Laser Machine

By

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No financial disclosure

- **Zeiss Mel 90**
- **Technolas 217z Platform (Bausch& Laumb)**
- **VISX Star S4 Platform (AMO)**
- **WaveLight Allegretto Wave Eye-Q Laser**
- **SCHWIND AMARIS Systemsm**

TTT range
Nomograms
OZ & BZ
Spot size& top
Fluence & Speed
Laser delivery
Tracking System
Room Temp & humidity
Corn Temp

Technolas 217z Platform

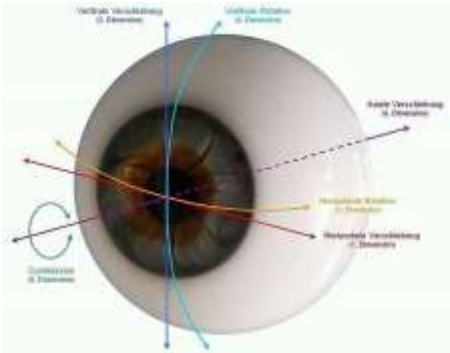
(Bausch & Lomb)

PlanoScan software using the **Zyoptix system**.
Flying spot technology utilizing a 1 or 2 mm beam at 100 Hz.

Advanced Control Eye tracking (ACE) and iris registration software:

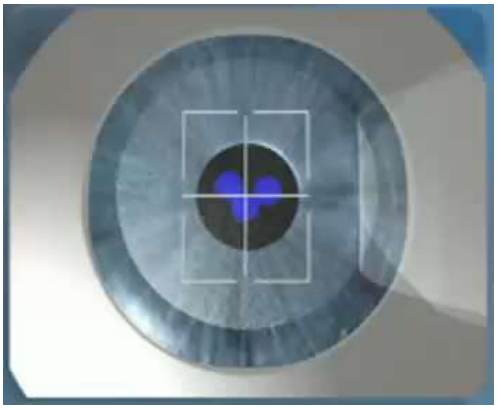
1- the correct patient and eye are treated.
2- It checks for rotational misalignment.
3- compensates for pupil center shifts.

The ACE technology tracks in four dimensions (*x*, *y,* and *z* axis as well as cyclorotation).



The active eye tracker = infrared imaging camera + scanning system

Sampling rate of 240 Hz plus a + **scanning system** and compensate within 2.4 ms.
The ***x-y*** active tracking of 1.5 mm.
Sudden loss of by the **eye tracker's video camera system.**
z-axis is passive if exceeds 0.5 mm.
cyclorotation at a sampling rate of 25 Hz within a 15-degree.

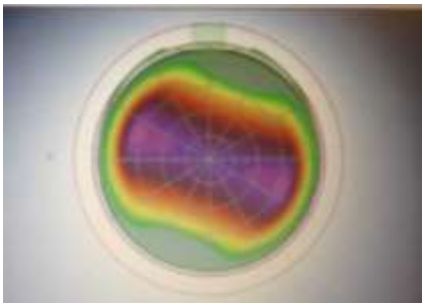


The PlanoScan platform is FDA approved for **ttt range** of −12D with 3DC, and +4D and 2C.
It is not FDA-approved for treatment of mixed astigmatism.

PlanoScan ttt offers a customizable **OZ** ranging from 4-7 mm in 0.1 mm increments.

BZ that extends the diameter of ttt for additional 2-3 mm. (*6mm OZ provides a total ablation of 8.9 mm for spherical corrections, and even larger ablations for cylindrical corrections)*

For cylindrical corrections, the Technolas 217z **maintains** the minor axis of the ellipse and extends the major axis. *This is in contrast to other systems, which decrease the minor axis, in order to create an elliptical ablation.*
So, the incidence of night vision symptoms with conventional ttt compares favorably with custom ttts using other systems.



