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Corneal rehabilitation of long term PMMA lens wearers using SGPII RGP lenses

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Corneal rehabilitation of long term PMMA lens wearers using SGPII RGP lenses

Abstract
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CORNEAL REHABILITATION OF LONG TERM PMMA LENS WEARERS

USING SGPII RGP LENSES

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APRIL 20, 1988

FOURTH YEAR THESIS PROJECT

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Acknowledgements

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ABSTRACT

The adverse effects of long term PMMA lens wearers include edema and corneal changes, which lead to decreased wearing time of lenses and refractive changes. To alleviate or prevent such detrimental effects, corneal rehabilitation with RGP lenses is mandated. In this study, long term PMMA lens wearers (average of 17.7 years) were refitted with the SGP II RGP lenses of the Permeable Contact Lens Company. The fitting technique consisted of using the lacrimal line/reference line in assessing a proper fit. Due to subsequent changes of the metabolism of the cornea, the lenses had to be modified during progress evaluations. After the cornea stabilized, the mean corneal thickness had decreased.
INTRODUCTION

The advent of gas permeable materials has created the potential for greatly enhancing the physiological compatibility of any contact lens in situ. The corneal environment now provided by these new materials offers a dramatic improvement when compared to that common to the PMMA designs of yesteryear.

Routinely refitting long term asymptomatic PMMA lens wearers has become a preferred standard of care for these individuals. Corneal changes that are characteristic of long term PMMA lens wear even in asymptomatic cases are:

1) Edema.
2) Corneal distortion.
3) Stromal changes.
4) Spectacle blur.
5) Refractive changes.
6) Increased corneal thickness.
7) Epithelial dessication-staining.
8) Endothelial changes: Polymegathism, Morphism.

The most probable cause for the above corneal changes is predominantly due to the hypoxic conditions created by the PMMA material. Oxygen is provided to the cornea by diffusion from blood supply, atmospheric oxygen, tear layer, and aqueous. The cornea requires 3-5% of normal atmospheric oxygen concentration to thrive. The tear pump provided by the exchanged tear volume via lens movement provides only 1-3% oxygen. Therefore, in order to supply additional oxygen to the cornea, the lens material must be permeable to air to prevent subsequent varying degrees of edema. RGP lenses are said to provide an additional 0-5% of oxygen needed for proper physiological metabolism.
Clinical studies have shown that RGP lenses induce less edema, corneal curvature changes, and spectacle refractive changes than that produced by PMMA lenses. It therefore behooves the clinician to create a more beneficial environment for the long term PMMA lens wearers. Although PMMA lenses provide adequate refactive error correction, the clinician must also be responsible for providing optimum corneal conditions that will allow for longevity of daily wear rigid lenses.

The purpose of this study is to establish the beneficial results from refitting with SGPII™ gas permeable lenses utilizing apical alignment fitting philosophies.

METHODS

Seven long term PMMA lens volunteers (5 female, 2 male) were chosen for this study based on their history of symptom free lens wear and unremarkable ocular response. Our definition of acceptable ocular response was minimal corneal staining, central corneal clouding of grade 2 or less, minimal corneal distortion and lens off refraction that provides 20/25 visual acuity or better. Duration of wear averaged 17.7 years with 13.4 or more hours of lens wear per day.

Pre study evaluation of the subjects was performed in our Pacific University Optometry Clinic at early evening hours after all day PMMA lens wear. The examination data included lens off and on visual acuities, refraction, biomicroscopy, keratometry, tonometry, pachometry, ophthalmoscopy, and verification of PMMA lenses.

Contact lens sphere powers averaged -3.35D ± 1.65 and ranged from -6.75D to -1.25D. Cylinder powers averaged -.643D ± .49 ranging from -1.25 to plano. Keratometric findings averaged 43.16D ± 1.94 ranging from 40.75D to 47.75D in the flat meridian and averaged 44.00D ± 2.28 ranging
from 41.000D to 48.250D in the steep meridian. The base curves averaged 7.84 mm and ranged from 7.26 to 8.40.

The new parameters to be ordered were based on diagnostic trial lens fittings and fluorescein pattern evaluation of the fit.

Fluorescein aids the clinician by enhancing corneal bearing relationships, movement, pooling, centering, tear exchange, and apical clearance. A desired contact lens/cornea relationship was established for purposes of consistancy for the study. The criteria for acceptance of fit was finalized by the Lacrimal Line/Reference Line (LL/RL) evaluation. This procedure is accomplished by using fluorescein and a biomicroscope with cobalt blue filter in place. The oculars are set at 45 degrees or more from perpendicular to the cornea plane while the blue light in optic section remained perpendicular to the contact lens/cornea apex. Two fluorescein lines will appear in moderate magnification; one represents the tear layer thickness under the contact lens (lacrimal line), while the other is the tear layer thickness present on the anterior surface of the lens (reference line). The ratio helps to quantify apical proximity. A 1:1 ratio means an alignment fit of the posterior surface of the lens and the contour of the central cornea. A 1:1.1 ratio or less means apical clearance. A 1:0.9 ratio or more means apical touch. We fit between 1:1 and 1:1.3. One must become accustomed to one's own estimation as the ratio will vary between clinicians. Two clinicians collaborated and agreed upon a ratio before accepting the fit. The lacrimal line can also be utilized to assess peripheral bearing/seal off conditions by viewing the wedge of tears at far periphery being continuous with the lacrimal line or not.

