ALL-LASER LASIK USING THE ZEISS VisuMax® – MEL 80™ REFRACTIVE WORKSTATION

A two-center study related to clinical outcome for all-laser LASIK corrections using the VisuMax® – MEL80™ workstation

RAINER WILTFANG, MD (AUTHOR) AND
MARTIN BECHMANN, MD
SMILE EYES AUGENKLINIK, MUNICH, GERMANY

DAN Z. REINSTEIN, MD MA(CANTAB) FRCSC FRCOPHTH
LONDON VISION CLINIC, LONDON, UK

Purpose: To evaluate the outcome and clinical performance of the Carl Zeiss Meditec refractive all-laser workstation consisting of the VisuMax® femtosecond laser system and the MEL 80™ excimer laser in a multicenter study.

Methods: In this multicentre study, 92 eyes underwent LASIK treatment, where all flaps were created with the VisuMax® femtosecond system followed by refractive treatment with the MEL 80™ excimer laser. It represents the first series of consecutive eyes treated at each of two reference clinics in March 2007. Follow-up was three months where manifest refraction, BSCVA and UCVA at one day, one week, one month and three months were gathered and analyzed. Also flap quality, the integrative solution with the MEL 80™ and its clinical performance were evaluated.

Results: At both sites, safe, predictable, and high-quality refractive outcomes were obtained. On average over the two sites, the three-month post-surgery MRSE mean was found to be −0.05 D ± 0.44 D within a range between −1.5 D to +1.5 D. Ninety-eight percent of the eyes were unchanged or gained one or two lines of BSCVA. Stability showed no significant change in refraction between one week and three months post-surgery, i.e. VisuMax® eyes show fast visual recovery. Due to only minor bubble generation in the stromal tissue, the refractive treatments could be performed immediately after the flap lift without affecting the MEL 80™ eyetracker.

Conclusion: The combination of VisuMax® and MEL 80™ reproduces the high quality of clinical outcomes well known from the MEL 80™. Flap quality was excellent with improved flap handling due to the advantageous sidecut geometry that enables much easier and safer flap repositioning than in conventional LASIK. Excellent handling in terms of ergonomic aspects and workflow as well as perfect interplay of the two lasers in the all-laser LASIK workstation allow very high safety and good success rates.

INTRODUCTION

Femtosecond laser systems for flap cutting in LASIK are becoming increasingly attractive for many different reasons. A very important clinical aspect is related to the improved flap thickness standard deviation for femtosecond flaps. Central flap thickness standard deviations of femtosecond lasers published vary between 5 μm and 19 μm, with an average of approximately 12 μm (see 5 and references therein). First prospective studies using the VisuMax® system show for a cohort of twenty-four eyes that 25 % of eyes were within 2 μm of the intended flap thickness, 54.2 % of eyes were within 5 μm of the intended flap thickness, and 87.5 % were within 10 μm of the intended flap thickness. The mean central flap thickness at 3 months for all eyes was 112.3 ± 7.9 μm, giving an accuracy of +2.3 μm (attempted thickness 110 μm) and a reproducibility of 7.9 μm[5]! In contrast to this excellent result, flap thickness standard deviation of certain mechanical microkeratomes is found to be in the range of 20 µm to 40 µm. With improved more recent mechanical microkeratomes flap thickness standard deviation between 12 µm and 20 µm was found (see 5 and references therein). Apart from flap accuracy and precision, also a more constant flap thickness and homogeneity over the flap area seems to be attainable[1, 5, 7] and, moreover, flap stability subjectively appears better for femtosecond laser flaps[7]. One may question: why is this so? To answer this question, we have to consider the principle behind the interaction between femtosecond laser light and tissue. It is based on a nonlinear optical interaction of light with the stromal tissue realized through a laser beam focused tightly into the stroma. Due to the strong temporal compression of the laser pulses (pulse length in the order of femtoseconds, 1 femtosecond equals 10^{-15} seconds), only very low light power is required for perforation, i.e. to disrupt the tissue. Microscopically small gas bubbles are formed subsequently, which further break up the tissue in the micrometer range. Small spot femtosecond lasers therefore have the ability to cut the corneal tissue through photodisruption with only minimal damage to the surrounding corneal tissue. Due to the precise scanning of the focused laser beam within the rigidly applanated area, an exact control of the cut plane and, hence, thin and constant flap thickness is possible. Mechanical microkeratomes, on the other hand, may suffer from mechanical bearing backlash, resulting in less accuracy. Maybe due to the change in mechanical load during the blade movement onto the cornea or for other reasons, they often tend to cut deeper in the periphery than in the center of the cornea. This could reduce stromal integrity to a higher level than with femtosecond laser systems and also may have impact into the visual results. Last but not least, femtosecond lasers in contrast to mechanical microkeratomes allow for a steep sidecut angle bringing better flap handling and repositioning into play (manhole cover "fit" of flap).

