

Shock and Pressure Waves - Magic Tools in Medicine

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Twenty-five years ago extracorporeally generated shock waves revolutionized urological stone therapy. Ten years later healing effects of shock waves were recognized and musculoskeletal indications became an important field of shock wave application. Recently pneumatically generated pressure waves were successfully applied to various maladies such as plantar fasciitis and achillodynia. Although the characteristics of pressure waves and their mechanism of generation significantly differ from shock waves, medical effects seem to be similar at least for superficial applications.

Shock waves are characterized by high peak pressure ($\sim 10\text{-}100$ MPa), short rise time ($t_r \sim 10$ ns) and low tensile wave components. The mechanism of generation requires supersonic processes like explosions (> 1500 m/s in water) or steep increases propagated by non-linear waves. Due to the short pulse duration ($t_d < 1$ μs) shock waves may be focused to small areas (< 10 mm). Shock waves are generated by electro-hydraulic, piezoelectric or electromagnetic principles. Pressure waves are often generated by low velocity impact of masses ($v \sim 1$ m/s) and feature lower peak pressure ($\sim 0\text{-}10$ MPa), longer rise times ($t_r \sim 500$ ns) and longer pulse duration ($t_d \sim 200\text{-}2000$ μs). Contrary to the above mentioned shock waves, focussing of this type of pressure waves to small treatment areas is not possible. Present pressure wave devices utilize pneumatically accelerated pistons which transmit pressure pulses by impact on a bounce plate in close contact with the skin surface. Important parameters to characterize shock and pressure waves are peak pressure (positive and negative), energy and energy flux density. In the case of shock waves, focal size defined as -6dB isobar-lines and 5 MPa isobar-lines is used to describe the dimensions of the treatment area. The technical differences result in diverse device concepts with or without localization modalities.