Laser Vision Correction with the All-Solid-State deep UV Laser LaserSoft: Clinical Results

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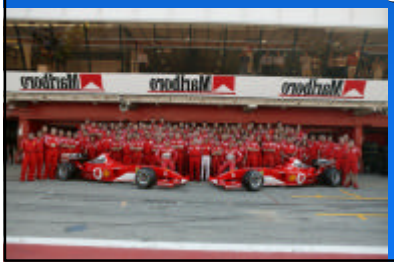


ITALY

Solid-State UV Laser for Refractive Surgery

- **Lasersoft (Katana Technologies GmbH, Germany)**
- cw-diode-pumped all-solid-state UV laser
- laser radiation wavelength: 210 nm
- high shot-to-shot stability
- high long-term UV output stability

Excimer vs. Solid-State

Excimer Laser	Katana LASERSOFT
Spot Size	
0.8-1mm	**0,2 mm**
Beam Quality	
Multimode (Additional optics for cleaning the Excimer beam)	**Single mode (gauss.)** Smooth surface
Repetition Rate	
50Hz- 500 Hz	**1 kHz**
Eye Tracking Speed	
approximately 150Hz	**>1 kHz**

Why a solid-state laser ?

Laser characteristics

Solid-state laser crystals used as laser medium

- Inexpensive to operate - no gas (Excimer)
- highly stable, long lifetime

Diode-pumping provides high efficiency

- cw pumping, high shot-to-shot and long term stability
- stable energy (fluence) and beam aiming (more precise rate of abl.)
- true all-solid-state approach

High repetition rates: 1 kHz (1000 s^{-1}) or more

- no high voltage gas discharge involved (Excimer)
- less energy per pulse
- less shock waves

Why a solid-state laser ?

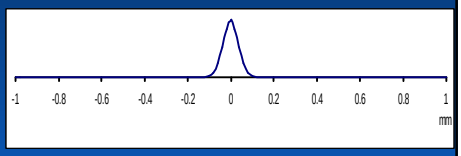
Beam Characteristics

Small spot size without additional beam-forming optics

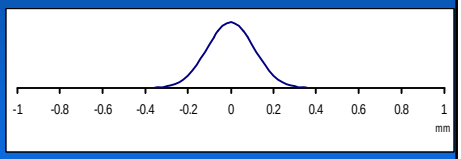
- accurate overlap of true gaussian spots
- very small spot size allows correction of corneal microirregularities, and thus reduction of high order aberrations
- very homogeneous corneal surface
- important for customized ablation
- lower energy per pulse than in standard excimer treatments

Flying Spot Beam Size Comparison

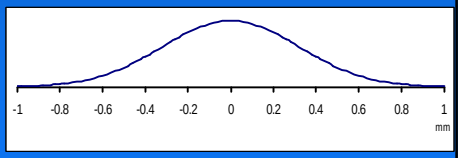
LaserSoft



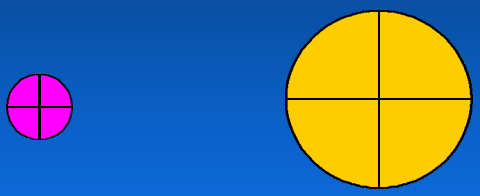
New Excimer lasers



Old Excimer lasers



Flying Spot Beam Size Comparison



0,2 mm 0 ,750 mm

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Lasersoft and Custom Ablation

Very small spot size fits nowadays requirements for effective custom ablation

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Why a solid-state laser ?

Gaussian Beam Profile

- Laser shot has a gaussian profile
- A proper ovelap between shots with a gaussian profile generates a very smooth surface of treated cornea.

Why an excimer laser cannot achieve a very small size flying spot?

- Laser itself generates very inhomogenous spatially broad laser beam distribuition with hot spot in the beam
- This comes from the way the excimer laser beam is generated in the gas discharge

Why an excimer laser cannot achieve a very small size flying spot?