With the VisuMax® – MEL 80™ workstation, Zeiss combined the advantages of femtosecond laser flap cutting with the excellent clinical outcomes of the approved MEL 80™ excimer laser into one unit with a pivoting patient bed. One goal of this study was to investigate if clear clinical indications could be found in order to demonstrate the mode of action of the different advantages discussed above. Therefore, we were interested in finding out how this system performs in daily practice regarding clinical outcome, workflow efficacy, and patient comfort. To answer this question, we performed a multicente study at two sites
(Dan Z. Reinstein, London Vision Clinic, London, UK and Rainer Wiltfang / Martin Bechmann, SMILE EYES Augenklinik, Munich, Germany) with consecutive patients treated with the VisuMax® – MEL 80™ workstation.

METHODS

PATIENTS

92 spherocylindrical myopic eyes treated at two different sites were retrospectively analyzed for this publication. Patients and data from the following reference sites were involved:

1. London Vision Clinic, London, UK;
   surgeon Dan Reinstein; 51 eyes,
2. SMILE EYES Augenklinik Airport Munich, Germany;
   surgeons Rainer Wiltfang / Martin Bechmann;
   34 / 7 eyes.

All patients were treated in March 2007 and these studies represent the first series of consecutive eyes at each of the two reference sites using the Zeiss workstation. Each site was equipped with the same workstation consisting of the (CE-marked, FDA-cleared) VisuMax® and the MEL 80™, each with the same software and nomogram release. Reference surgeons followed the same clinical protocol and recommendations. Patients were screened for corneal pathologies by complete ocular examinations. Patients with ocular pathologies like severe dry eye, keratoconus, corneal scars, corneal dystrophies, other ocular diseases with a certain history, and previous ocular surgery were excluded.

	Mean	Range
Age	34 y	23 y – 54 y
K-Values	(7.76 ± 0.24) mm	(7.11 to 8.39) mm
Sphere	(–3.72 ± 1.97) D	(0 to –10.00) D
Cylinder	(–0.85 ± 0.63) D	up to -3.00 D
MRSE	(–4.12 ± 2.02) D	(–10.50 to -0.75) D

Table 1: Pre-surgery subject demographics for the two-center Zeiss VisuMax® – MEL 80™ workstation study, 92 eyes.

The gender distribution of the patients recruited was uniformly distributed with 46 % males and 54 % females. Further details of the subject demographics of the 92 eyes are summarized in Table 1.

Preoperative assessment included manifest refraction, best corrected visual acuity (BSCVA), uncorrected visual acuity (UCVA), and at all sites also encompassed corneal topography measurements using ATLAS 995 (Carl Zeiss Meditec, Jena, Germany) and ocular wavefront sensing using WASCA™ ANALYZER (Carl Zeiss Meditec, Jena, Germany).

VisuMax® – MEL 80™ REFRACTIVE WORKSTATION

The Carl Zeiss Meditec refractive workstation is an integrative solution consisting of the VisuMax® femtosecond laser system used for flap cutting and the MEL 80™ excimer laser system for the refractive treatment. A pivoting patient bed combines the two laser systems to become one unit. Therefore, the entire surgical procedure, i.e. flap cutting plus refractive treatment, can be carried out without having to move the patient between these steps and without delay times between femtosecond flap cut and excimer laser ablation. Through applanation of the eye to the spherically curved contact glass during the docking procedure, the eye is immobilized when suction is applied. Contact glasses for VisuMax® flap cutting were selected following the manufacturer recommendation out of three types; small (S), medium (M), and large (L). The size of the contact glass is chosen depending on the limbus diameter. The proper selection is important due to the unique corneal suction approach leaving the sclera untouched.

