Pterygium-induced corneal refractive changes

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To study the effect of pterygium on corneal topography, a retrospective analysis of 151 eyes with primary pterygia was done. All cases underwent videokeratography preoperatively and one month postoperatively. Statistical analysis of average corneal power (ACP), corneal astigmatism, surface regularity index (SRI) and surface asymmetry index (SAI) was done before and one month after surgery. Topographic indices were compared statistically for various grades of pterygia. Increase in the grade of pterygium had a significant effect on topographic indices. Corneal astigmatism reduced from 4.40±3.64 diopter (D) to 1.55±1.63D (P value <0.001) following surgery. The regularity of corneal surface improved and asymmetry of the cornea reduced one month after surgery. Pterygium leads to significant changes in corneal refractive status, which increase with the increase in the grade of pterygia and improve following pterygium excision.

Key words: Astigmatism, corneal topography, pterygium

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Pterygium is commonly seen in India, a part of the “pterygium belt” described by Cameron. The indications for pterygium surgery are (a) visual impairment; (b) recurrent inflammation; (c) motility restriction; (d) cosmetic disfigurement.

Pterygium leads to a considerable effect on corneal refractive status which has been previously measured in various studies by refraction, keratometry and corneal topography. In the present study pre and postoperative corneal topography was evaluated for each case.

Materials and Methods

A retrospective analysis of 151 eyes with primary pterygia was done. Patients with history of trauma, previous surgery, patients having corneal scars were not included in the study. On slit-lamp examination with slit beam focused on the nasal limbus, pterygium was graded depending on the extent of corneal involvement:

Grade I – between limbus and a point midway between limbus and pupillary margin

Grade II – head of the pterygium present between a point midway between limbus and pupillary margin and pupillary margin (nasal pupillary margin in case of nasal pterygium and temporal margin in case of temporal pterygium)

Grade III – crossing pupillary margin

Corneal topography analysis was obtained with computerized videokeratography (TMS-2, Computed Anatomy Inc, New York, NY), which was performed by an experienced optometrist one day prior to surgery and one month after it [Figs. 1-2].

All eyes underwent pterygium excision with conjunctival autograft transplantation.
Results were expressed as an arithmetic mean ± standard deviation. Values were compared against the grades of pterygium using one-way analysis of variance (ANOVA). Statistical analysis of average corneal power (ACP), corneal astigmatism was calculated from the Sim K values, surface regulatory index (SRI), surface asymmetry (SAI), min K and refractive cylinder was done before and one month after pterygium surgery using paired t-test. Corneal cylinder and refractive cylinder were compared using Mann-Whitney test; corneal astigmatism amongst various grades was compared using one-way analysis of variance (ANOVA with Bonferroni’s correction of P values for multiple comparison).

### Results

Preoperative topographic indices in various grades of pterygium have been shown in Table 1. Corneal astigmatism, SRI and SAI were seen to increase with the increase in the grade of pterygium. Comparing the corneal astigmatism amongst the various grades of pterygium [Table 2] a statistically significant

### Table 1: Grade of pterygium and topographic indices

| Grade | Number of eyes | ACP     | CornealCyl | Min K     | SRI       | SAI       |
|-------|----------------|---------|------------|-----------|-----------|-----------|
| I     | 31             | 43.64±1.77 | 1.15±1.24  | 43.19±1.89 | 0.26±0.24 | 0.77±0.37 |
| II    | 66             | 43.37±1.99 | 4.11±2.92  | 40.78±3.03 | 0.45±0.44 | 1.51±1.02 |
| III   | 38             | 41.69±2.61 | 7.01±3.16  | 39.05±4.70 | 1.42±0.80 | 3.25±1.65 |
| DMP   | 16             | 42.04±1.53 | 5.36±4.97  | 37.95±4.69 | 0.67±0.68 | 1.51±1.29 |
| P value|                | < 0.001  | < 0.001    | < 0.001   | < 0.001   | < 0.001   |

DMP- Double-headed pterygium, ACP- Average corneal power, CornealCyl- Corneal cylinder, SRI- Surface regularity index, SAI- Surface asymmetry index, Min K= Minimum keratometry reading.

