CORNEAL TOPOGRAPHY CHANGES AFTER VITREO-RETINAL SURGERY*

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Abstract

Background and Objective: To report the results of a prospective study to assess corneal topography changes after vitreo-retinal surgery procedures.
Patients and Methods: Computer-assisted videokeratography using a Topographic Modeling System-1 (TMS-1) were prospectively performed before and after vitreo-retinal surgery (vitrectomy with or without scleral buckling) in 12 eyes (patients) with varied vitreo-retinal pathology including cytomegalovirus (CMV) retinitis, CMV-related retinal detachment, retinal detachment with and without proliferative vitreo-retinopathy, trauma, acute retinal necrosis, and macular hole. Preoperative and postoperative surface regularity index (SRI), surface asymmetry index (SAI), and induced astigmatism were determined.
Results: Patients were followed for an average of 4.1 months (range: 2-6 months). Mean preoperative SRI was 0.58 (0.05-1.06) and postoperative SRI was 0.77 (0.25-1.36). Mean preoperative SAI was 0.47 (0.24-0.93) and postoperative SAI was 0.59 (0.21-0.99). Mean induced astigmatism was 0.3 diopters.

Conclusion: Even though no statistically significant difference was found between preoperative SRI, SAI, or induced astigmatism and postoperative SRI, SAI, or induced astigmatism; our study suggests that the central corneal optical quality (SRI) and the asymmetricity of the anterior corneal curvature (SAI) deteriorates after vitreo-retinal surgery.

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Introduction

It has been considered that vitreo-retinal surgery causes corneal shape changes leading to postoperative astigmatism.[1-3] Keratometric studies have previously shown that the corneal curvature changes after scleral buckling surgery.[4-8] Although some studies have regarded these corneal changes as clinically insignificant, the patient's visual acuity is certainly impaired more severely than expected by the keratometric cylinder. This may be due to changes in corneal shape that are both irregular and asymmetric.

Hayashi et al [9] conducted a prospective study to investigate corneal shape changes due to scleral buckling surgery using computer-assisted videokeratography. They found that circumferential scleral buckling surgery produces prolonged irregular and asymmetric corneal shape changes, whereas the patterns of the changes differed depending on the buckling procedure used.

Our study was designed to investigate the induced corneal shape changes after vitreo-retinal surgery (vietrectomy with or without scleral buckling) by using computer-assisted videokeratography.

Patients and Methods

Computer-assisted videokeratography using a topographic Modeling System-1 (TMS-1; Computed Anatomy, New York, NY) were prospectively performed before and after vitreo-retinal surgery in 15 eyes (patients) with varied vitreo-retinal pathology including cytomegalovirus (CMV) retinitis, CMV-related retinal detachment, retinal detachment with and without proliferative vitreo-retinophaty, trauma, acute retinal necrosis, and macular hole (Table 1). A vitrectomy was performed in all cases with a circumferential scleral buckling in two of them. These eyes were all operated on successfully by the authors between September 1996 and March 1997. Exclusion criteria from this study included: 1) history of previous scleral buckling surgery, 2) corneal disease found in a slit-lamp biomicroscopic examination or TMS-1, and 3) poor quality videokeratograph.

Table N° 1

Vitreo-retinal pathology of eyes included in the study (12 eyes)*	
RRD	05 eyes
CMV-related RD	02 eyes
Macular Hole	01 eye
RRD + PVR	01 eye
CMV Retinitis	01 eye
ARN-related RD	01 eye
Traumatic RD	01 eye
Total	12 eyes

*RRD = Rhegmatogenous retinal detachment (primary repair), RD= Retinal Detachment, CMV= Cytomegalovirus, PVR= Proliferative Vitreo-retinopathy, ARN = Acute Retinal Necrosis

Table N° 2

Vitreo-retinal procedures * performed in eyes included in the study (12 eyes)**	
Primary Pars Plana Vitrectomy	12 eyes
Silicone Oil	05 eyes
Gas (C3F8)	05 eyes
Pars Plana Lensectomy	02 eyes
Ganciclovir Implant	02 eyes
EEC + IOL	02 eyes
Scleral Buckling	02 eyes