Adjustable flap parameters are flap thickness, flap diameter, hinge width, hinge location, and sidecut angle. Docking and alignment is performed pursuant to patient cooperation through patient fixation onto the blinking green fixation light during the whole procedure. By means of adjustment of the internal optics of the VisuMax®, the patient's refraction can be compensated for and the fixation light is always seen as a sharp point during the whole procedure. The curved applanation accompanied by onlya low increase in intraocular pressure means that this important property is fulfilled during the whole docking procedure and after the initiation of the suction (Carl Zeiss Meditec's 'gentle corneal interface concept')!

Spherocylindrical refractive corrections have been done with the Carl Zeiss Meditec MEL 80™ excimer laser system. It is a high-speed flying spot scanning excimer laser with 0.7 mm Gaussian beam (FWHM) and 250 Hz repetition rate. It has integrated eye registration and eye tracking capabilities. Further information of the MEL 80™ excimer laser can be found elsewhere. For all treatments, active eye tracking was enabled and implemented standard nomograms for sphere and cylinder corrections were used. All treatments were performed using the ASA (advanced surface ablation) profiles that aim at aspheric corrections.

SURGICAL PROCEDURE

Flap thickness set for the 92 eyes were between 105 µm and 130 µm, with the majority at 120 µm for site 2 and 110 µm (all 51 eyes) at site 1. For all eyes treated, the flap sidecut angle was set to 110° (where 90° sidecut angle would be perpendicular to the corneal surface at sidecut position). The hinge position was either superior or nasal depending on the refractive cylinder axis at site 2 and always superior at site 1. The hinge width was set to 3.5 mm in all cases. Used flap diameters were between 7.5 mm and 8.9 mm with a mean of 8.0 mm. Except for certain cases where S-type contact glasses seemed to be better adapted due to the white-to-white diameter, M-type contact glasses were normally used. Patients were asked to fixate on the green blinking fixation light during the docking procedure. Docking is performed by controlling the patient bed to align the patient with the contact glass. This alignment procedure and the applanation procedure are observed through the operating microscope. When applanation takes place, the applanation zone size can be easily inspected by mediation of the fluid meniscus seen through the contact glass. This meniscus starts to cover the whole inner zone during increased applanation on the contact glass and is pushed to the outer edge if applanation is sufficient. The contact glass was either centered with the pupil center or with the vertex depending on the surgeon's preference during the docking procedure to create the flaps centered respectively. Following the flap creation, the patient bed with the patient in a supine position was rotated 180° under the MEL 80™ for the refractive procedure. Rotation can be done in seconds without any mechanical obstacles. Only slight residual bubbles generated during the VisuMax® flap cut were present after alignment of the patient under the MEL 80™. Hence, no further waiting time or flap bed massage was necessary and instant eye tracker operation was possible in all cases. Flaps were lifted under the MEL 80™ using standard surgical instrumentation.

PATIENT FOLLOW-UP

Postoperative follow-up visits after one day, one week, one and three months included determination of manifest refraction, best corrected and uncorrected visual acuity (BSCVA, UCVA), WASCA™ ANALYZER (Carl Zeiss Meditec, Jena, Germany) ocular wavefront measurements, and ATLAS 995 (Carl Zeiss Meditec, Jena, Germany) topography measurements. In addition, patients responded to a questionnaire.

RESULTS

Analysis of the data was driven by the following defined study end points: predictability (attempted vs. achieved refractive outcome), refractive outcome for manifest spherical equivalent (MRSE), efficacy evaluated by uncorrected visual acuity (UCVA), safety evaluated by best spectacle corrected visual acuity (BSCVA), stability of the correction over time, adverse events, intra-operative and postoperative complications, and ergonomic aspects regarding the usage and workflow of the VisuMax® – MEL 80™ workstation.

Post-OP	Mean	Range
Sphere	(−0.08 ± 0.45) D	(−1.50 to +1.75) D
Cylinder	(−0.26 ± 0.26) D	up to -1.00 D
MRSE	(−0.05 ± 0.44) D	(−1.50 to +1.50) D

Table 2: Three-month post-surgery subject demographics for the two-center Zeiss VisuMax® – MEL 80™ workstation study, 74 eyes.