Nomogram

TABLE 6.1 Nomogram for Technolas PlanoScan

Age (y)	OZ (mm)	Blend Zone in Original PlanoScan (Spherical Correction)	Microns Removed per Diopter Original Algorithm (µm)	Blend Zone in Advanced PlanoScan Algorithm (Spherical Correction)	Microns Removed per Diopter with Advanced PlanoScan Algorithm (µm)	Blend Zone in Advanced Zyoptix Nomogram (Spherical Correction)	Percentage of MR with Flap Creation with Intralase	Percentage of MR with Flap Creation with Moria Microkeratome or PRK
18–30	7.0	9.9 × 9.9	24	8.9 × 8.9	20	9.2 × 9.2	OD 103% OS 101%	OD 102% OS 100%
31–39	6.5	9.6 × 9.6	21	8.5 × 8.5	17	8.7 × 8.6	OD 102% OS 100%	OD 100% OS 98%
40–49	6.2	9.1 × 9.1	19	8.2 × 8.2	16	8.3 × 8.3	OD 101% OS 99%	OD 99% OS 97%
>50	6.0	8.9 × 8.9	18	7.9 × 7.9	14	8.1 × 8.1	OD 100% OS 98%	OD 98% OS 95%

The above represents Dr. Weisenthal's personal nomogram for use with the Technolas excimer laser.

To optimize results using the PlanoScan, it is important for the surgeon to create a **personalized nomogram**.
One should continually monitor outcomes and modify ttt plans especially after a major maintenance service call or a change in the optics.

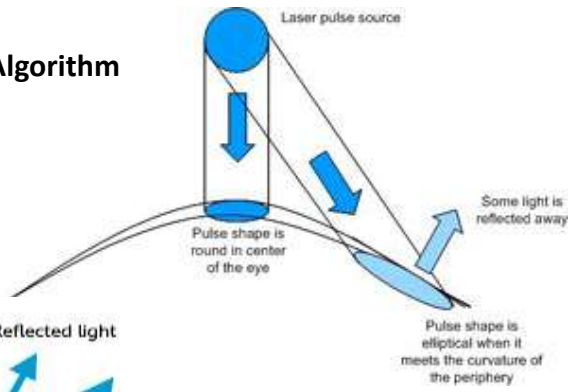
- **Large OZ optimizes the visual outcome and promotes refractive stability. However, it also increases the depth of tissue ablation.**
- **It is better to have a large OZ with surface ablation than have LASIK with a reduced OZ in younger patients.**
- *15 µm/D at a 6 mm OZ. However, it has become less with advanced PlanoScan algorithm using a combination of 1 and 2mm **beam sizes** rather than a 2-mm flat top beam.*
- **Smaller spot size reduces the BZ and slightly reduces the central ablation depth.**
- **Treat the full MR in patients<40 years and the CR in patients>40.**
- **The OZ should be > the diameter of the mesopic pupil by at least 0.3-0.5 mm.**

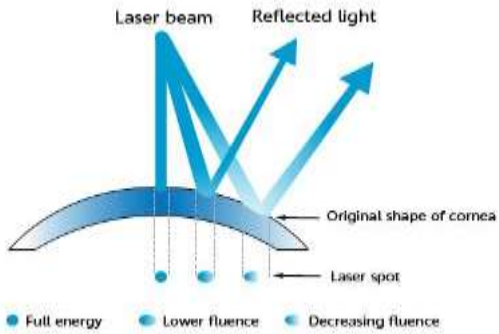
Zeiss Mel 90

The **FLEXIQUENCE** switch function (250 Hz / 500 Hz), the ablation profile **Triple-A** and the outstanding intra-operative ablation speed of up to **1.3 seconds /1D**.

