Postoperative changes in refraction are expected in the majority of patients following surgical procedures for retinal detachment. The surgical technique appears to influence these changes. The episcleral-encircling buckle is utilized frequently for retinal surgery. The most severe cases of distortion of the globe occur with additional segmental buckle.

The probable mechanism for changing the refractive error is elongation of the globe by the pressure of equatorial band. However it may be possible to prevent an excessive induced refractive error. Smiddy found axial lengthening and corresponding induced myopia. In this study, the correlation between the increase in spherical equivalent and axial length was high (p=0.000). Lancaster states that an increase of 1 mm in axial length corresponds to a refractive change of 2.5 to 3 D.

Most studies have found induced myopia after scleral buckling surgery. The amount of increased axial length depends on the height of encircling scleral buckle. The amount of induced myopia has been reported to be greater in phakic eyes than in aphakic eyes. This is explained by an anterior displacement of the lens and optical considerations from refraction at spectacle plane. Burton indicated that astigmatism may result from alteration of corneal curvature.

The refractive errors gradually diminished over the six-month follow up, with residual errors of -0.50 to -1.00 D remaining stable. Grupposo reported on the refractive changes in 105 cases of retinal detachment. In his study, the largest spherical change was -5.50 D and the largest cylindrical change was -4.00 D. Approximately 50% of patients had astigmatic errors greater than 0.50 D, but only 13% of the patients had errors that exceeded -1.00 D.

High astigmatism following scleral buckling has been reported infrequently. Induced changes in corneal shape decreased gradually over time. After encircling with additional segmental buckling, the refractive astigmatism axis corresponded to the segmental buckle. These findings thus implied that segmental buckling may induce astigmatism, and this effect was greater when a buckle was placed closer to the cornea. The encircling, intended to make an equal circular indentation of the eye, also produced a certain degree of corneal distortion and thus led to an irregular, but not statistically significant asymmetric astigmatism, 6 months after surgery.

Now let us look at individual types of surgeries and its resultant refractive error.

Encircling elements

Encircling procedures induce the greatest change in refractive error. Generally, the change is a spherical refractive change. The change is greater for phakic eyes than aphakic eyes, because of the anterior shift of lens resulting in an increased shift. The amount of direction of refractive error change is related to the height of indentation induced by the encircling band.

The various factors which modify the refractive changes in these cases are the size of the encircling element and the height that it induces in the retina. The height of the encircling element is dependent of the distance between the anterior and posterior suture placement for the encirclage and also the tightness of the sutures. If the distance between the anterior and posterior sutures placed in an encirclage is less, it will induce a higher intend on the retina and hence shorten the eye. Similarly, if a tighter suture is applied, then also the intend will be higher and hence, the anteroposterior diameter of the eye gets shorter inducing hyperopia. However if we use wider encircling elements, the effect is mostly compression in the center, which increases the axial length to cause myopia.

Rubin, found that low to moderate buckle height (band width of 2 mm) resulted in -1.56 D to -2.24 D of change in phakic eyes and -0.74D to -1.14 D change in aphakic eyes. High encircling buckles of 5mm indentation result in hyperopic shift of +0.35 D for phakic eyes and +0.59 D for aphakic eyes. Low to moderate buckles induce an increase in axial length while higher buckles shorten the axial length.

Segmental buckles

Segmental buckles produce astigmatism and of lesser magnitude than encircling elements. Again, the size of the buckle used, the tightness of sutures, placement of sutures and the anteroposterior location of the buckle in relation to the cornea all modify the induced refractive error.

But large radial elements that extend anteriorly beyond the ora serrata induce irregular astigmatism. Changes in corneal topography occur with segmental circumferential sponges, by steepening in the meridians of the buckle. Encircling buckles produce either corneal flattening with focal central steepening or flattening on one side with steepening on the opposite side.
How to minimize refractive errors in buckling?

To minimize the buckling-induced refraction changes, several recommendations may be made regarding scleral buckling procedures. Careful surgical planning and maneuvering are thus required to minimize the induced corneal astigmatism. The band should elevate easily 1 to 2 mm and not snap back to indent the globe. When abundant drainage of subretinal fluid and hypotony occurs 6, it should be preferable to inject gas into the vitreous cavity site rather than to tighten the band excessively.

A change in refractive error stabilizes usually within 2 to 3 months after sclera buckling. The error can be corrected using spectacles, contact lenses or refractive surgeries.

Refractive Changes After Silicone Oil

Silicone oil has a higher refractive index than vitreous 10. The refractive shift created by silicone oil depends on the status of the lens.

In a normal phakic eye, the silicone oil form a concave surface behind the lens, thereby acting as a minus lens inside the eye making the eye hyperopic. Based on Gullstrand schematic eye there is an increase of 8D hyperopia. In practice the shift has been seen shifting from no change to +10 D change, an average of 6D.

In aphakic eyes, the silicone oil produces a convex surface (bulging through papillary aperture), thereby creating a myopic refractive shift. The amount of myopic shift depends on the papillary aperture diameter. Based on the schematic eye calculation, a refractive shift from +12.5 D to +5.6 D has been observed in aphakic eyes filled with silicone oil. Stefansson and colleagues observed an average shift of 7.4 D.

The silicone oil tamponade with vitreous surgery are used as a temporary procedure. Therefore refractive changes with silicone oil are not permanent. In cases where prolonged or permanent tamponade is required, contact lens wear is suitable to minimize anisoconia associated with anisometropia. An IOL with plano posterior surface can minimize these changes.

References