SCHWIND
eye-tech-solutions

Smart Pulse Technology

An Outlook into the Future

Smart Pulse Technology

Agenda

- From Past to Future
- Current Situation
- Observations
- Actions
- Results
- Take Home Message

From Past to Future

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Since our first excimerlaser in 1992 our ablation algorithm significantly changed over time.

1992: Broad beam working with concentric ablation patterns (Keratom)

1994: Broad beam + scanning slit (Keratom II)

2000: Flying and scanning spot (ESIRIS)

2005: Randomized flying spot (SCHWIND-CAM software)

2007: Sophisticated spot distribution with ITEC (AMARIS)

Future: What‘s next?

Current Situation

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Let's look on the current situation:

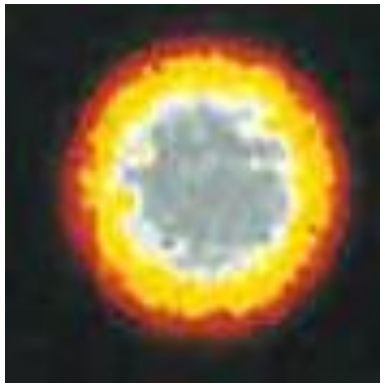
- Our refractive results are great in all type of treatments
- Post-op visual quantity and quality are excellent

Nevertheless for the aim of frankness we point out some potential challenging points:

- Ablation smoothness (The use of transepithelial PRK is the most demanding in terms of roughness, since the number of pulses involved exceeds twice as many as in PRK or LASIK treatments)
- Visual acuity and subjective feeling at day one post-op

Current ablation on Photopaper

Smart Pulse Technology



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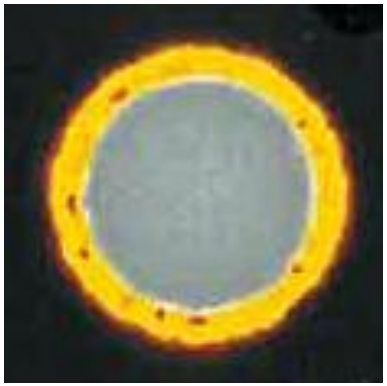

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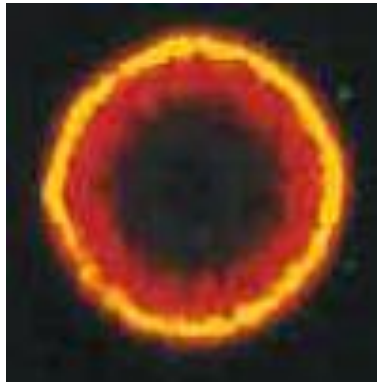

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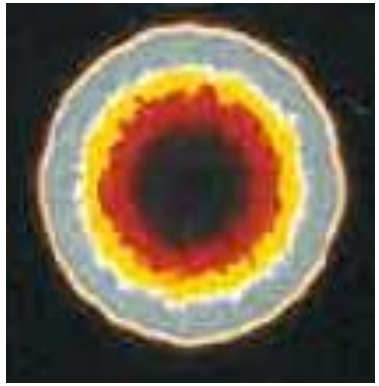

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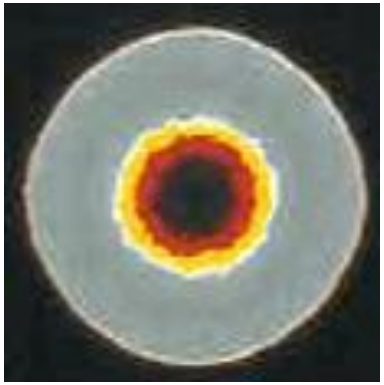

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Samples without **Smart Pulse Technology**

How did we improve?

