NEAR VISION AREA WITHOUT BINOCULAR DISTORTIONS

IN PERSONALIZED FREE-FORM PROGRESSIVE LENSES WITH AN INCREASING CURVATURE FRONTAL BASE CURVE

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INTRODUCTION

The ideal optical **base curve** for each dioptric is represented in the **Tscherning Ellipse**: a graphical representation of the frontal surface power according to the total lens power in the best-form lenses *(Figure 1)*. The **Tscherning ellipse shows two possible solutions**:

- **The Oswalt branch**: represents the flatter curve most appropriate for a lens, which has become the basis for standardized lens base curve.
- **The Wollaston branch**: the most curved frontal surface.

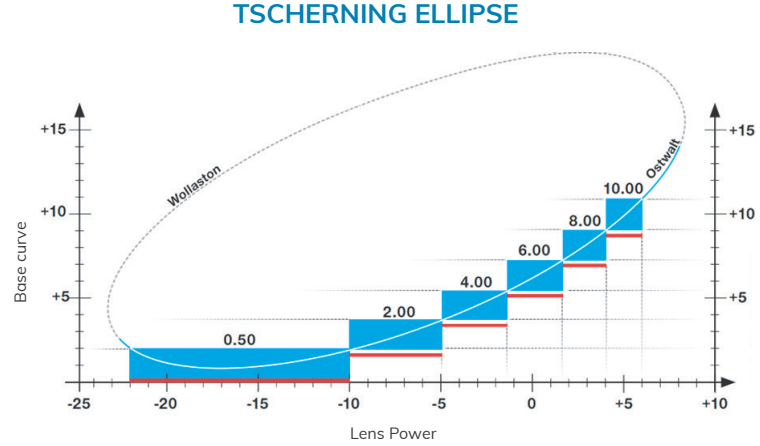

Figure 1

When the power of a lens is selected with its **ideal base curve, the wearer enjoys a clear vision with minimal oblique astigmatism**. On the other hand, if the base curve falls outside the ideal range for a determined optical power, the wearer's off-axis visual acuity decreases precipitously. This performance has a great influence in a progressive lens since the **reading zone can only be accessed in an oblique angle**. Therefore, if the base curve is poorly matched, the patient might experience an abrupt drop-off in visual acuity of the reading area.

A **progressive addition lens (PAL)** has many optical powers; and therefore has many ideal base curves, which increase a diopter from the top to the bottom. The **distance visual area needs a flatter base curve**, whereas a **steeper base curve is most appropriate for the near visual area**. When a free-form progressive lens is manufactured with a single vision lens blank, various optical powers must share a single base curve. Consequently, the near zone does not have a correspondent frontal surface. In order to improve the base selection on the single vision lens blank, a continuously increasing base curve (three diopters from the top of the lens blank to the bottom) is proposed to have a better suited progressive prescription.

PURPOSE

To evaluate the differences in near vision areas without binocular distortion in personalized free-form progressive lenses due to the use of an increasing variable frontal base curve of the lens.

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MATERIALS AND METHODS

DESIGN

A double-blind prospective observational longitudinal trial was performed on a sample of 21 presbyopic subjects (15 women and 6 men between 50 -63 years old), who have been worn progressive lenses for at least one year.

CLINICAL TRIAL PROCEDURE

After wearing a pair of tested PALs for a week, the undistorted near visual area was evaluated using a special test from IOT.

The test consists of a chart with different lines of letters of visual acuity 0.1 LogMAR, which patients have to choose their favorite lecture line (*Figure 2*) at 35 cm, without moving their heads.

Afterwards, the selected line is separated from the rest (*Figure 3*), and patients read the letters from the central one to their right/left areas until the blurry vision starts (**clear near vision area**) and/or they cannot recognize any more characters (**limit near vision area**).

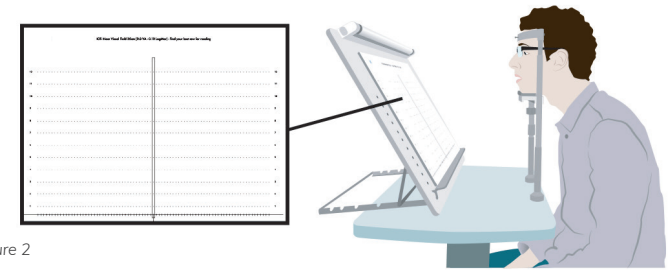

Figure 2

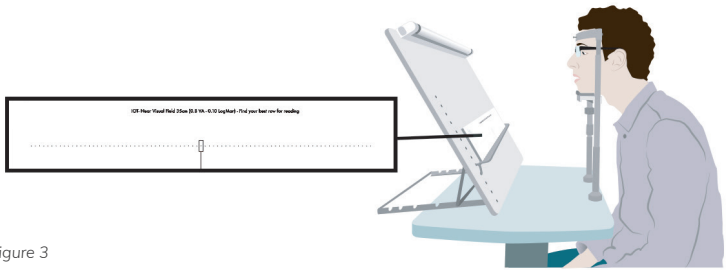

Figure 3

STATISTICAL ANALYSIS

Design of randomized complete block test was used to determine differences in visual acuity among the lens designs. All statistical tests were performed using *Statgraphics Centurion XVI.II* software.

