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Applications of Shock Wave Research to Developments of Therapeutic Devices.

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Underwater shock wave research applied to medicine started in 1980 by exploding micro lead azide pellets in water. Collaboration with urologists in the School of Medicine, Tohoku University at the same time was directed to disintegration of kidney stones by controlling shock waves. We initially proposed a miniature truncated ellipsoidal cavity for generating high-pressures enough to disintegrate the stone but gave up the idea, when encountering the Dornie Systems' invention of an extracorporeal shock wave lithotripter (ESWL). Then we confirmed its effectiveness by using 10 mg silver azide pellets and constructed our own lithotripter, which was officially approved for a clinical use in 1987. Tissue damage during ESWL was attributable to bubble collapse and we convinced it could be done in a controlled fashion. In 1996, we used 160 mJ pulsed Ho:YAG laser beam focusing inside a catheter for shock generation and applied it to the revascularization of cerebral embolism, which is recently expanded to the treatment of pulmonary infarction. Micro water jets discharged in air were so effective to dissect soft tissues preserving small blood vessels. Animal experiments are successfully performed with high frequency water jets driven by an actuator-assisted micro-pump. A metal foil is deformed at high speed by a Q-switched Nd:YAG laser beam loading. We used this technique to project micro-particles or dry drugs attached on its reverse side and extended it to a laser ablation assisted dry drug delivery or DNA introductory system.