### Introduction

Several corneal abnormalities result in decreased visual acuity due to irregular astigmatism or corneal opacities. Corneal degenrations, eczemas, dystrophies, keratoconjunctivitis sicca and scars are examples of abnormalities that can reduce vision. The management of these patients may include fitting corneal rigid gas permeable (GP) contact lenses (1). However, fitting these lenses in advanced cases can be challenging as a result of lens decentration, dislocation, or discomfort. Surgery may be the next option for those patients that cannot be fit for or are unable to tolerate contact lenses. Modern scleral lenses offer a new alternative for patients who have not had success with other lens types. Scleral Lenses were first reported in 1888 by Adolph Fick and have now been reintroduced in newer materials. The manufacturing process for scleral lenses has been improved, and larger lens diameters can now be accurately reproduced. The designs of contemporary scleral lens prototypes were largely developed by both Don Ezekiel, O.D. and Perry Rosenthal, M.D. (2,3). Reciently scleral lenses have been manufactured using high Dk materials. Parameters including diameter, base curve, peripheral curve and power can be customized for each lens.

Scleral lenses are large diameter gas permeable lenses that rest beyond the limits of the cornea on the sclera. Successful fitting of scleral lenses may defer surgery for 12-17 months and decrease the risk of corneal scarring (4). Scleral lenses may be indicated for primary and secondary corneal eczemas, post-corneal transplants, and corneal scars. In addition to multiple uses for scleral lenses.

The purpose of this study was to evaluate the indications and clinical results of fitting the Jupiter Scleral LensTM in patients with corneal abnormalities at the UC Davis Eye Center.

### Materials and Methods

The electronic medical record of 63 patients fit with scleral lenses (from October 2009 to March 2011) at the UC Davis Eye Center were reviewed. The variables analyzed included basic demographic data, diagnosis, previous contact lens wear, previous surgery, length of scleral contact lens wear, and (where possible) the reason for abandoning lens wear. In addition, correct visual acuity before and after scleral fitting as well as subjective assessment of vision and comfort were examined. All patients were fit with Jupiter Scleral LensesTM (Essilor Contact Lens Division, Dallas, TX).

The Jupiter scleral lens (Mediess Innovations / Essilor) ranges from 15.0 to 24.0 mm in diameter but may be customized to any diameter. It is a semi-sealed lens that does not need to align closely with the cornea. The ideal fit of a scleral lens is a complete vault over the cornea and limbus with resting on the sclera. The Jupiter scleral lens has three zones: the corneal zone, the limbal zone, and the scleral zone. The lens is fit on the principle of sagittal depth, which is the measurement from a flat plane to the highest point of a concave surface. All lenses were fit with complete corneal clearance. The statistic lens should vault the limbus and align with the scleral conjunctiva.

The statistical analysis of the variables was compared using linear mixed effect models with a random effect for each patient. In this setting, the linear mixed effect model may be viewed as analogous to a 1-level (subject) ANOVA with data from eyes from the same patient. The distributions of binary variables were compared using Pearson’s chi-square test with a 5% significance level. No corrections for any correlations between data from eyes from the same patient.

### Results

One hundred and seven (107) eyes of 63 patients (41 male and 22 female) were fit with scleral lens between October 2009 and March 2011. The length of follow up ranged from 3 to 17 months. Mean age of the patients was 47.5 years (Range = 8-84). Study seven eyes had keratoconus (where 18 eyes had undergone surgery). Other conditions included pellucid marginal degeneration (7 eyes), irregular astigmatism post penetrating keratoplasty (10 eyes) for other conditions than keratoconus (-14 eyes), irregular astigmatism post radial keratotomy (3 eyes), post-LASIK ectasia (5 eyes), corneal scarring (post trauma or herpetic disease) (3 eyes), Salzmann’s nodular degeneration (1 eye), aphakia (3 eyes), recurrent erosion syndrome (2 eyes), keratoconjunctivitis sicca (1 eye) and chronic graft versus host disease (1 eye) (Figure 1). Eighty six eyes (80%) had been previously fit with contact lenses and were either clinically intolerant of the lenses and/or were subjectively unhappy with them. Fifty two eyes had previously worn gas permeable contact lenses, 17 soft contact lenses, 6 piggyback lenses, 26 hybrid lenses, and 2 scleral lenses fitted elsewhere. The mean diameter of scleral lenses was 16.6mm (Range = 14.8mm - 20.2mm). Reports of subjective visual acuity were good or better in 79% of the eyes evaluated. The lenses were either comfortable or very comfortable with significant improvement and the rate of complications related to scleral lens wear.