The Advanced Ablation Algorithm offers a high degree of precision, predictability, intelligent energy correction, aspherically optimized design with minimal tissue removal.
This results in gentle ttts of standard, and also eyes with higher and lower level of ametropia. All combined into one single ablation algorithm: **Triple-A**

Advanced Ablation Algorithm





Surgical microscope	OPMI® pico **with integrated HD video camera**
Illumination	Ring illumination: stepless adjustment; sectional light; satellite illumination; optional slit lamp illumination
Active eye tracker	Infrared, pupil and limbus tracking, **1050 frames per second** (fps), manual ablation center selection, automatic Pupil Center Shift Correction
CCA+ (plume removal system)	Integrated into the device, automatic adaptation for 250 Hz / 500 Hz operation

Spot scanning parameters	
Beam dimensions	0.7 mm FWHM (full width at half maximum), Gaussian beam profile

Treatment range: -12 D to +3 D (up to 3.0 DC)

Optional	Monitor with touch screen, keyboard, printer, CRS-Master, PRESBYOND® Laser Blended Vision

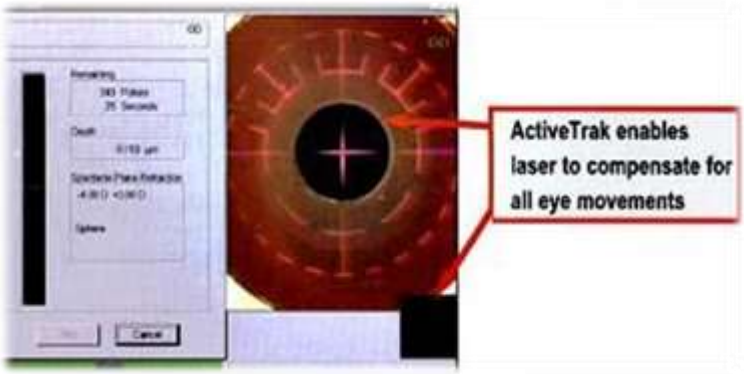
VISX Star S4 Platform

(AMO)

The AMO VISX system
FDA approved in 1998, most widely used in USA (but with less flexibility and ttt ranges than outside USA).

A number of hardware and software technologies in Visx Star S4 including ActiveTrack 3D eye tracking, variable spot scanning, autocentering, adjustable pulse repetition rate, wide range of laser ttt and IR.

The **ActiveTrak 3-D eye tracking system** : tracks eye movements with an undilated pupil within a zone of 1.5 mm in the x-y-axis and 2mm in the z-axis, sensed within 30 ms.



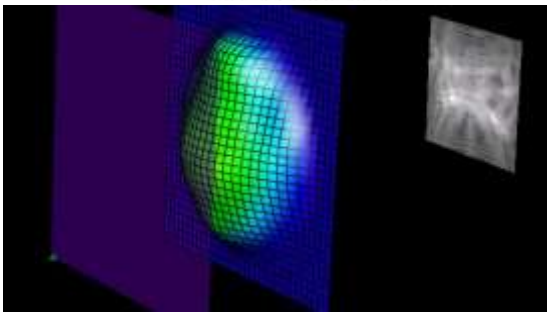
Variable spot scanning (VSS), with the spot diameter varying from 2 to 6 mm.

Variable Spot Scanning

Combines advantages of larger and smaller diameter beams

Allows tissue to be removed in the shortest possible time

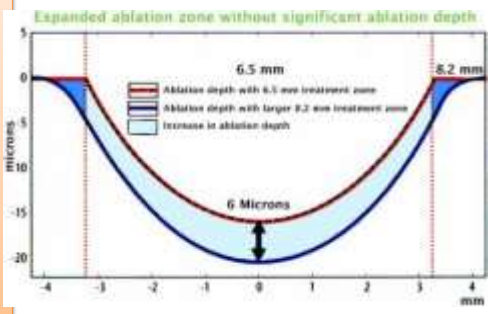
Smooth ablation



Reduced risk of postoperative glare and haloes? Smoother ttt, smoothly integrate a BZ extending the ablation zone out to 8 mm.

Tissue and time saving? The ablation with **VSS** is neither deep nor lengthy as with a single-sized small flying spot.