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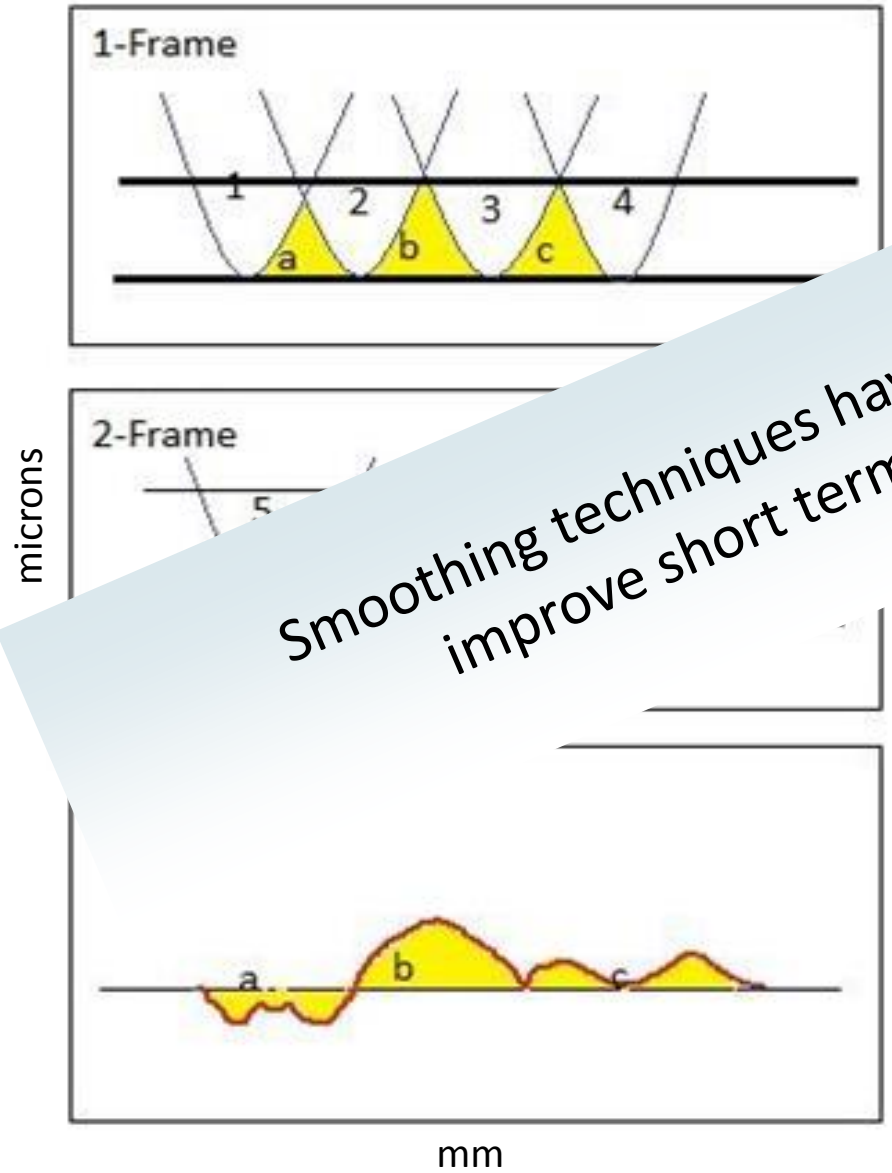


Smoothing techniques have been applied to improve short term outcomes

...ned during the
...process – exaggerated

Generally speaking, the local residual roughness shall be less than the depth of a single pulse

How did we improve?