### Table 2: Comparison between corneal astigmatism among various grades

| Groups (I) | Groups (J) | Mean difference (I-J) | Std. error | P value | 95% confidence Interval |
|------------|------------|-----------------------|------------|---------|-------------------------|
|            |            |                       |            |         | Lower bound | Upper bound |
| Grade I    | Grade II   | -2.9293*              | 0.6593     | <0.001  | -4.6925     | -1.1661     |
| Grade III  | Grade II   | -5.8587*              | 0.7382     | <0.001  | -7.8185     | -3.8989     |
| Grade DMP  | Grade II   | -4.2096*              | 0.9321     | <0.001  | -6.7023     | -1.7168     |
| Grade I    | Grade III  | 2.9293*               | 0.6593     | <0.001  | 1.1661      | 4.6925      |
| Grade III  | Grade DMP  | -2.9294*              | 0.6166     | <0.001  | -4.5784     | -1.2804     |
| Grade DMP  | Grade III  | -1.2803               | 0.8437     | 0.788   | -3.5368     | 0.9763      |
| Grade I    | Grade II   | 5.8587*               | 0.7382     | <0.001  | 3.8989      | 7.8185      |
| Grade II   | Grade III  | 2.9294*               | 0.6166     | <0.001  | 1.2804      | 4.5784      |
| Grade DMP  | Grade III  | 1.6491                | 0.9024     | 0.418   | -0.7641     | 4.0624      |
| Grade I    | Grade DMP  | 4.2096*               | 0.9321     | <0.001  | 1.7168      | 6.7023      |
| Grade II   | Grade DMP  | 1.2803                | 0.8437     | 0.788   | -0.9763     | 3.5368      |
| Grade III  | Grade DMP  | -1.6491               | 0.9024     | 0.418   | -4.0624     | 0.7641      |

*The mean difference is significant at the 0.05 levels, DMP - Double-headed pterygium
increase in astigmatism was noted with the increase in the grade from I to III.

The comparison and analysis of pre and postoperative values are presented in Table 3. The mean ACP increased from 42.91±2.20 diopter (D) to 44.25±1.77D (P value < 0.001) after pterygium excision.

The mean preoperative topographic astigmatism was 4.40±3.64D and reduced postoperatively to 1.55±1.63D (P value < 0.001). The refractive cylinder reduced from 1.94±2.24D to 0.78±1.07D.

Refraction was done in 140 eyes; in 11 eyes it was not possible due to cataract. The refractive cylinder before surgery was 1.94±2.24D, which was less than the topographic cylinder of 4.25±3.63D (P value < 0.001). The refractive cylinder reduced from 1.94±2.24D to 0.78±1.07D.

### Discussion

A pterygium-induced refractive change often leads to visual impairment. These changes are localized and cannot be measured accurately either by refraction or keratometry. In 140 eyes in which refractions were recorded there was poor correlation between the magnitude of refractive cylinder and topographic cylinder. This can be due to the hemi-astigmatic nature of the induced changes. During manifest refraction patient deals with two images, one from the more superficial temporal cornea and one from the flatter nasal cornea. The patient preferentially views the more spherical image and therefore the corneal changes are incompletely reflected in the refraction.

Keratometry measures only the central cornea and peripheral cornea is ignored and hence the results can be erroneous in eyes with pterygium. Computerized videokeratography remains the best tool for evaluating the corneal surface changes induced by pterygium.

Pterygium was seen to have a considerable effect on topographic indices in the present series. Flattening was seen in the horizontal meridian, which was associated with astigmatism. The exact mechanism of flattening is not clear. It is thought to be caused by the formation of tear meniscus between the corneal apex and the elevated pterygium, causing an apparent flattening of the normal corneal curvature.

Lin and Stern found a significant correlation between the pterygium size and corneal astigmatism; they reported pterygium to induce significant degrees of astigmatism once it exceeded >45% of the radius. Tomidokoro et al. evaluated the percentage extension of pterygium on cornea and found larger pterygia to adversely affect astigmatism, asymmetry and irregularity of the cornea. In the current study pterygia were divided into grades depending on the extension of pterygium on the cornea. Grade II or larger pterygium was associated with increase in astigmatism, asymmetry and irregularity. The ACP reduced significantly in Grade II or larger pterygium. Hence, for patients with pterygium requiring cataract surgery, decision of surgery should be taken depending on the grade of pterygium; in cases with Grade I, atrophic and non-progressive pterygium one can consider cataract surgery directly. However, pterygium Grade II or larger significantly affects the refractive component of cornea which can lead to erroneous intraocular lens power calculation and post-cataract refractive surprise. Hence in cases with pterygium Grade II or larger, a stepwise approach should be followed; pterygium excision should be performed prior to cataract surgery. By time-course analysis, cornea has been shown to stabilize one month after pterygium surgery. Hence, cataract surgery or refractive surgery if considered should be performed at least one month after pterygium surgery. Simultaneous cataract and pterygium surgery should not be done in cases with large pterygium as one may have an unexpected refractive surprise postoperatively.