*. More than one procedure was performed in all eyes
** EEC + IOL = Extracapsular Cataract Extraction and Intraocular Lens Implant, C_3F_8 = Perfluoropropane

A pars plana vitrectomy was performed using a Premier vitreous cutter (Storz Instrument Company, St. Louis, MO) in all patients. Three 1.0 mm-wide sclerotomies were made using a microvitreal (MVR) blade from 2.5 to 3.5 mm posterior to the limbus. The infusion line was sutured in the infero-temporal quadrant. In two patients, a circumferential scleral band (Mira 240; Mira, Waltham, MA) was sutured with the posterior border located 12 mm posterior to the limbus. In two patients, an extracapsular cataract extraction with intraocular lens implantation was performed. In two patients, a

ganciclovir intraocular device (Chiron Intraoptics, Irvine, CA) was implanted in the infero- temporal quadrant after prolonging the scleral incision circumferentialy to 5.5 mm. After vitrectomy, liquid 5.000 centistokes (cs) silicone oil (Richard-James, INC., Peabody, MA) was injected in five eyes and perfluoropropane (C_3F_8) gas in five patients (Table 2).

Computer-assisted videokeratography using the TMS-1 was performed before surgery as well as from 2 to 6 months after surgery in all patients. No patient had any other ocular surgery performed between preoperative and postoperative videokeratographs.

The videokeratograph was taken three times with the TMS-1 at each visit. The data from the highest quality Keratograph of the three were stored in a TMS-1 computer. The stored data then were processed into two types of corneal topographic maps: 1) the normalized scale map and 2) The differential map. Each cornea was shown in the normalized map at every 0.4 diopters. The change in the keratograph between the preoperative and postoperative visit was shown in the differential map produced by TMS-1 software package. This software package subtracts the topographic data of the preoperative map from those of the postoperative map and expresses the difference in refractive power as a color coded map. In addition, preoperative and postoperative surface regularity index (SRI), surface asymmetry index (SAI), and induced astigmatism were determined.[10] The SRI is the index that represents the surface regularity of the central cornea. The smaller the SRI the better is the central corneal optical quality.[11] The SAI is the index that represents the asymmetricity of the anterior corneal curvature. The greater the SAI, the more asymmetric is the anterior corneal curvature.

Statistical analysis were performed to compare various groups using chi square test. All analysis were performed using the current versions of the Statistical Analysis System (SAS Institute, Carey, NC). Any difference in which the P value was below 0.05 was considered statistically significant.

Results

Three patients were excluded from the study because of poor quality videokeratographs. Our remaining 12 patients had an average age of 47.2 (19-71) years old. All patients were Hispanic, and 50% were male. Patients were followed for an average of 4.1 months (range: 2-6 months). Four patients were aphakic at the end of the surgical procedure, while 8 were phakic. Mean preoperative SRI was 0.58 (0.05-1.06) and postoperative SRI was 0.77 (0.25-1.36). Mean preoperative SAI was 0.47 (0.24-0.93) and postoperative SAI was 0.59 (0.21-0.99). Mean induced astigmatism was 0.3 diopters. No statistically significant difference was seen in preoperative SRI, SAI, or induced astigmatism as compared to postoperative SRI, SAI, or induced astigmatism.

Selected Cases

The induced changes in corneal topography due to circumferential scleral buckling surgery were evaluated using the differential map. Peripheral corneal steepening almost in 360° was seen (Figure 1). The induced changes in corneal topography due to ganciclovir implant surgery were evaluated using the differential map. Peripheral corneal steepening on the quadrant opposite to the implant was notice on one case (Figure 2-A) and on the same side of the implant on another case (Figure 2-B). The induced changes in corneal topography due to combined posterior vitrectomy and extracapsular cataract extraction surgery were evaluated using the differential map. Corneal steepening was notice related to the limbal wound with flattening on the opposite side of the cornea (Figure 3). The induced changes in corneal topography due to vitrectomy surgery without any other procedure except silicone oil or gas injection were evaluated using the differential map. Peripheral corneal steepening and flattening maybe related to sclerotomy sites (Figure 4-A) were seen in most cases. Another case with very little changes was seen (Figure 4-B).