- To generates a small spot you have to put an extra optical elements in the beam pass to filtering the central part out
- This throws away a lot of energy
- This filtering process tries to achieve a gaussian beam distrubution
- The additional filters are expensive and need to be replaced regularly

Why an excimer laser cannot achieve a very small size flying spot?

- You cannot filter out the hot spots becouse they are distribuited statistically at different places for each shot of the laser
- You shape the beam in the right way in general
- The hot spots are the reasons for ablations problems becouse they ablate additional corneal material in an umpredictable statistical way

Why a solid-state laser can achieve a very small size flying spot?

- Laser itself generates a gaussian fundamental beam mode
- Not neccessary to put additional optics for filtering the light
- you have the opportunity to transmitt less energy on the cornea

Why a solid-state laser ?

Beam Characteristics

Excellent (Gaussian) beam spot distribution

- high quality of the ablated surface

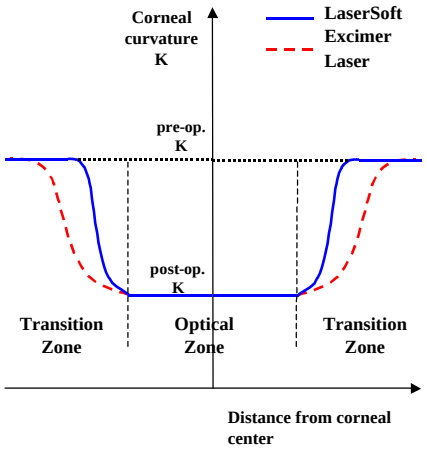
Highly collimated beam

- fast scanning, no higly accurate focusing necessary, increased beam precision

Diode Solid-State Laser are excellent candidates for true scanning small spot lasers

Smaller transition zone

LaserSoft's beam means true optical and well-defined tissue-saving transition zone



Solid-State UV Laser

Ablation Algorithm

- ablation profiles designed to preserve the strongly aspherical feature of normal cornea
- Minimal induction of spherical aberration
- Optimized to allow better stability of fluency even on peripheral cornea (more spots)

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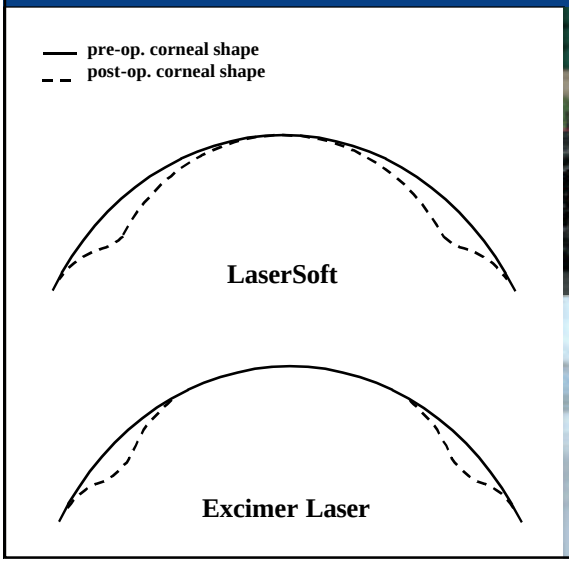
Better Performance in Hyperopic Eyes with LaserSoft



Why a solid-state laser ?

Eye Tracker

- eye-tracker latency: 1 ms
- monitoring centration of ablation with very high repetition rate
- Acting on the x-y axes as well as well as on ocular rotation.

