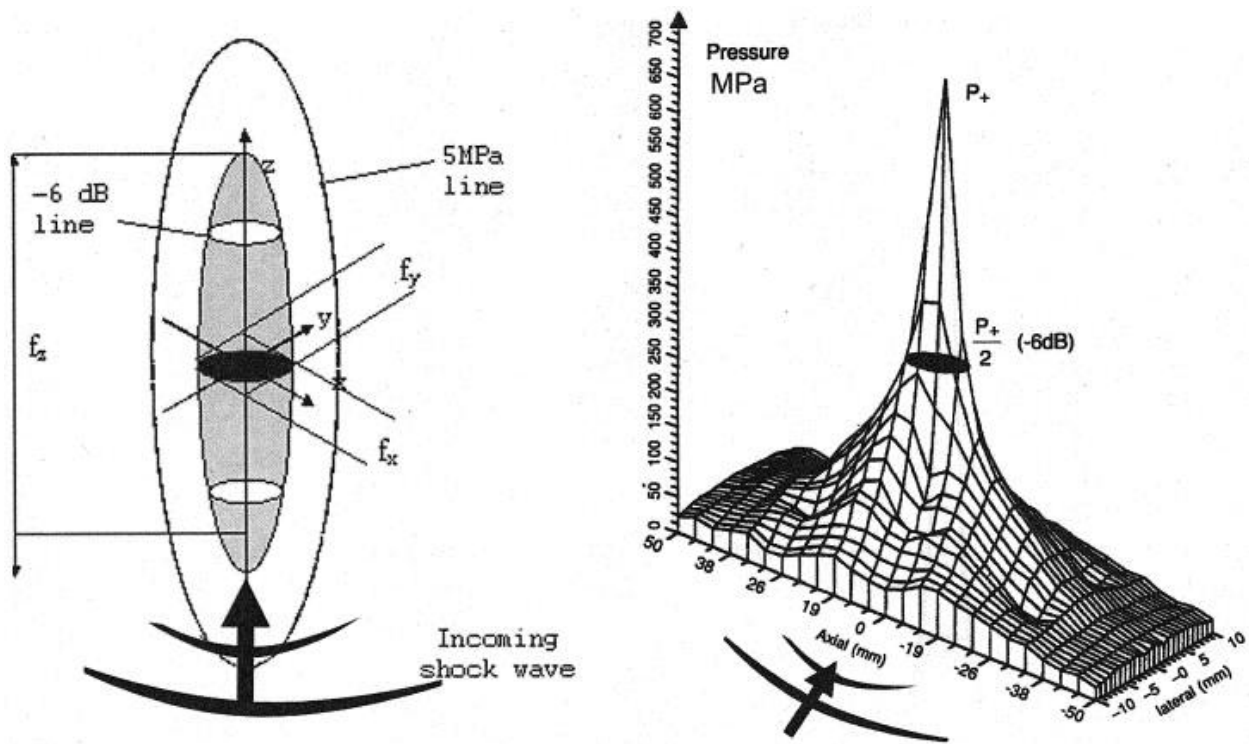
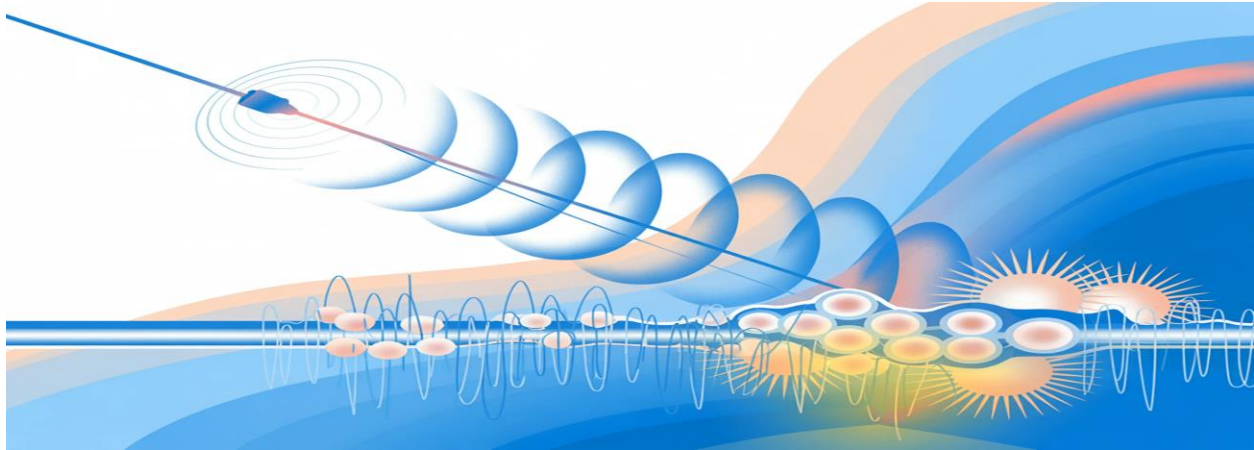