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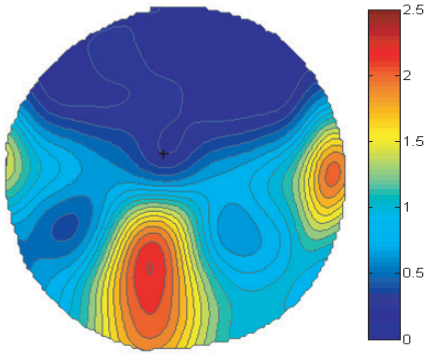
MATERIALS AND METHODS *continued*

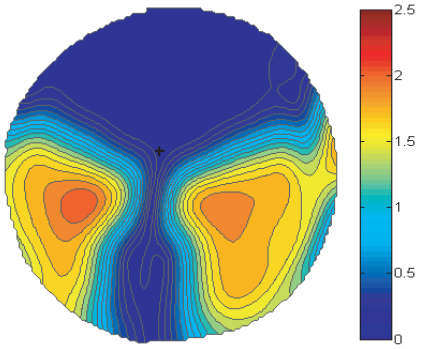
PROGRESSIVE LENSES

2 progressive addition lenses, were tested for a week each. Both lenses, which were developed by IOT, showed the same power distribution perceived by the users, according to Sheedy's research *(Figure 4)*.

MEAN POWER MAP



CYLINDER POWER MAP



SHEEDY CONTOURS

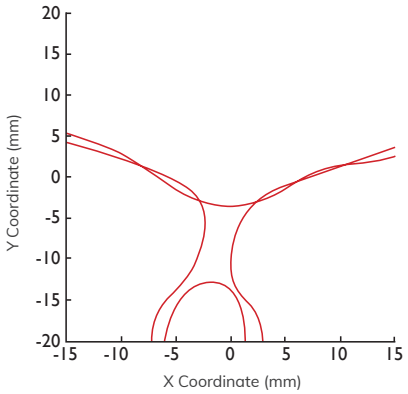
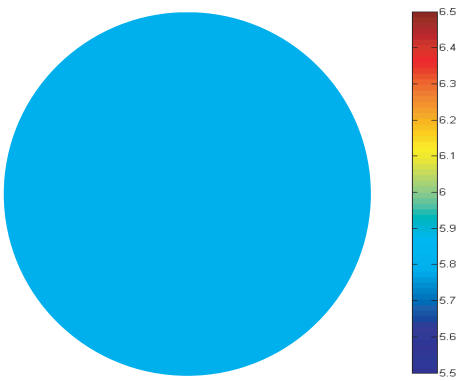


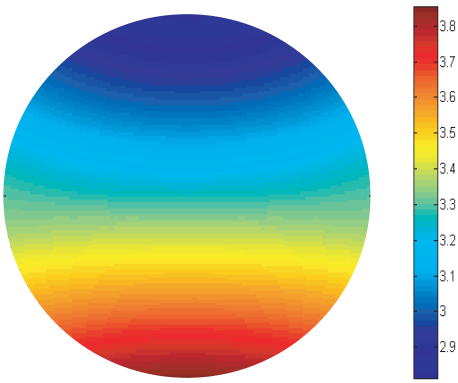
Figure 4

However, one of the PALs showed an **aspheric base curve**, which increased its curvature from the top to the bottom part of the lens (Camber™ lens blank, Younger Optics). The other PAL had a simple **spherical base curve** *(Figure 5)*.

FRONTAL BASE CURVE

PAL-A (SPHERICAL BLANK)





PAL-B (CAMBER™ BLANK)

Figure 5

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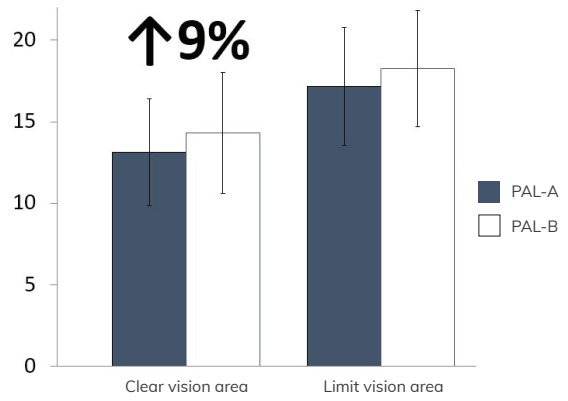
RESULTS

The clinical assessment of the undistorted near vision area revealed significant differences among the different PALs tested. A **significantly wider and clearer near visual area was found in the progressive lenses with an increasing variable frontal base curve**.

A significant **increase of 9% in clear vision** of the near visual area was found in patients wearing lenses with an increasing variable frontal base curve (*Figure 6*).

UNDISTORTED NEAR VISION AREA



	PAL-A	PAL-B	P-VALUE
CLEAR NEAR VISION AREA (MM)	13.13 ± 3.28	14.32 ± 3.60	0.006*
LIMIT NEAR VISION AREA (MM)	17.17 ± 3.71	18.25 ± 3.57	0.070

Figure 6

CONCLUSIONS

The area of near vision without distortion can be improved using a variable frontal base curve that increases in curvature from top to bottom. Specifically, in this work, an increase of 9% in the clear area of near vision was found, indicating a better visual performance for reading tasks.

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