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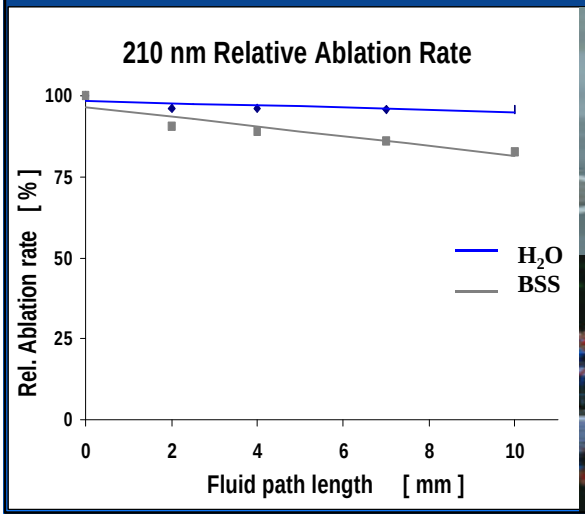
Ablation Not Influenced by H_2O or BSS
(experimental results)



Why a solid-state laser ?

Stability and Longevity

- surgical performance with reduced variability
- fluence stability unrelated to wearing out of gas
- no gas exchange / discharge
- solid-state UV laser and diode pumping system mean long lifetime and efficiency
- reduced maintenance costs

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Why a solid-state laser ?

Patient Comfort

- high repetition rate (1kHz)
- ablation with significatively reduced stress waves
- ablation or laser firing generates no audible sound
- treatment in a silent, patient-reassuring environment
  - no sudden patient movement as laser starts

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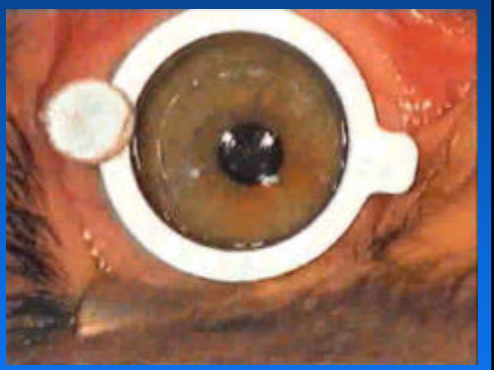
Solid-State UV Laser

Clinical Data

- 37 eyes
- age: mean 38
  (from 18 to 60)
- sex: female 21 eyes
  male 16 eyes
- eye: left 18 eyes
  right 19 eyes



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Solid-State UV Laser

Preoperative Refraction

(mean ± SD)

- SE : mean -1,71 D ± 3,71 D (from -8,00 to 6,75)
- Sphere : mean -1,46 D ± 3,32 D (from -8,00 to 6,00)
- Cylinder : mean -0,51 D ± 1,97 D (from -3,75 to 6,50)

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Solid-State UV Laser

Postoperative Refraction – Six Month

(follow-up rate 81.1 %, 30 eyes)

- SE : mean -0,04 D ± 0,26 D (from -0,50 to 0,75)
- Sphere : mean -0,01 D ± 0,21 D (from -0,25 to 0,75)
- Cylinder : mean -0,07 D ± 0,28 D (from -1,00 to 0,50)

Attempted vs Obtained, SE:

-0.04 D ± 0.26 D

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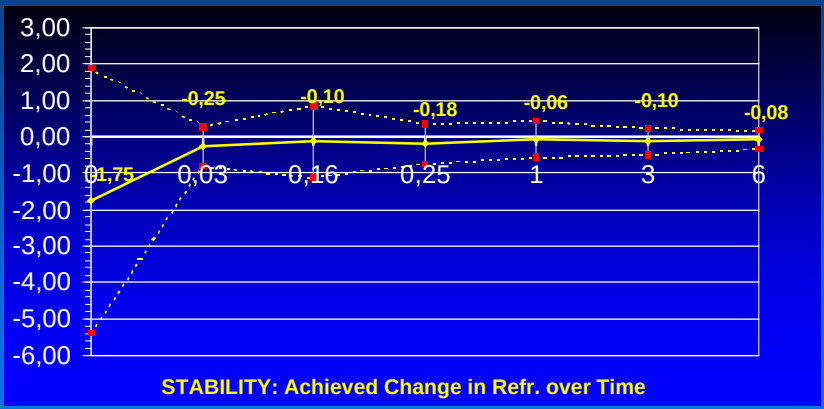
Refractive Stability