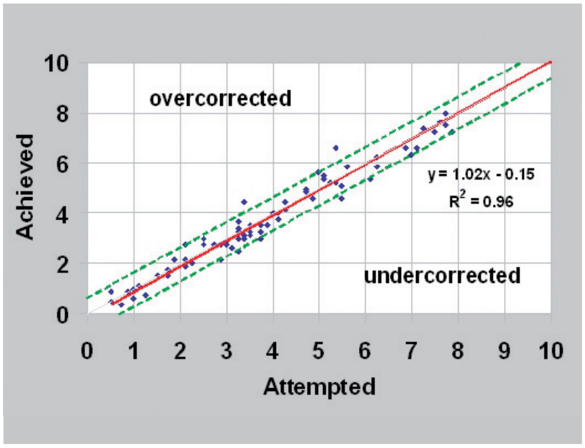

Figure 1: Predictability MRSE. Predictability mean spherical equivalent achieved vs. attempted for 74 eyes at three month post-surgery collected from two sites

Site 1	45	y = 1.02x − 0.15	R^2 = 0.95
Site 2	29	y = 1.01x − 0.14	R^2 = 0.98
Total	74 eyes	y = 1.02x − 0.15	R^2 = 0.96

REFRACTIVE OUTCOME

In total over both sites, the 3-month post-surgery follow up visit was 80% or 74 eyes. The analysis of the refractive outcome for this follow-up cohort provided the following results: Results given in Table 2 will be further detailed and assigned to the two participating sites below.

Predictability refraction achieved vs. attempted manifest refraction spherical equivalent (MRSE) correction was found to be relatively equal between the two sites. Results for the entire cohort of 74 eyes from the two sites are presented in Figure 1. The differences given in terms of linear regression can be found in the table attached to the figure. Most of the eyes (>80 %) were corrected within a range of ± 0.5 D around plano. In conjunction with this finding, the mean MRSE changed from −4.12 D ± 2.02 D preoperatively to −0.05 D ± 0.44 D postoperatively on average over the sites. These are reliable high-quality results.

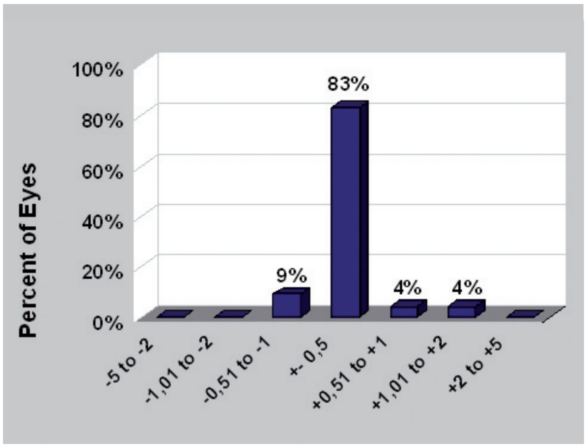

Figure 2: Refractive outcome for MRSE at three month. Percentage of the eyes within attempted, sectioned in the intervals as given on the abscissa for 74 eyes together for all three sites.

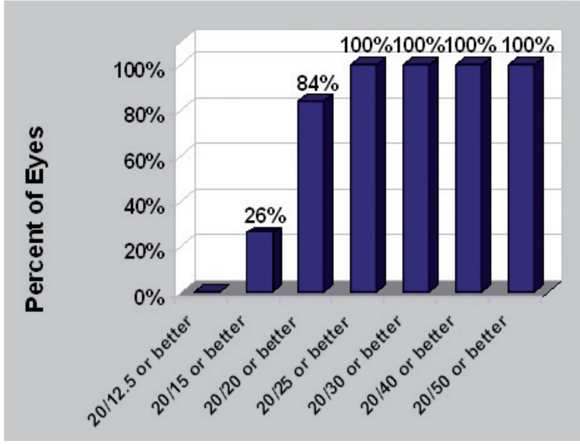

Figure 3: Efficacy at three month. Cumulative percentage of eyes with uncorrected visual acuity in the intervals given on the abscissa for 31 eyes collected from both sites. Note only eyes with attempted plano refraction are gathered.

		(−0.51 to −1.00) D	± 0.50 D	(+0.51 to +1.00) D	(+1.01 to +2.00) D
Site 1	45	13 %	73 %	7 %	7 %
Site 2	29	3 %	97 %	-	-
Total	74 eyes	9 %	83 %	4 %	4 %

Cumulative		20/15	20/20	20/25	20/30
Site 1	7 eyes	86 %	100 %	100 %	100 %
Site 2	24 eyes	8 %	79 %	100 %	100 %
Total	31 eyes	26 %	84 %	100 %	100 %