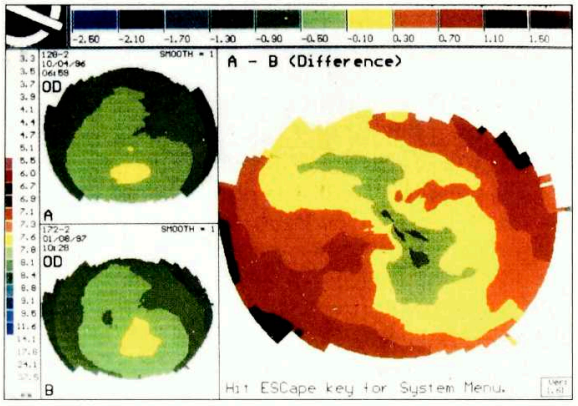

Figure 1. The induced changes in corneal topography due to encircling scleral buckling surgery were evaluated using the differential map.
Peripheral corneal steepening almost in 360° is seen in this case

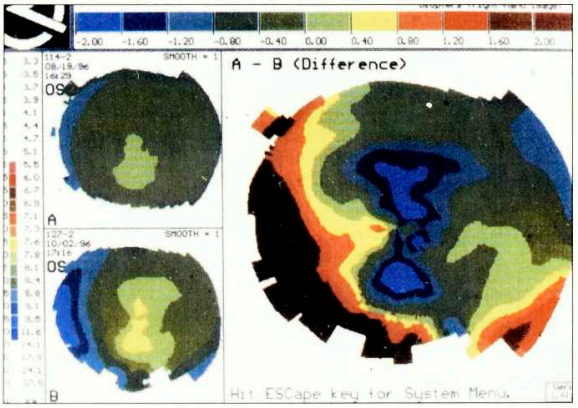

Figure 2 A. The induced changes in corneal topography due to cataract implant surgery were evaluated using the differential map. Peripheral corneal steepening on the quadrant opposite to the implant was noted on one case

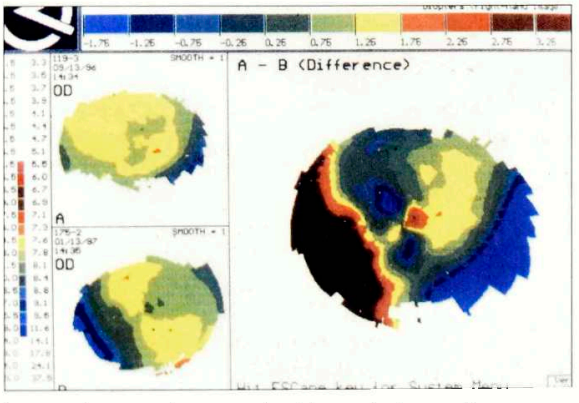

Figure 2 B. and on the same side of the implant on another case

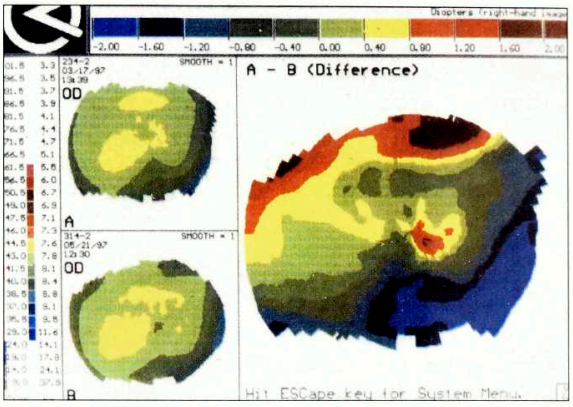

Figure 3. The induced changes in corneal topography due to vitrectomy and extracapsular cataract extraction surgery were evaluated using the differential map. Corneal steepening was notice related to the limbal wound with flattening on the opposite side of de cornea