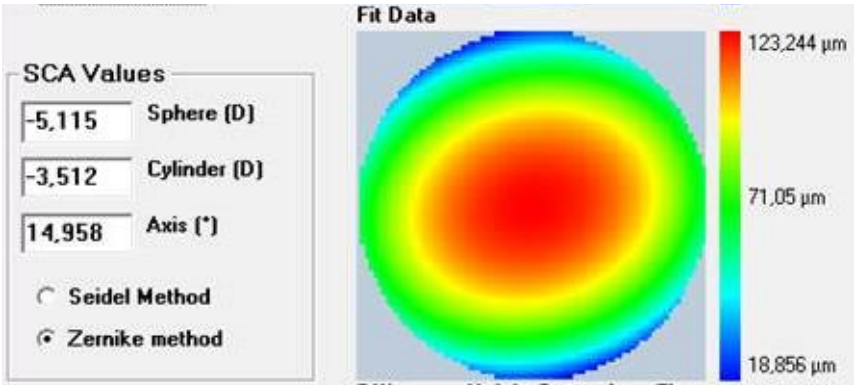
Smart Pulse Technology

The goal is to enhance short term outcomes by reducing the residual roughness (improving smoothness of the residual bed) without compromising stability or long term outcomes (including aberrations).

The development has been completed by **SCHWIND eye-tech-solutions**, with the feed-back of **Paolo Vinciguerra** as well as the extremely valuable input by **David Lin**.

Actions

Screenshot of a simulated ablation pattern using a Schwind Software (R&D)



Theoretical ablation volume

Actions

Previous publications have beeen used as a starting point

Schwind publications:

Ablation Resolution in Laser Corneal Refractive Surgery: The Dual Fluence Concept of the AMARIS Platform.
Arba-Mosquera S, Hollerbach T. Advances in Optical Technologies, vol. 2010, Article ID 538541, 13 pages, 2010. doi:10.1155/2010/538541

Simulation of the impact of refractive surgery ablative laser pulses with a flying-spot laser beam on intrasurgery corneal temperature.
Shraiki M, Arba-Mosquera S. Invest Ophthalmol Vis Sci. 2011 Jun 1;52(6):3713-22

Analytical optimization of the ablation efficiency at normal and non-normal incidence for generic super Gaussian beam profiles.
Arba-Mosquera S, Verma S. Biomed Opt. Express; 2013; 4: 1422-1433

Improving the ablation efficiency of excimer laser systems with higher repetition rates through enhanced debris removal and optimized spot pattern.
Arba-Mosquera S, Klinner T. J Cataract Refract Surg; 2014; 40; 3: 477-484

Actions

Previous publications have beeen used as a starting point

Third Party Publications:

Experimental setup to determine the pulse energies and radiant exposures for excimer lasers with repetition rates ranging from 100 to 1050 Hz. Mrochen M, Wuellner C, Rose K, Donitzky C. J Cataract Refract Surg. 2009 Oct;35(10):1806-14. doi: 10.1016/j.jcrs.2009.05.021.

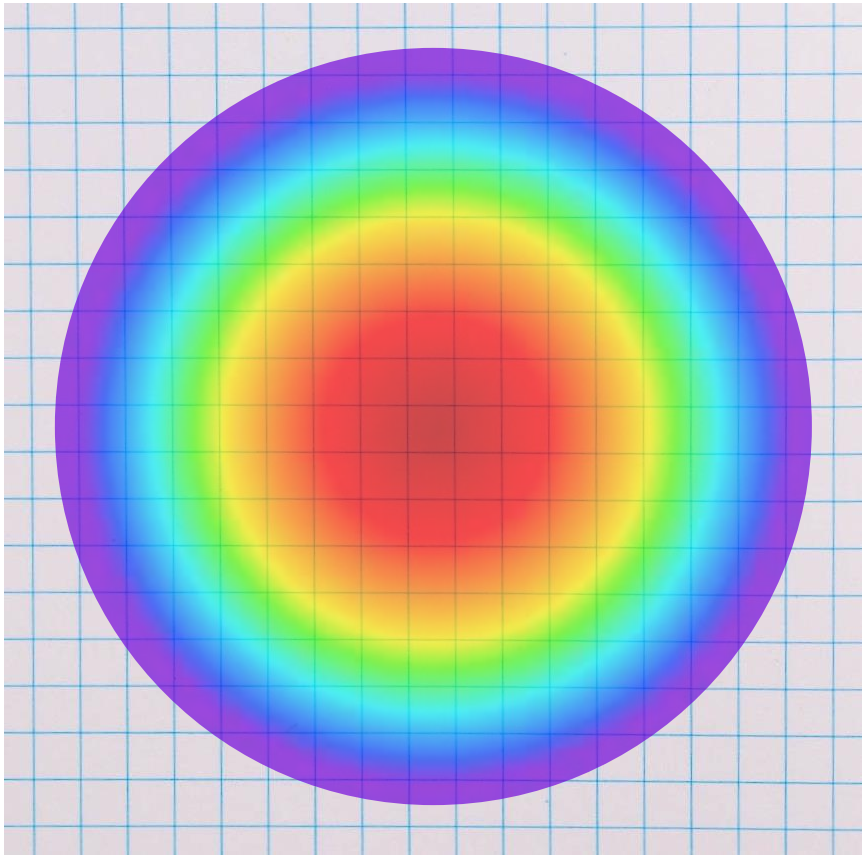
Effect of time sequences in scanning algorithms on the surface temperature during corneal laser surgery with high-repetition-rate excimer laser. Mrochen M, Schelling U, Wuellner C, Donitzky C. J Cataract Refract Surg. 2009 Apr;35(4):738-46. doi: 10.1016/j.jcrs.2008.12.034.

