Treatment of urolithiasis with the FREQuency-Doubled Dual pulse Nd:YAG Laser (FREDDY-Technology): Results of 660 patients with the first and the new advanced system

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Introduction
The introduction of ESWL had opened up a new dimension in the treatment of the urolithiasis. After the initial euphoria over this new, non-invasive therapy, the focus was again cast on treatment times, especially after the continuous discussions regarding costs in the health care system and the recent introduction in Germany of new billing practices (DRGs). With multiple ESWL treatments, the onset of hydronephrosis, stone fragments remaining in the ureter following treatment (Steinstrasse), and post-operative measures such as temporary catheters, it often takes weeks until the patient is healed and able to return to work. For this reason endoscopic lithotripsy methods are gaining more and more in relevance.

With the introduction of modern laser procedures for the endoscopic treatment of stones, even large urinary calculi can now be quickly and effectively fragmented. A specially developed laser for lithotripsy, the FREDDY Laser*, avoids the risk of injury to surrounding tissue, even at maximum power.

Materials and Methods
The laser pulse, which is transferred by a thin, highly flexible glass fiber (quartz ø 280µm, outer ø 420 or 730(µm) is composed of an infrared (1064 nm) and of a green portion (532 nm), created through frequency doubling. The stone's absorption of green light (see (1) in Fig.1) creates a plasma which is enhanced by the infrared fraction (2). The plasma produces a mechanical shock wave which fragments the stone.

Results
456 of the 660 patients were treated with the U100, 204 with the advanced system U100Plus. In 77% of the U100Plus cases we used the energy setting 160mJ double pulses @ 10 Hz (= 3.2 W mean power), for the U100 the standard setting was used (=1.2 W mean power). Despite the significant higher energy application of the U100Plus, we observed no case of ureter perforation or damage to surrounding tissue.

In Fig. 5 the overall stone free rate and the need to change the therapy (ultrasound lithotripsy, endoscopic stone extraction, open surgery) of the two systems is compared. One can see a slight, but clear improvement of the results in the advanced system.

Comparing the number of pulses needed for successful fragmentation (Fig. 6), a clear shift to a smaller number of pulses was found. This corresponds to the results in Fig. 7 where the time consumption of the U100Plus is depicted.

We found for 45.1% of all cases a time need below 30 min., for 65.7% 40 min., and 81.4 % of all cases could be completed in maximum 1 hour.

The necessity to perform a second session could also significantly be reduced from 14.7% to 7.4% in the patient group treated with the U100Plus (see Fig. 8).

Conclusions
Endoscopic lithotripsy with the FREDDY laser of the first as well as the advanced type is a safe and fast method for the fragmentation of all urinary calculi. The advanced type especially improves fragmenting capability with very big and extremely hard concrements at the same intrinsic safety standard as the first device1).

We found the setting of 160 mJ double pulses @ 10 Hz to be best suitable for fast fragmentation and defined this setting as the standard in our house.

Treatment duration until the patient is stone free is short, and costs as well as patient recovery times are also markedly reduced.

Fig. 1 Operating principle of the FREDDY laser with calculi and tissue

Fig. 2 Energy parameters of the two laser types

Fig. 3 Distribution of stone sites

Fig. 4 Distribution of age and sex

Fig. 5 Comparison of success rate

Fig. 6 Comparison of pulses needed

Fig. 7 Duration of procedures

Fig. 8 Necessity for 2nd session


*)Manufacturer: W.O.M. WORLD OF MEDICINE AG, Germany, Berlin