### Discussion

In this study, we report the results of scleral lens fitting with the Jupiter LensTM in 107 eyes of 63 patients with a variety of ocular conditions. Eighty six eyes (80%) had been fit with contact lenses previously and were either intolerant of them or were unhappy with their visual acuity. Clinicians have advocated surgical procedures such as the placement of intracameral ring segments or corneal transplantations as the next step in management. With the availability of effective scleral lenses, patients may now have an additional non-surgical option. Some in our series attained BCVA of 20/20.

The most common conditions in our study were corneal ectatic disorders (KCN, PMD, post-LASIK ectasia) and irregular astigmatism post corneal transplant surgery. Although the literature demonstrates the utility of scleral lenses in patients with dry eyes or other ocular surface disease (6 - 13) our series included only one patient with chronic GVHD and one patient in whom the primary diagnosis was keratoconjunctivitis sicca.

The improvement of BCVA compared with previous contact lenses or spectacle correction in all our cases was a mean gain of 3.5 Snellen lines (SD = 2.6). When fitting scleral lenses in patients with keratoconus, Schomack et al (2010) found an improvement of 2.9 lines and a median visual acuity of 20/20 (5). Romero-Rangel et al reported an improvement in BCVA of two or more Snellen lines in 53% of 76 eyes fitted with scleral lenses for ocular surface disease (6). With the Boston Ocular Surface Prosthesis, Stassen et al reported an improvement of best corrected visual acuity in mean logarithm of the minimal angle of resolution (logMAR) in patients with ectasia or astigmatism (-0.54) and in patients with ocular surface disease (-0.12) (7). The overall improvements were -0.39 units.

Other authors report success not only in BCVA but also in symptoms after fitting scleral lenses in patients with ocular cicatricial pemphigoid, Stevens-Johnson Syndrome, graft-versus-host disease and complex blepharoptosis (-12).

### Patients who abandoned scleral lenses had significantly less improvement in visual acuity relative to previous contact lenses or glasses when compared to those who did not abandon scleral lenses wear (P=0.005, see also Figure 2 a and b). Patients who abandoned scleral lens wear were also significantly less likely to find the lenses comfortable (P=0.029).

The mean age (P=0.949), mean scleral lens diameter (P=0.186) and distribution of genders (P=0.986) did not differ significantly between patients who abandoned scleral lenses and those who did not. After at least 3 months of wear, 25 eyes (23%) abandoned scleral lenses.

In the present study, during fitting the Jupiter LensesTM, patients had significantly less improvement in visual acuity relative to previous contact lenses or glasses when compared to those who did not abandon scleral lens wear (P=0.005, see also Figure 2 a and b). Patients who abandoned scleral lens wear were also significantly less likely to find the lenses comfortable (P=0.029).

Eighty-four percent of this group reported complaints (figure 4). The mean age (P=0.949), mean scleral lens diameter (P=0.186) and distribution of genders (P=0.986) did not differ significantly between patients who abandoned scleral lenses and those who did not. In summary, scleral lenses were an very effective option for the majority of our patients with corneal abnormalities providing, in a significant number of cases, both better visual acuity and comfort.

### References

Available upon request.

### Melissa Barnett

Melissa Barnett is a principal optometrist at the UC Davis Medical Center in Sacramento, CA, where she performs primary and medical eye examinations, and fits specialty contact lenses in addition to teaching ophthalmology residents. She lectures and has been published on subjects including contact lenses and creating a healthy balance between work and home life for women in optometry. In her spare time she enjoys cooking, yoga, and spending time with her husband, Todd Erickson, also an optometrist, and two sons, Alex(5) and Drew (3).