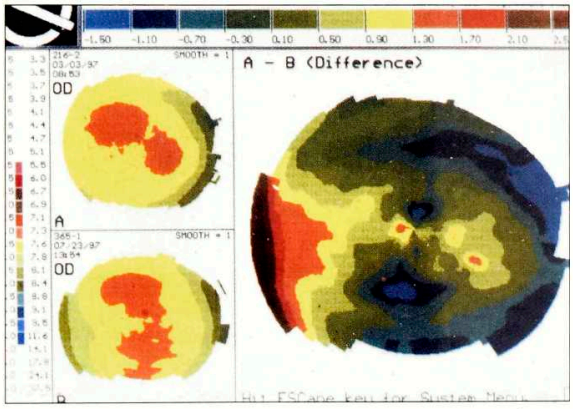

Figure 4 A. The induced changes in corneal topography due to vitrectomy surgery without any other procedure except silicone oil or gas injection were evaluated using the differential map. Peripheral corneal steepening and flattening maybe related to sclerotomy sites

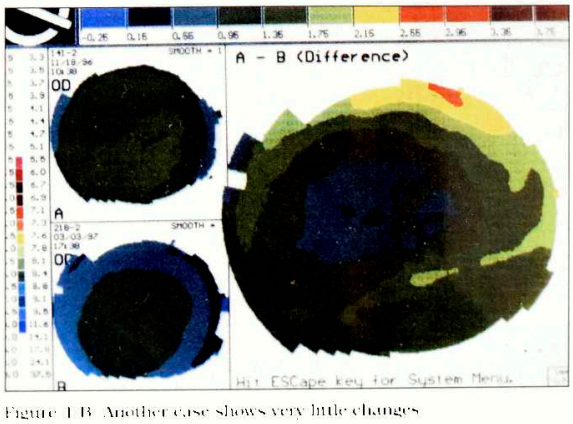

Figure 4 B. Another case shows very little changes

Discussion

Previous keratrometric studies reported that scleral buckling surgery caused changes in the corneal curvature and induced postoperative corneal astigmatism.[4-8] Some researchers have suggested that the induced astigmatism is slight and transitory, and not clinically significant.[4-6] However, the induced astigmatism has been found to be irregular and asymmetric.[7] We believe that any kind of vitreo-retinal surgery will cause corneal changes and that a patient undergoing such a procedure will develop important changes regarding his or her refractive status. Our study was designed to investigate the induced corneal shape changes after vitreo-retinal surgery by using computer-assisted videokeratography.

In addition, we analyzed changes of the SRI and SAI produced by the TMS-1 software package to indicate quantitatively the irregularity and the asymmetricity of the postoperative corneas. The SRI is the index indicating the regularity of the central corneal curvature. The SAI is the index expressing the asymmetricity of the anterior corneal curvature. Wilson and Klyce[11] showed that best corrected visual acuity was correlated significantly with SRI and SAI.

The induced changes in corneal topography due to vitreo-retinal surgery in our study were very variable. The induced changes in corneal topography due to circumferential scleral buckilng showed corneal steepening almost in 360º was seen. The induced changes in corneal topography due to ganciclovir implant demonstrated corneal steepening on the quadrant opposite to the implant on one case and on the same side of the implant on another case. The induced changes in corneal topography due to vitrectomy and extra-capsular cataract extraction surgery revealed corneal steepening related to the limbal wound with flattening on the opposite side of the cornea. The induced changes in corneal topography due to vitrectomy surgery without any other procedure except silicone oil or gas injection showed peripheral corneal steepening and flattening maybe related to sclerotomy sites in most cases. However, some cases had very little changes.

Our analysis shows that the central corneal optical quality (SRI) and the asymmetricity of the anterior corneal curvature (SAI) deteriorates after vitreo-retinal surgery. This study suggests that vitreo-retinal surgery induce central curvature changes as well as asymmetric peripheral changes. However, our numbers did not reach statistical significance probably due to the small number of patients. In addition, we had a short follow-up of only up to 6 months. Long term studies are necessary to determine if these corneal changes persist over time. This information may be important in planning surgical repair of retinal detachments in patients after refractive surgery.[12]

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