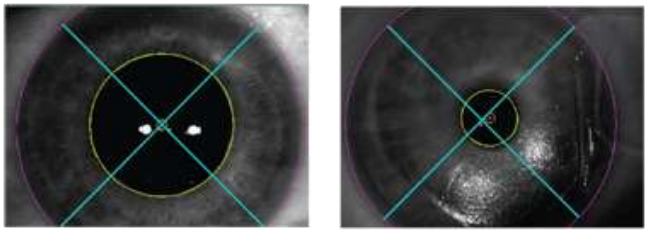
Constant corneal temperature



The VISX Star S4 laser **pulse repetition rate** can be adjusted from 1.5 to 10 Hz for conventional ttt.

The autocentering feature: automatically finds the geometric center of the undilated pupil.

It is therefore important to keep the lighting as low as possible at the time of autocentering and engaging the active tracking system to get the same pupil center as was during refraction.



When wavefront data is captured under scotopic illumination but treatment is performed under mesopic illumination, the pupil changes size, shifting its center. Unless the laser compensates for this, fine treatments will be applied off-target.

Iris registration is available for custom laser ttt, but is not available for conventional LASIK.

Wide range of laser ttt: VISX Star S4 laser has a unique FDA approval for a wide range of refractive errors, for mixed astigmatism (−14D with up to +5DC, +5D with up to +3DC, Mixed astigmatism for up to +6DC).

Conventional ttt at the upper limits of the approved range is less reliable than at lower levels of refractive error. *(search for alternative lines)*

TREATMENT ZONES

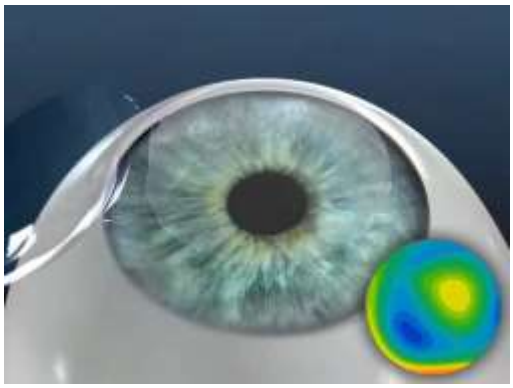
For myopia are 6 and 6.5 mm and the BZ will extend the ttt zone 8mm.
For mixed astigmatism and hyperopia are 9 mm with the deepest part of the ablation at 5mm in hyperopia.
Using the **BZ** can allow the surgeon to choose 6 rather than 6.5-mm OZ without a noticeable increase in night glare or haloes.
This saves 3 µm/D of stromal ablation. The addition of an 8 mm BZ adds an overall 8 µm to the maximum ablation depth for ttts of <10 D.

NOMOGRAM ADJUSTMENT

To the intended stromal than surface ablation ttt to prevent an overcorrection in myopia and regression in hyperopia.

In Bansal-Kay nomogram, the <u>percentage adjustment</u> increases with age and with the SE, only to the spherical not the astigmatism component.

MIXED ASTIGMATISM the desired ttt can be entered directly into the laser computer.
The FDA-approved mixed astigmatism profile for conventional and custom ablation is a distinct advantage of the VISX laser.



ABLATION DEPTH CALCULATION

Reducing ectasia risk by reducing stromal ablation when possible.
12 µm/D of **SE** for **myopia** correction with a 6mm and 15-µm/D for a 6.5mm ttt zone. Therefore, the resultant ablation depth will be less when astigmatism is being treated in addition to myopia.

The standard **hyperopic** ttt with the VISX laser is a 9mm zone with a maximum ablation depth of 8 µm/D of SE occurring at a 5-mm ring around the treatment center. So, it is less of a challenge than the myopic ttts regarding ablation depth

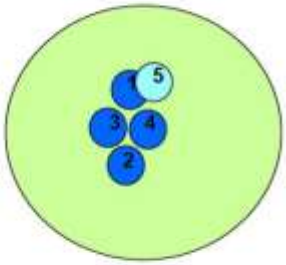
WaveLight Allegretto Wave Eye-Q Laser

This platform is a scanning flying spot excimer laser that exists at **three frequencies,** 200, 400, and 500 Hz, with a pulse duration of 12 ns.