Influence of spatial and temporal spot distribution on the ocular surface quality and maximum ablation depth after photoablation with a 1050 Hz excimer laser system. Mrochen M, Schelling U, Wuellner C, Donitzky C. J Cataract Refract Surg. 2009 Feb;35(2):363-73. doi: 10.1016/j.jcrs.2008.10.053

Actions

Current definition of the AMARIS laser spot

The ablation profile till now is described as a 3 dimensional volume with x/y/z-coordinates based on a flat=plane corneal surface.



Actions

New definition of the AMARIS laser spot

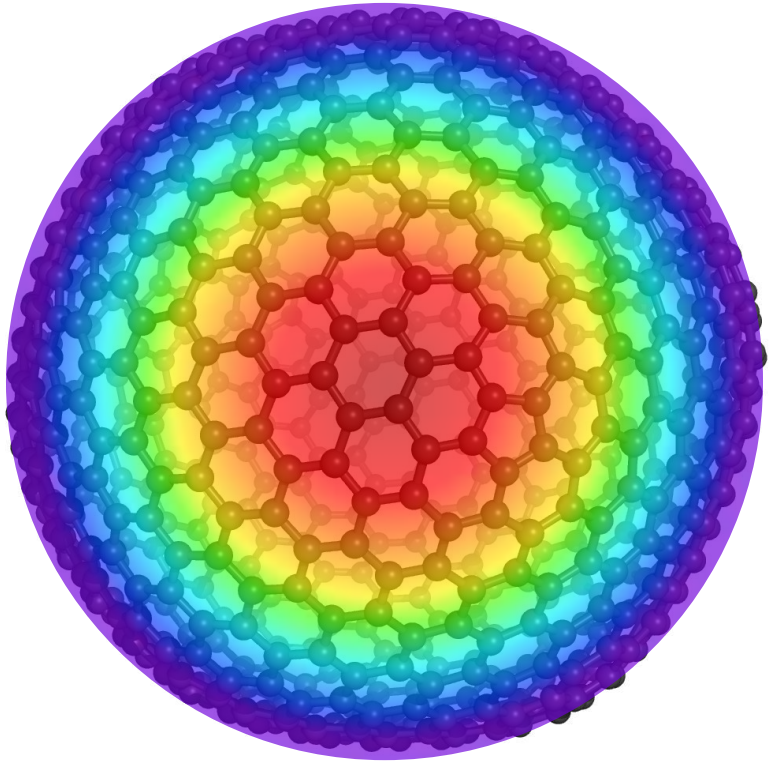
A more sophisticated way was found by using fullerene structures. Which, in a sense, can be explained by the following comparison.

The new ablation profile is described as a 3 dimensional volume which is based on a curved corneal surface.

Actions

Current definition of the AMARIS laser spot

The ablation profile till now is described as a 3 dimensional volume with x/y/z-coordinates based on a curved corneal surface where each position has an equidistant in the 3 dimensional room.