Refractive outcome – MRSE percent within attempted

Refractive outcome is shown in Figure 2. 83 % of all eyes from the two sites are found between ± 0.5 D around the attempted target refraction. Cumulative 96 % are within ± 1 D with no clear trend towards overcorrection or undercorrection. Only 4% or 3 eyes of all 74 eyes fall out of the ± 1 D into the ± 2 D interval. As stated above, we believe this refers to the non-optimal system parameter settings at the very beginning of the study and also due to the surgeon's learning curve. The former effect seems to have the dominant influence. Our interpretation is based on the fact that most"outliers" responsible for the eyes within ±1 D to ± 2 D as well as some of those between ± 0.5 D to ± 1 D range were clearly attributable to the first treated eyes, and the results were better after adaptation and optimization of the VisuMax® system parameters.

Efficacy – UCVA at one month

Findings for the uncorrected cumulative visual acuity (UCVA) at three months post-surgery for both sites are summarized in Figure 3. About one quarter of the patients are 20/15 or better (26 %), and 84 % are at least 20/20. All eyes are 20/25 or better. We believe this data to be representative, although only 31 eyes were covered for the efficacy analysis. This result is all the more impressive if the unchanged and non-adapted MEL 80™ nomogram implementation is taken into account.

Safety – Change in best corrected visual acuity

Best spectacle corrected visual acuity (BSCVA) changes pre- to post-surgery (see Figure 4) demonstrate safety of the VisuMax® flap cutting followed by the MEL 80™ refractive correction approach. 99 % of all eyes were unchanged or gained one or two lines after three months post surgery. Only one eye lost one line, but no eye lost two or more lines.

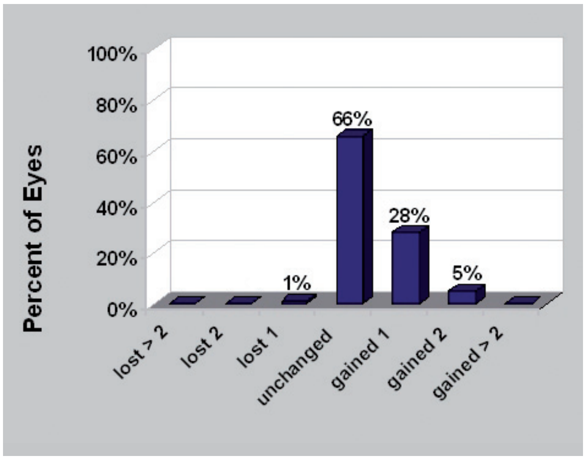

Figure 4: Safety at three month. Percentage of eyes change in best spectacle corrected visual acuity in the intervals given on the abscissa for 74 eyes together for the two sites.

		Lost 1 line	Unchanged	Gained 1 line	Gained 2 lines
Site 1	45	2 %	53 %	38 %	7 %
Site 2	29	–	83 %	14 %	3 %
Total	74 eyes	1 %	66 %	28 %	5 %

Stability – Refraction (MRSE)

We found stability (see Figure 5) of the refractive correction over time to be excellent. The refractive end point of the mean MRSE appeared to be stable by the one-week visit. The three-month results showed slight improvement compared to the one-week results. Moreover, we found the scattering of the stability data around the mean to be within the ± 0.5 D interval.

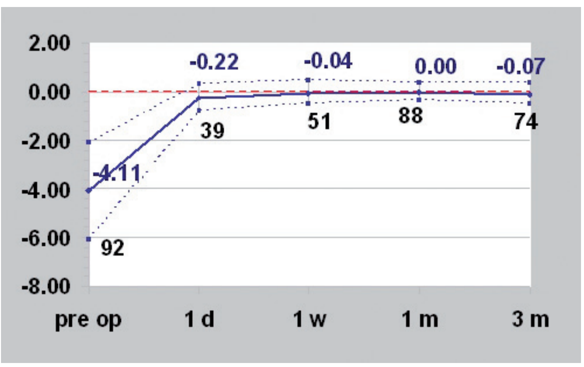

Figure 5: Stability after three months. MRSE change from pre-surgery to 1 day (1 d), one week (1 w), one month (1 m), and three months (3 m) post-surgery for 74 eyes collected from both sites.