The ablation times are **very rapid** (the 400-Hz ablates 1D at 6.5mm OZ in only 2 seconds).

Thermal Optimized Shot Distribution

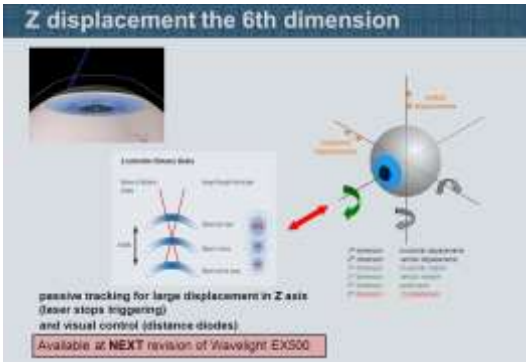
- Due to the high pulse frequency, there is a theoretical risk of **thermal effects**[1]
- ALLEGRETTO WAVE® Eye-Q laser prevents this by only allowing **every fifth pulse to overlap** with a **previous one**
- Optimal temporal and spacial shot distribution is required to minimize potential thermal load



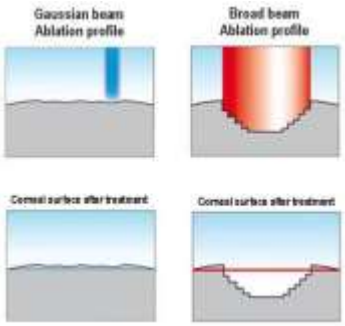
Optimized shot distribution ensures that **only every 5th pulse is allowed to overlap the first**. This helps **minimize thermal build up** and provides adequate time for plume evacuation

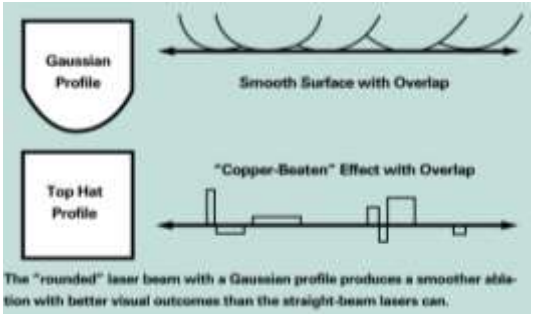
1. Mrochen M et al. *J Cataract Refract Surg.* 2009;35:363-373.

- An advantage particularly in high astigmatic correction?
- An integrated **cross-line projector** that allows horizontal, vertical, as well as *z*-axis centration. Correct height alignment is achieved with two precise distance **laser diodes**.



- The laser's **PerfectPulse Technology** utilizes a Gaussian beam profile and a 0.95-mm **spot size** to ensure a smooth and precise ablation.
- This is coupled with a high speed (<6 ms) pupil based **eye-tracking** system that does not require pupil dilation(ranging 1.5 to 8.0 mm).





The laser is less sensitive to changes in **temperature and humidity**?
(65- 86°F temperature and 20-70% relative humidity).
Because the optics of the beam formation is protected inside a tube system that is nitrogen gas purged.
Only a very short part of the excimer laser beam is exposed to ambient air.
The overall fluence is calibrated and adjusted for the room conditions **once a day**.

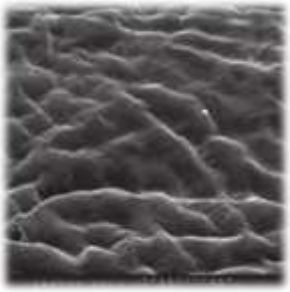
A built-in **slit lamp** allows to inspect both flap alignment, interface clarity on the operating table, and to find the flap edge in a retreat case.