Results

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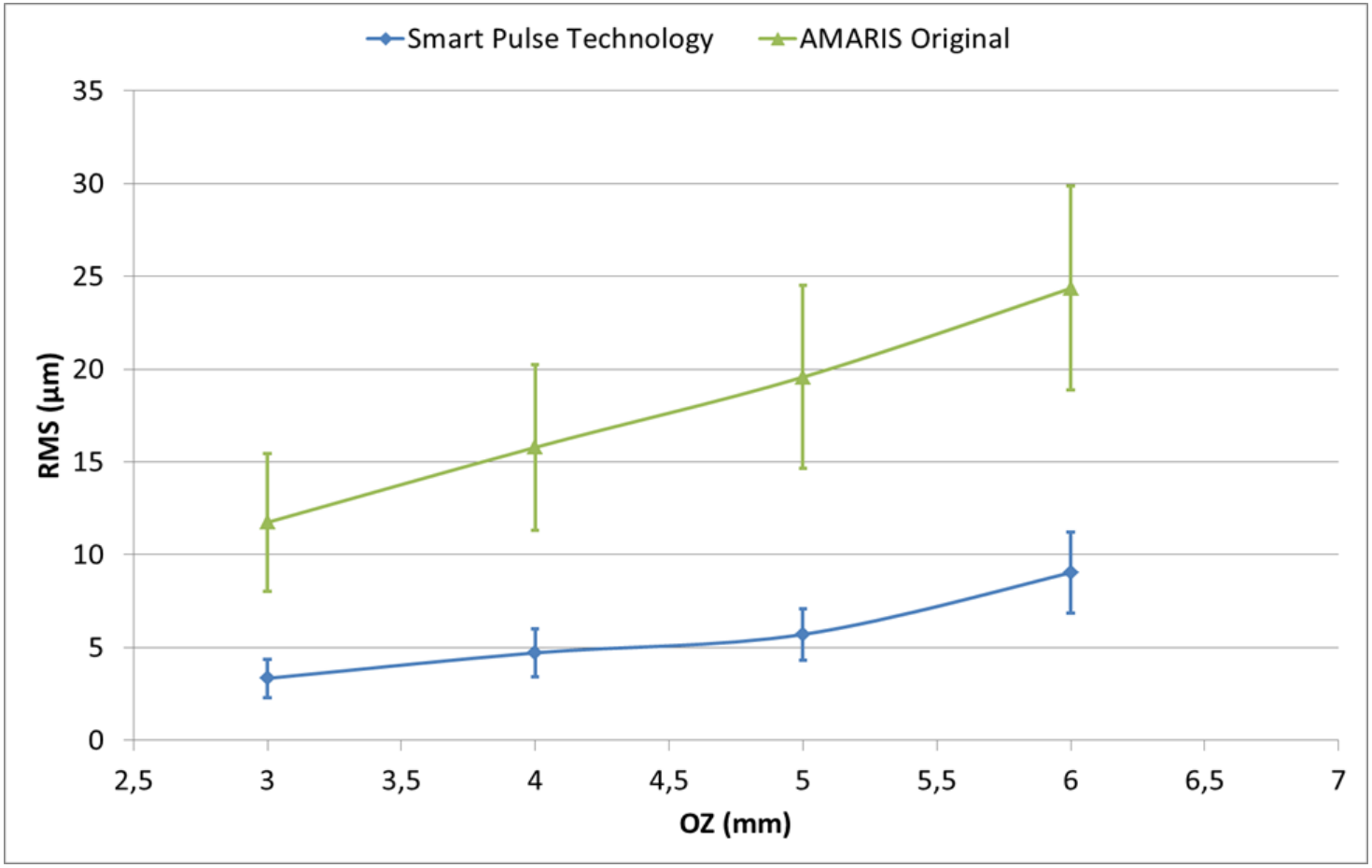

Roughness on PMMA, represented by the RMS, could be reduced by -60%, so residual roughness is just 40% of the previous one.