Fig. 4: Shock wave sources used in medicine⁷

storzmedical.com

shockwavetherapy.org





Microporation physics: At the focus, the nanosecond-rise-time pressure pulse (10–100 MPa) creates cavitation—microbubbles expand and implode within microseconds. The resulting microjets and shear forces transiently open nanopores in cell membranes (reversible poration lasting seconds to minutes), allowing influx of ions, proteins, and signaling molecules without permanent damage.

EFFECTS: Focused extracorporeal shockwave therapy (fESWT) delivers high-energy acoustic pulses—about zero point one to zero point four millijoules per square millimeter—into targeted tissue, creating brief, intense mechanical stress.

This triggers mechanotransduction: cells sense the pressure wave via integrins and cytoskeletal tension, converting it into biochemical signals. Key pathway? ATP bursts out of stressed cells, binds purinergic P2Y receptors, then fires up ERK1/2 and p38 MAPK—driving proliferation (more S-phase entry, Ki-67 upregulation) and survival.

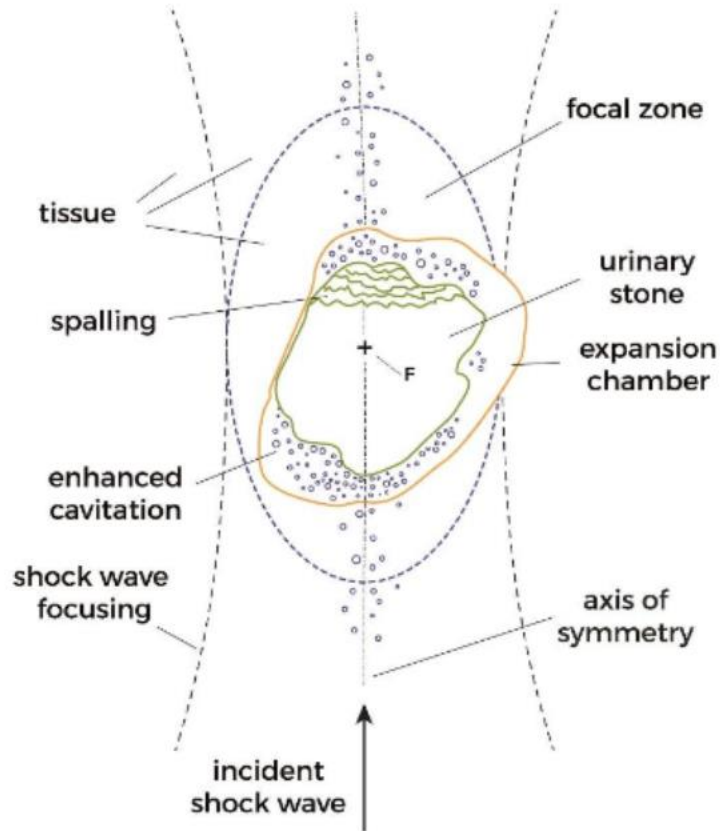
On healing: it ramps VEGF and nitric oxide, sparking angiogenesis—new vessel growth for better oxygen and nutrient delivery. TGF-beta1 and IGF-1 climb too, pushing fibroblasts to crank out collagen I/III and remodel extracellular matrix.

Inflammation drops—lower MMPs, cytokines, substance P—while M2 macrophages rise, shifting repair from chronic to regenerative.

Stem cells (mesenchymal) get nudged: proliferation, differentiation, homing to injury sites. Result? Accelerated tendon-bone healing, wound closure, less fibrosis.

Bottom line: mechanical jolt → ATP-ERK cascade → growth factors + anti-inflammatory shift → faster, stronger tissue repair. No magic—just physics meeting biology.

Expansion chamber and spalling during ESWL



esmed.org

Shock Waves vs. Radial Pressure Waves in Medicine - European Society of Medicine

Downstream effects: Poration triggers mechanotransduction— Ca^{2+} influx activates MAPK/PI3K/Akt pathways, upregulating VEGF, proliferation, migration, and anti-apoptotic signals. Physiologically, this drives angiogenesis, stem-cell recruitment, reduced inflammation, and accelerated tissue repair.