ADVERSE EVENTS AND COMPLICATIONS IN THE VisuMax® GROUP

As the femtosecond flap cutting using VisuMax® was a completely new approach, we paid special attention to findings related to adverse events and complications. One main issue with LASIK in general is the occurrence of dry eyes. In total over the two sites, we had 20 cases suffering from mild sicca syndrome (see Table 3). After three months, about half of the eyes with sicca syndrome completely disappeared and in 11 cases, the sicca syndrome remained. This number is absolutely comparable to our experience with microkeratome flap generation and confirmed our expectations in this respect. We did not expect to find a measurable difference in dry eye syndrome between eyes treated with the VisuMax® and a mechanical microkeratome with the limited amount of eyes treated in this study. It is still under debate if a difference in

Adverse Events / Complications	Quantity – overall / three months		
	Site 1	Site 2	Total
Dry eye	13 / 8	7 / 3	**20 / 11**
Epithelium in the interface	4 / 4	0	**4 / 4**
Eye irritated	0	0	**0**
VA blurry, (interface) Haze, other complaints	0	0	**0 / 0**
DLK / corneal infiltrate or ulcer?	0 / 0	0 / 0	**0 / 0**
Microstriae	0	2 / 1	**2 / 1**
Opening of flap / flap lift / flap repositioning	0	1	**1**
Corneal epithelial defect involving the keratectomy	0	0	**0**
Flap complications (lost, incomplete, too thin, other)	0	0	**0**
Light sensitivity (not transient light sensitivity syndrome)	10 / 0	0	**10 / 0**

Table 3: Summary table of adverse events or complications for both sites. The first number given in each cell represents the overall event number and the second number shows the finding after three months post-surgery.

sicca could be reasonable and understandable in view of the origin of sicca discussed so far today. The cut geometry of the VisuMax® femtosecond laser system is definitely different to the cut geometry of a mechanical microkeratome[5, 7]. VisuMax® flaps appear to be more consistent whereas mechanical microkeratomes often cut deeper in the periphery and thinner in the center. Moreover, the sidecut geometry is different in that it is much steeper in the VisuMax® flaps compared to mechanical microkeratome flaps. It must be noted that the VisuMax® is not restricted to steep sidecut angles but also allows flat running flaps at the edges. However, we found steeper steps to be advantageous for the purpose of flap handling. Furthermore, we had four cases of epithelium in the interface and no case of DLK. In 2 cases, we found microstria formation after surgery, which in one of the eyes disappeared completely after three months. At site 1, some patients (ten eyes) complained about an increased light sensitivity for a short time directly post-surgery. This light sensitivity disappeared fully within a few weeks and no patient suffered from light sensitivity after three months. It must be emphasized that the light sensitivity found was neither as pronounced as the known transient light sensitivity syndrome (TLSS), nor were there clinical indications for TLSS present in our opinion (see, for example 6). In some cases, we were concerned with technical issues. In 4 cases, we observed inadequate suction immediately registered by the system while docking of the contact glass to the eye. Inadequate suction in such cases was related to the wrong selection of the contact glass size and could be avoided by using the appropriate white-to-white limbus diameter. In a few very early cases we observed suction leakage due to a factory defect of the contact glass. The problem was solved by increasing contact glass production quality control measures.

WORKFLOW EFFICIENCY, PATIENT COMFORT AND OTHER ASPECTS

The VisuMax® learning curve was shorter than for a mechanical microkeratome although the VisuMax® device itself appeared very impressive to us during the first inspection. This is due to the clear and safe control concept and the straightforward application approach implemented in the system. Carl Zeiss implemented a very effective, safe, and easy-to-use contact glass interface with the ‘gentle corneal interface’ concept. Unlike other femtosecond laser systems[2, 3, 4,], suction is applied only to the cornea and limbus rather than to the sclera, hence avoiding trauma to the conjunctiva. Moreover, in contrast to most other femtosecond laser systems[3, 4], the VisuMax® creates a spherical contact interface only with the corneal surface and limbus. Due to a curved contact glass design, excessive deformation of the cornea is avoided. This unique corneal suction approach guarantees very low suction pressure and, therefore, keeps the IOP increase mediated low as well. This is very important for the surgeon and very comfortable for the patient. All our patients could clearly see the fixation target during the docking procedure and after initiation of the suction. This makes it possible to perform docking and alignment pursuant to patient cooperation (auto-centration) that is a prerequisite for good flap centration. The effective suction time is about the treatment time for flap cutting itself because there is no additional adaptation process and additional suction time necessary as with other systems[4]. We found the short suction to be very convenient for the patient also. Net flap creation time that also corresponds approximately to the suction time for the procedure lies between 20 to 45 seconds depending on the flap diameter and treatment mode selected. We experienced the fast and straightforward bilateral flap creation with the VisuMax® as very advantageous. Last but not least, the low VisuMax® femtosecond pulse energy avoids thermal heating and access energy to be deposited in the stromal tissue. Therefore, no change in the postoperative steroid regime is required when transferring from mechanical microkeratomes to femtosecond flap cutting.