Results

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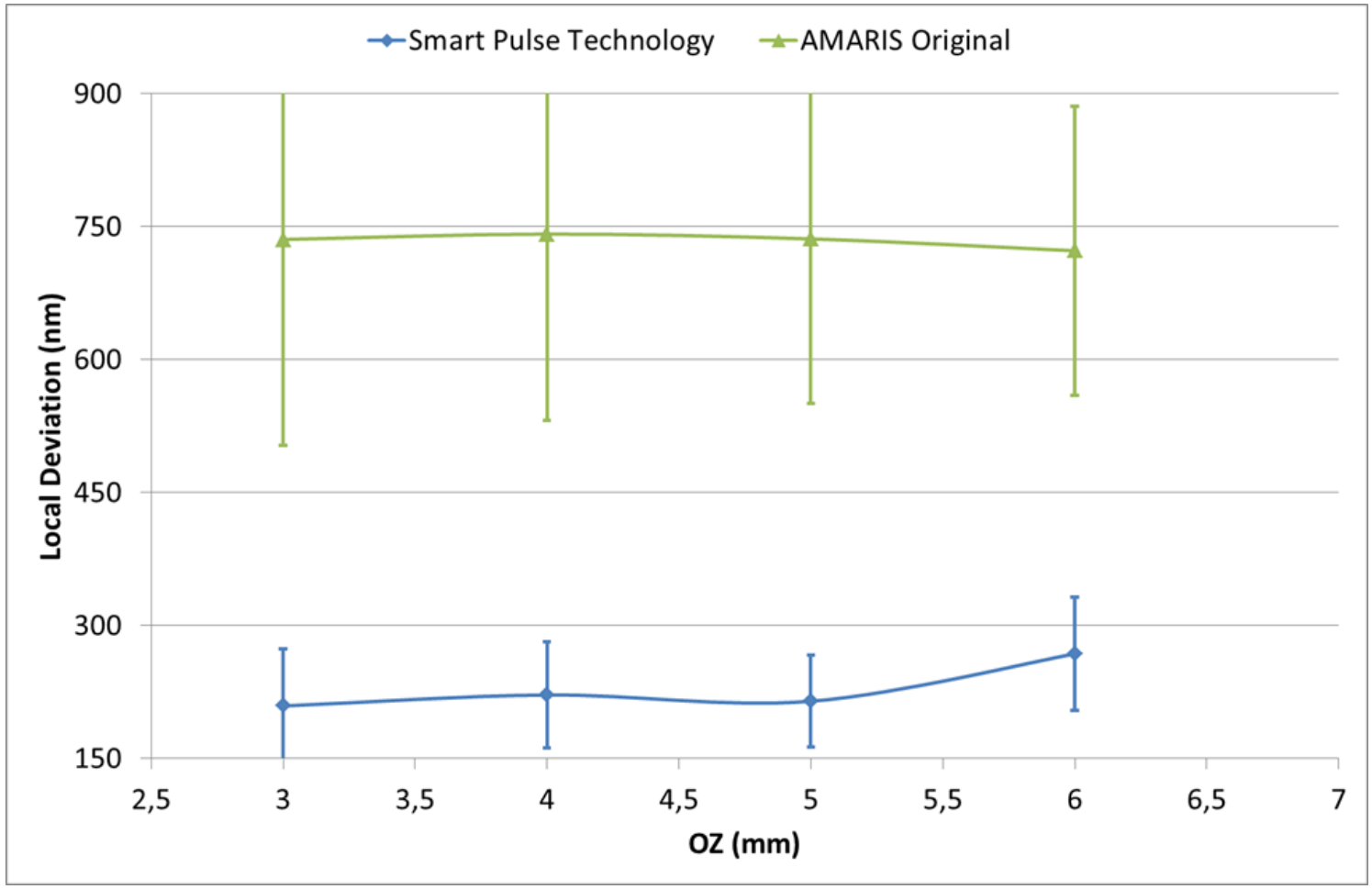

