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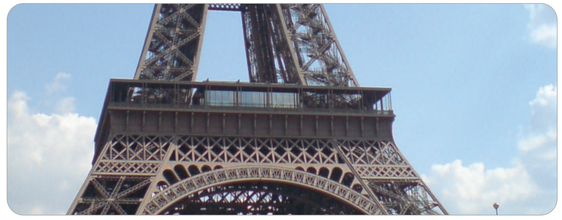

challenges in ENDOUROLOGY
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Highly Safe, Athermal Destruction of Stones in Kidney, Ureter and Bladder by Means of Ultra-Short Dual Wavelength Laser Pulses

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Introduction & Objectives

Despite the many benefits that laser lithotripters with flexible fiber probes offer to the surgeon, limitations of standard devices based on Holmium (Ho:YAG) technology can cause major negative side effects during treatment. The risk of accidental tissue perforation or coagulation by thermal laser energy is high, and the energy pulse durations of ≥ 300 µs of Ho:YAG lasers also cause thermal damage to plastic catheters, stents and dormia baskets.

Our clinical study compared the conventional Ho:YAG technology with an innovative double-frequency dual-wavelength lithotripsy laser which uses ultra-short pulses to overcome such disadvantages.

Material & Methods

This clinical trial included extended laboratory research and surgical cases of intracorporal stones (n=4) comparing the effects of different energy settings, pulse durations and types of laser radiation. Laser lithotripters used were a Ho:YAG laser (wavelength 2.100 nm, single pulse duration 350 µs), and lithotripsy laser FREDDY 400 plus (wavelengths 532 & 1.064 nm, single pulse duration 1,2 µs). In both cases, highly flexible fiber probes (core diameter of 300 µm) were used to compare various important treatment factors. Main parameters evaluated were the efficacy at stone, overall speed of treatment, potential negative side-effects at sensitive tissue or instruments and the overall handling.

Results

Although both laser systems were able to successfully disintegrate solid stone material, we found strong differences between the visible effects of the dual-wavelength FREDDY system and the Ho:YAG lithotripter. The dual-wavelength laser showed an increased ability to disintegrate stones from the inside at a faster rate, with high ultra-short energy pulses of 1,2 µs duration. The external shockwaves of the Ho:YAG had the tendency to push the targeted material away. On the other hand, the dual-wavelength laser yielded far less stone migration during operation despite emitting a more powerful kinetic energy. Furthermore, the ultra-short pulses of 1,2 µs did not cause any soft tissue damage or damage to sensitive parts such as catheters or dormia baskets.

Conclusion

Our findings highlight the advantages of ultra-short dual-wavelength lasers in countering the undesirable thermal effects on soft tissue and sensitive instruments during lithotripsy treatment. The highly promising results will be subject to further investigation in future clinical studies.

Author's Opinion

The key benefit of lithotripsy laser FREDDY 400 plus is its ability to emit a highly intense shockwave in a fraction (~1/300) of the time that a Ho:YAG laser is technically capable of. This avoids unwanted thermal effects such as perforation, coagulation or damages at instruments.

Fig. 1

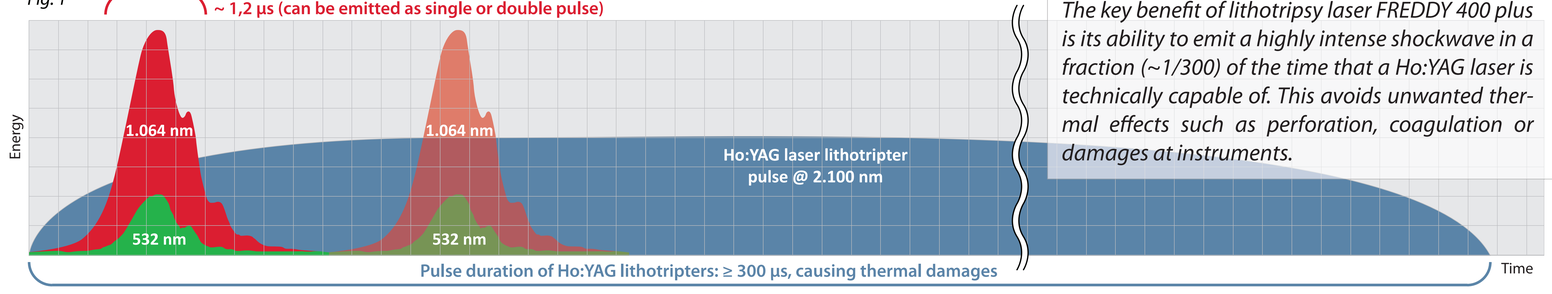


Fig. 2a

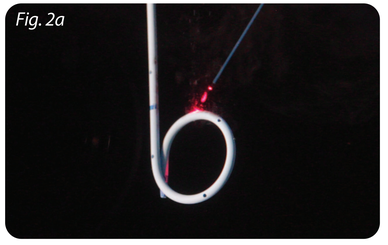


Fig. 2b

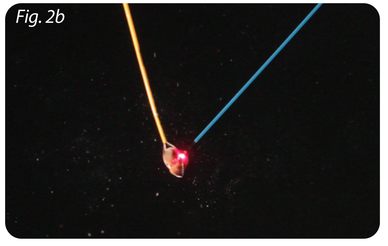


Fig. 2c

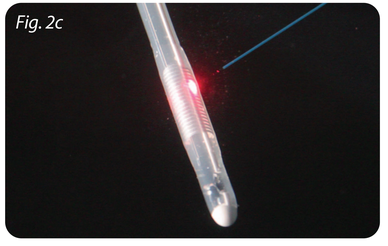


Fig. 3

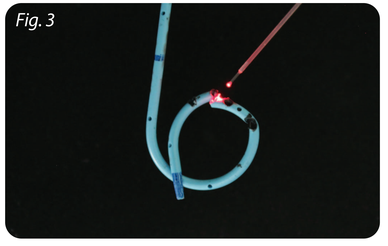
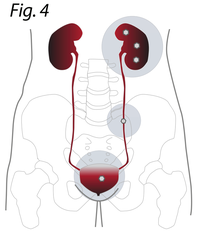


Fig. 4



We emitted energy pulses with both lasers at a range of sensitive materials such as stents, dormia baskets and catheters.

The pictures show the athermic emission of the energy pulses of the FREDDY laser (fig. 2a , 2b, 2c). The Ho:YAG laser caused strong thermal effects such as the partial perforation or even complete destruction (fig. 3).

In particular the treatment of stones in more distant, sensitive organs such as ureter or kidney (fig. 4) require a very careful therapy where negative thermal side-effects need to be avoided.

Fig. 5

Dual-wavelength lithotripsy laser FREDDY 400 plus by Limmer Laser