# Femto-LASIK treatment for myopia and presbyopia using a non-linear aspheric ablation profile and micro-monovision

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**We present a case of successful femto-LASIK treatment for myopia and presbyopia performed with the MEL 80 excimer laser (Carl Zeiss Meditec AG) using a non-linear aspheric ablation profile and micro-monovision. Postoperatively, neural adaptation time was less than 1 week, and the patient achieved full spectacle independence in his everyday life.**

## CASE HISTORY

A 60-year-old presbyopic male with myopia presented seeking a solution that would provide him with spectacle independence in his everyday life. His spherical refraction was -4.50 D OD and -4.00 D OS. He demanded freedom from glasses for far and intermediate vision because he participates in many sports as part of an active lifestyle, and he stated that he cannot tolerate multifocal glasses. The anamnesis questionnaire showed that his preferred distances for performing near and intermediate tasks were typically greater than 50 cm.

The patient was determined to be a good candidate for a femto-LASIK procedure using a non-linear aspheric ablation profile for increased depth of focus and targeting micro-monovision.

## PREOPERATIVE ASSESSMENT

At our center, patients aged <65 years who have good, stable BCVA are first evaluated for laser vision correction rather than lens exchange. According to our protocol, the assessments performed in this patient included autorefractometry and keratometry (NIDEK CO., LTD., ARK-1a), non-contact tonometry (NIDEK CO., LTD., NT-530), pachymetry, corneal topo- and tomography with keratoconus screening (OCULUS Optikgeräte GmbH, Pentacam HR), and corneal biomechanical properties measurement (OCULUS Optikgeräte GmbH, Corvis ST). Full eye wavefront, scotopic and photopic pupil diameter (Carl Zeiss Meditec AG, WASCA) and stereopsis were also measured. Next, the patient's near and far uncorrected and corrected subjective visual acuity and manifest refractions were tested both monocularly and binocularly by an ophthalmologist; ocular dominance and monovision tolerance were also determined (Table 1). The patient had right eye dominance, and he could tolerate 1.75 D of monovision.

Cycloplegic refraction was determined after pupil dilation with pilocarpine. Slit lamp examination revealed no sign of cataract nor any posterior segment abnormalities. Based on the testing and measurements, the patient was found eligible for laser corneal refractive surgery.

Managing patient expectations for surgical outcomes is also an important component of the preoperative visit for laser vision correction. All patients watch an educational video that informs them about the basic features of the treatment and answers several frequently asked questions, thereby allowing the refractive surgeon to focus on patient-specific issues, such as visual outcome, neural adaption time (2-3 months), and changes in field of view.

## TREATMENT

Manifest refraction, ocular dominance, and preferred monovision tests were repeated by the surgeon before the procedure to check their validity. Since the patient's scotopic pupil size was 5.71 mm OD and 5.67 mm OS, the optical zone was increased to 6.5 mm from the default 6 mm.

The treatment was planned on the CRS-Master workstation (Carl Zeiss Meditec AG) using data from the topography and wavefront measurements and other inputs determined by the surgeon (Figure 1). The ablation data file that is generated is transferred electronically to the laser via USB memory stick.

| | Refraction | CDVA | Binocular CDVA | Dominant eye | Add to distance correction | CNVA* | Monovision target |
|---|---|---|---|---|---|---|---|
| OD | -4.50 D sph | 1.0 | 1.10 | X | +2.50 D | J2 | 0.00 D |
| OS | -4.00 D sph | 1.0 | | | +2.50 D | J2 | -1.75 D |

Table 1: Results of preoperative subjective tests
CDVA: corrected distance visual acuity; CNVA: corrected near visual acuity
*CNVA is measured from 40 cm using Csapody's reading test and converted to Jaeger standard.




Figure 1: Screenshot of the CRS-Master Laser Blended Vision planning software module.

The flap was created with an FS60 femtosecond laser (Abbott Medical Optics Inc.). Flap diameter and thickness were 8.9 mm and 110 µm, respectively. The aspherical refractive correction was performed using a MEL 80 excimer laser. The target refraction of the non-dominant eye was set to -1.75 D. Apart from the difference in the planning process, the procedure and its aftercare are the same as for standard femto-LASIK.

## POSTOPERATIVE FOLLOW-UP

Uncorrected distance visual acuity (UDVA) at the postoperative day 1 examination was 0.95 OD and 0.2 OS, and the patient was able to read J2 binocularly. While he was happy with his acuity, he complained about hazy, blurry vision.

At his next visit on postoperative day 7, the patient reported that the haziness disappeared on the second day after surgery, but he still had a small amount of blur. His binocular UDVA and UNVA were 1.00 and J2, respectively. UDVA in his right eye was 1.2, indicating that neural adaptation was not complete.

At 1 month after surgery, the patient reported that the blur completely disappeared on the day after his previous check-up. His binocular UDVA was 1.1, he was able to read J2, and he stated he was completely satisfied with the results.

The patient returned for follow-up again at 2 and 6 months after surgery. He reported experiencing some increased eye dryness, but said it was easily manageable with artificial tears and that his symptoms were decreasing with time. Binocular UDVA continued to improve during follow-up as the neural adaptation process progressed and the eye dryness decreased (Table 2).

## SUMMARY

This case demonstrates successful application of a non-linear aspheric ablation profile for presbyopic corneal femto-LASIK treatment using the MEL 80 excimer laser and a micro-monovision target. Postoperative neural adaptation time was about 1 week, and the patient gained full spectacle independence in his everyday life.

Our 7-year experience with blended vision treatments shows that precise preoperative determination of the manifest refractions and ocular dominance are crucial elements for achieving success and patient satisfaction. We also pay particular attention to finding the optimal refraction difference between the dominant and non-dominant eyes and assessing monovision tolerance. It should be noted that some myopic patients show no clear eye dominance. In such cases, more effort is necessary to ascertain the patient's monovision preference (i.e. testing both for near vision) if any.

In conclusion, the corneal laser blended vision approach described here is a safe and effective method for simultaneously correcting presbyopia and refractive error. Proper patient education and management of expectations, however, are very important to minimize any complaints during the period before postoperative healing and neural adaption are complete. ■

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| Postoperative visit | Eye | UDVA | Refraction | CDVA | Binocular UDVA | Binocular UNVA |
|---|---|---|---|---|---|---|
| Day 1 | OD | 0.95 | +0.50 | 1.0 | 0.9 | J2 |
| | OS | 0.2 | -1.75 | 1.0 | | |
| Day 7 | OD | 1.2 | +0.25 | 1.2 | 1.0 | J2 |
| | OS | 0.25 | -1.75 | 1.0 | | |
| Month 1 | OD | 1.0 | -0.25 | 1.1 | 1.1 | J2 |
| | OS | 0.4 | -1.75 | 1.0 | | |
| Month 2 | OD | 1.1 | 0.00 | 1.1 | 1.2 | J2 |
| | OS | 0.35 | -1.50 | 1.0 | | |
| Month 6 | OD | 1.1 | 0.00 | 1.1 | 1.2 | J2 |
| | OS | 0.35 | -1.50 | 1.0 | | |

Table 2: Visual acuity and refraction outcomes at follow-up from day 1 to month 6

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