749nm = 0.749 µm => matches ~1 pulse
272nm = 0.272 µm => matches ~1/3 of a pulse

Results on Photopaper

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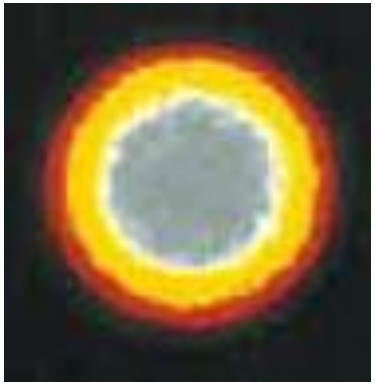

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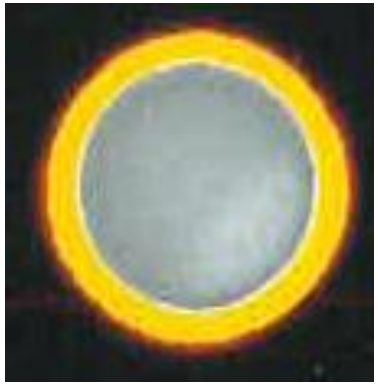

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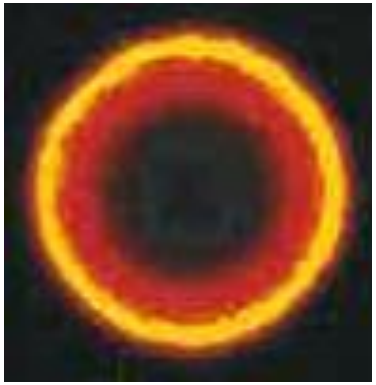

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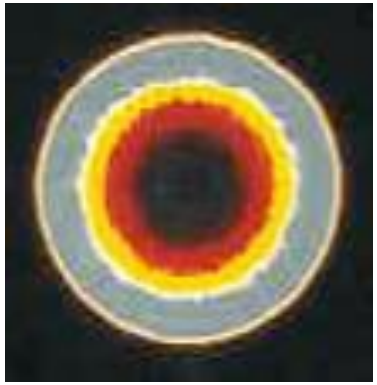

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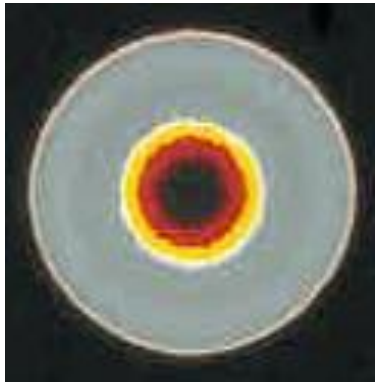

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Samples with **Smart Pulse Technology**

Clinical Results

Smart Pulse Technology

Early results and personal feedback of Dr. Paolo Vinciguerra and Dr. David Lin are extremely positive.

First day results (few eyes only) significantly improved, objectively measured (visual acuity and topographic smoothness) and as well as by the subjectively reported satisfaction level of the patients.

Long term results are pending.

Dr. Vinciguerra will provide his early experience with the **Smart Pulse Technology** during the Schwind Lunch Symposium on Sunday – Where we hope to see you again ;-)

Take Home Message

Smart Pulse Technology

The new feature, named **Smart Pulse Technology**, ensures that immediately after ablation a corneal smoothness is achieved with an unprecedented level of precision.

To accomplish this aim, the SCHWIND researchers have adjusted the theoretical pulse shape considered in the software to the real ablative pulse shape.

Take Home Message

Smart Pulse Technology

Smart Pulse Technology, will be optionally available for all AMARIS users (likewise to DCC, SCC or 7D).

The improvement of this **Smart Pulse Technology** will be available beginning of next year.

Thank you very much for your kind attention!

Vielen Dank für Ihre Aufmerksamkeit!

Thomas Magnago

Head of Customer Support Department

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