The lens design was determined by using the accepted base curve of the trial lens. The lenses were of larger overall diameter than previous PMMA lens design. This allows for a reduction of the O.A.D. if necessary. Also a
larger O.A.D. aids in better centration and flare problems. A tricurve design was chosen with the intermediate curve being 0.5 mm flatter than the optic zone radius and 0.2 mm wide. The peripheral curve is 2.0 mm flatter than optic zone radius and 0.3 mm wide. This allows for further flattening with modification in order to provide for a proper edge meniscus. A medium blend was put on all lenses. An over refraction provided the lens power ordered. Due to our lens supply limits, we needed to design lenses that could be modified easily rather than replaced.

The lenses were dispensed, followed by evaluations weekly for 1 month and then twice a month for 2 months. Visual acuities, keratometry, lens off and on refraction, biomicroscopy, and pachometry measurements were taken at these follow-ups. Boston Cleaning and Reconditioning solutions were provided. Enzyiming was done weekly.

RESULTS

Lens on visual acuities of 20/20 were established with all lens refits. End of study spectacle correction provided 20/20 acuity in all cases. Changes in the lens off refraction after day 30 were not statistically significant ("t" test with 13 degrees of freedom, p>.82 for sphere and p>.42 for cylinder). Refer to the following graphs.
Full time wearing schedules were given at the dispensing. No patients reported reduced wearing time throughout the study.

Modifications allowed for increased comfort. Some of the modifications were; anterior bevels, blending, O.A.D. reduction, peripheral curve flattening, and polishing.

Corneal thickness decreased an average of 0.026 mm in 7 days and 0.056 mm in 30 days. A comparison of baseline mean corneal thickness to that of day 30 demonstrated that the change in corneal thickness is significant ("t" test with 13 degrees of freedom, p<0.01). Refer to graph 3.
This data suggest that the SGPII™ lenses provided oxygen supply to adequately decrease varying degrees of edematous corneas.

Mean corneal curvatures changes from baseline to day 30 were not statistically significant for both the mean flat and steep meridians ("t" test with 13 degrees of freedom, p>0.85 & p>0.76 respectively). Refer to graph 4 & 5 below.
On subjective preference based on overall vision and comfort, 5 of the 7 patients preferred the SGPII™ lenses over the PMMA lenses. One patient was undecided and one patient preferred the PMMA lenses. This dissatisfaction may be more solely due to mishandling of the lenses by the patient.

The complication most prominent in the study was 3-9 staining with one case of epithelial keratitis. All of these were alleviated through modifications.

DISCUSSION

The SGPII™ rigid gas permeable lenses (dK 43 x 10⁻¹¹) along with the fitting design produced a reduction of edema, prolonged wearing time, good visual acuities, less spectacle blur, unaltered corneal curves, and no distortion.

Prolonged PMMA lens wearers should be refit with a RGP lens utilizing the Lacrimal Line/Reference Line ratios in order to provide proper physiological and metabolic conditions for the cornea. Changes in overall lens design were made in order to maximize tear exchange and lens movement with proper centering. Sarver et. al.⁶ reported that tear pump alone should provide adequate oxygen to the cornea; in addition, we found that gas permeable lenses add to the overall rehabilitation of the cornea that tear pump alone cannot provide.

Tomlinson and Bennet⁷ found greater corneal curve changes and refractive changes than we experienced in our study. This can be accounted for by the many different fitting theories presently being used to refit long term PMMA lens wearer. By keeping many of the parameters constant throughout our study, more emphasis was placed on providing a optimal environment for the cornea.
CONCLUSIONS

The results of this study suggest that immediate refitting of long term PMMA lens wearers with SGPII™ lenses is a reasonable management option. Proper clinical judgement of fluorescein patterns using LL/RL ratios is an effective method for a diagnostic lens fit.

The patient must be informed that the newly fit lenses are temporary and that lens changes may be warranted as the cornea returns to its normal state. A wearing schedule should be similar to the patient's current schedule. The patient must be seen on a regular basis (weekly) until the cornea is physiologically stable and free of any insult. If at any time during the follow-up period the cornea fails to improve or worsens, alternate forms of care must be provided i.e.; refitting or redesigning the lens, complete withdrawal, or referral to an appropriate practitioner. The drawback is increased chair time, however, patient comfort, satisfaction, and overall corneal health makes refitting a desired option. This method may not be appropriate in all cases, but this fitting method may be less costly for the patient in the long run. The SGPII™ lens is an excellent lens of choice for refitting and rehabilitation of the oxygen deprived cornea.
REFERENCES


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