Stern and Lin reported improvement in topographic indices in 16 eyes; they reported corneal astigmatism to reduce from 5.93±2.46D to 1.92±1.68D. Tomidokoro et al. analyzed 119 eyes and reported increase in corneal spherical power from 43±1.18 to 45±1.6D. Yagmur et al. studied the effect of pterygium excision in 30 eyes and found topographic astigmatism to reduce from 4.65±3.02 to 2.33±2.26D. In the current study all the topographic parameters were seen to improve significantly following pterygium excision.

The relationship between the preoperative refractive cylinder and postoperative refractive cylinder (Pearson’s correlation coefficient, r = .2986) was expressed by the following equation:

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\text{Postoperative refractive cylinder} = 0.283 \times \text{preoperative refractive cylinder}
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Computerized videokeratography remains the best tool in evaluating pterygium-associated corneal changes. The corneal changes were seen to improve significantly following pterygium excision.

### References

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Drug-induced acute myopia following chlorthalidone treatment

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We report a case of sudden loss of vision due to the development of acute myopia after the intake of chlorthalidone used for treating systemic hypertension. Clinically this was associated with ciliary spasm, shallow peripheral choroidal effusion and retinal striae at the macula with increase in macular thickness seen on optical coherence tomography. All these findings were reversed completely once the drug was discontinued. Development of acute myopia should be kept in mind as an adverse effect of a commonly used antihypertensive drug, namely chlorthalidone.

Key words: Acute myopia, chlorthalidone, diuretic

We report a case of sudden loss of vision due to the development of acute myopia after the intake of chlorthalidone used for treating systemic hypertension. Clinically this was associated with ciliary spasm, shallow peripheral choroidal effusion and retinal striae at the macula with increase in macular thickness seen on optical coherence tomography. All these findings were reversed completely once the drug was discontinued. Development of acute myopia should be kept in mind as an adverse effect of a commonly used antihypertensive drug, namely chlorthalidone.

Case Report

A 30-year-old male presented in the emergency department with a history of bilateral blurring of vision of one-day duration. He had never worn glasses and past medical history was notable for hypertension. He was taking atenolol 50 mg (Hipres, CIPLA Pharmaceuticals). Since his systemic hypertension was not well controlled with this drug his physician had switched over to a combination of atenolol 50 mg with chlorthalidone 12.5 mg (Tenoric 50, IPCA Pharmaceuticals). He started this medication four days prior to the episode of blurring of vision. Visual acuity at presentation was 20/120 in both eyes. Slit-lamp examination of the anterior segment was unremarkable. Direct and consensual pupillary reactions were normal. Color vision testing using Ishihara's pseudo isochromatic chart was within normal limits. Refraction was done and his visual acuity was improving to 20/20 in both eyes with a spherical correction of –3 dioptr sphere (DS). Gonioscopy revealed normal open angle in both the eyes. A cycloplegic refraction revealed a value of –3 DS/-0.5 diopter cylinder (DC) x 80° in the right eye and –3.75 DS/-1.0 DC x 130° in the left eye. Indirect ophthalmoscopy revealed shallow peripheral choroidal elevation. Slit-lamp biomicroscopy revealed retinal striae radiating from the fovea [Figs. 1A and B]. There were no vitreous cells. B-scan ultrasonography showed shallow peripheral serous choroidal detachment [Fig. 2]. A-scan biometry was done to measure the axial length. An optical coherence tomogram (OCT - Stratus version 4.0, Zeiss ophthalmics) was also done since retinal striae were present, which showed a mild thickening of the macula. The patient’s blood pressure was 140/100 mmHg in the forearm in supine position. Hematological evaluation including renal parameters and computerized tomogram of the head were within normal limits.

The patient was advised to stop atenolol chlorthalidone combination drug. He was reviewed after five days and his visual acuity had improved to 20/20 without any refractive error. Fundus examination revealed disappearance of retinal striae at the macula and peripheral choroidal effusion had also resolved [Figs. 3A and B]. The OCT was repeated which showed reduction in the thickening at the macula. A change analysis was done using the software in Stratus OCT version 4.0 which revealed definite reduction in the thickness of the macula. A presumptive diagnosis of drug-induced acute myopia due to chlorthalidone was made.

Discussion

We report a case of acute myopia induced by oral consumption of chlorthalidone for systemic hypertension. Chlorthalidone...