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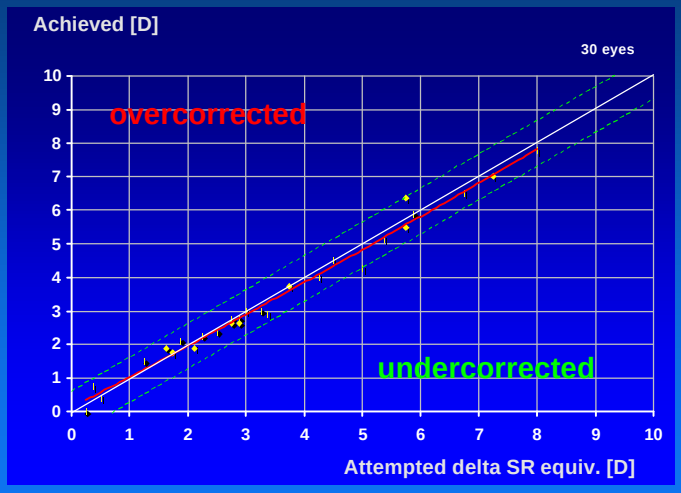
6-Month Refraction, SE

Attempted vs. Obtained



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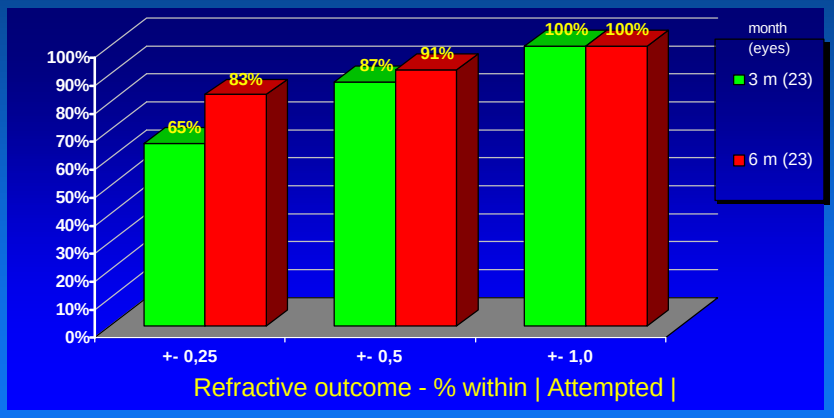
Refraction, SE

% within attempted correction six months follow-up - LASIK



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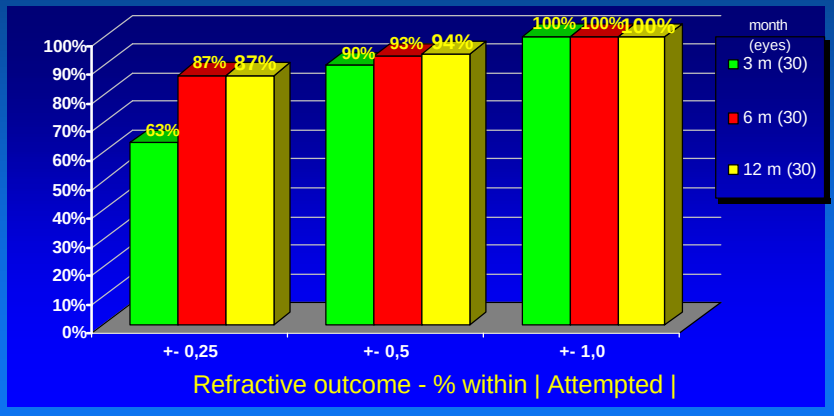
Refraction, SE

% within attempted correction one year follow-up



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Solid-State UV Laser

Applying less energy to the cornea, using a small flying spot of 0.2 mm this solid-state UV laser appears as an effective solution for refractive surgery.

A more homogeneous treatment has the potential of inducing less scarring.

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Lasersoft - Conclusions

A safe, reliable, stable, more compact, and less costly alternative to gas-operating excimer lasers for refractive surgery

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