SCHWIND AMARIS SYSTEMS

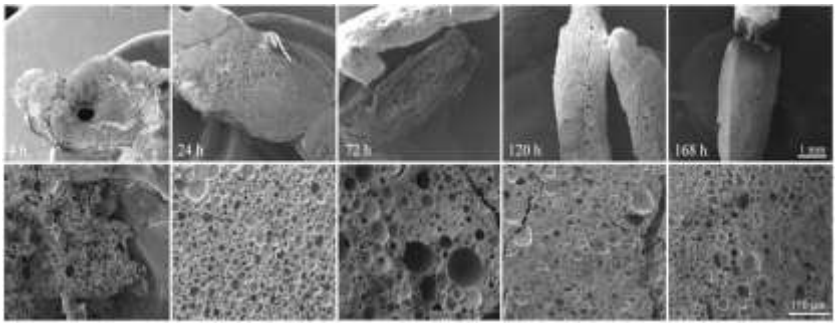
SCHWIND AMARIS 750S

The **SCHWIND AMARIS** is a **6th** generation excimer laser. It has both a 750 Hz and a 500 Hz version.

An **Automatic Fluence Level Adjustment** (**AFLA)** which achieves perfect smoothness with high ablation speed.
The result is that approximately 80% of the laser ablation is performed with a high fluence value, while the remaining 20% with low fluence.



The ideal smoothing of the surface is achieved by adding low fluence pulses at the end of the treatment.
A small spot size of 0.54 mm and a Super-Gaussian beam profile provide a precise ablation volume avoiding vacancies and corneal roughness.

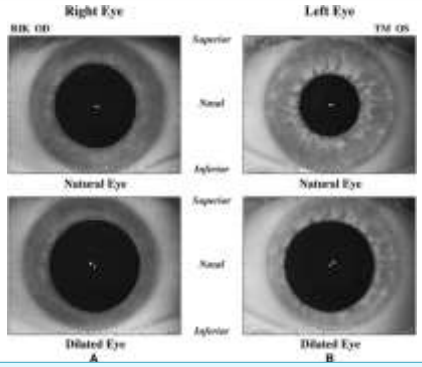


• The small spot size allows a **high-speed ablation** time. This reduces the stromal bed dehydration during a large correction.
The 750-Hz laser system at a 6mm OZ corrects 1D in 1.5s.

• An **Intelligent thermal Effect Control** (ITEC) that reduces the damage to surrounding corneal tissue at the extremely high ablation speed.
(temperature rise is <5° and significantly <40° denaturation).

• **Active tracker** continuously tracks and actively compensates for eye movements including **dynamic cyclotorsion (DCC)** by detecting both the pupil and the limbus.
(The total reaction timeis typically <3 ms).

The **limbus** is used as a reference for ablation, meaning that the center point of the ablation is the same throughout the ttt because the laser system tracks the pupil in relation to the limbus.



Automatically adjusted illumination to maintain the pupil diameter at the beginning of the ttt as the preoperative examination.

Treatment Spectrum

The range of −15 to +8 DS, and −7 and +7 DC. The SE must be within the range of −9 and +6 D.
As previously stated, higher corrections are possible, but there are no data to support safety and efficacy.

Compared to Wavelight Allegretto Eye-Q, Schwind Amaris 750S excimer laser was more effective in high astigmatism correction.

Graefes Arch Clin Exp Ophthalmol (2014) 252:1679–1686

The optimized refractive keratectomy **(ORK)-CAM9** is a planning software tool that calculates the size of the optimal transition zone.

The ORK-CAM defines the ablation per pulse, depending on the ttt method, so nomogram adjustment is unnecessary.

The AMARIS laser beam is guided through a completely enclosed beam path in **a vacuum**. No disturbing elements can impair the quality of the laser beam, nor deviation of results as with the use of nitrogen

Real-time pachymetry provides measurements before the preparation, after lifting the flap, during and after the laser ttt.
This allows changing the surgical plan intra-operatively if the stromal bed is thinner than expected. Pachymetric data can be saved for future reference in the event of retreatment.

TRANSPRK is an all-laser version of surface ablation (55 µm centrally and 65 µm peripherally within 8 mm zone, which is smaller than in manual PRK, the healing process is about 1 or 2 days shorter.

Additionally, both the epithelium and the stroma are ablated in a single procedure, achieving short overall ttt time and minimizes corneal dehydration.


Thank
You