VisuMax® provides good structural separation of the flaps from the flap bed tissue. The flap beds were smooth with a finely structured stromal bed surface and clean edges. Flap opening is easy and comparable to a mechanical microkeratome flap relift after three months. Flaps created are different to microkeratome flaps because they have a step sidecut angle. We found that flap repositioning is more precise and that flaps insert naturally into their bed (like manhole cover “fit” of flap). Flaps seem to be more stable and behave more practically. We associate this with the more constant flap thickness that is found in (5) to be published soon. In this study, it was found that flap thickness is highly predictable with the VisuMax® (mean central flap thickness for 24 eyes at 3 months post-surgery: 112.3 ± 7.9 µm for intended flap thickness of 110µm, i.e. accuracy of +2.3 µm and reproducibility 7.9 µm).

Through the pivoting patient bed combining the two laser systems, an ergonomic workflow of the entire surgical procedure, i.e. flap cutting plus refractive treatment, is guaranteed without having to move the patient between these steps and without delay times between femtosecond flap cut and excimer laser ablation. Only minimal opaque bubble layer (OBL) was present on arrival at the MEL 80™ and the eye tracker was instantly functional without any need for stromal bed massage.

CONCLUSION

The Carl Zeiss Meditec workstation combining VisuMax® and MEL 80™ provides safe, predictable, stable, and high-quality refractive outcomes, with a fast visual recovery. No adverse events occurred and complications like microstria and dry eyes for femtosecond flap cutting were comparable to the experiences gained with the established LASIK procedure over years. Flap quality is excellent and flap beds very smooth. We attribute the improved flap handling and repositioning to the advantageous sidecut geometry and homogeneous thickness of the flaps. Due to the clear concept of the application procedures, only a very short learning phase is required to get used to the workstation and its usage. It is safe and effective in daily practice and allows for a high level of surgeon reliance and patient comfort due to the 'gentle corneal interface concept', enabling low corneal suction and short suction times.

REFERENCES

1. *Michela Cimberle, New femtosecond laser provides cutting accuracy and 'gentle touch', OSNsupersite 18.09.2007, http://www.osnsupersite.com*
2. *Mike P. Holzer, Corneal surgery with the Femtec laser, Cataract & Refractive Surgery Today Europe, Vol. 2, No. 3, 63-64, April 2007*
3. *Anton C. Wirthlin (reviewer), The ultrastable and compact Femto LDV, Cataract & Refractive Surgery Today Europe, Vol. 2, No. 3, 65-66, April 2007*
4. *John Marshall, IntraLase: the most versatile femtosecond laser choice, Cataract & Refractive Surgery Today Europe, Vol. 2, No. 3, 67-69, April 2007*
5. *Dan Z. Reinstein, Accuracy and Reproducibility of Flap Thickness with the VisuMax® Femtosecond Laser System, to be published.*
6. *Gonzalo Muñoz, César Albarrán-Diego, Hani F. Sakla, Jaime Javaloy, Jorge L. Alió, Transient light-sensitivity syndrome after laser in situ keratomileusis with the femtosecond laser – Incidence and prevention, J. Cataract Refract. Surg., Vol. 32, 2075-2079, December 2006*
7. *Rainer Wiltfang, Zeiss VisuMax® femtosecond system in combination with the MEL 80™ excimer laser, to be published*

DS No.: 0000000-1508-678
Specifications subject to change.
Printed in Germany. Printed on environment-friendly paper, bleached without the use of chlorine. PUBLICIS X/07

Carl Zeiss Meditec AG
Goeschwitzer Strasse 51–52
07745 Jena
GERMANY

Phone: +49 36 41 22 03 33
Fax: +49 36 41 22 02 82
info@meditec.zeiss.com
www.meditec.zeiss.com

Carl Zeiss Meditec Inc.
5160 Hacienda Drive
Dublin, CA 94568
USA

Phone: +1 925 557 4100
Fax: +1 925 557 4101
info@meditec.zeiss.com
www.meditec.zeiss.com