Original research article

Changes in Corneal Curvature and Axial length After Glaucoma Filtration Surgery

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Abstract

Background:Glaucoma is a disease known since the Hippocrates time. This term indicates a number of neurodegenerative diseases having in common a progressive optical atrophy resulting from the apoptosis of retinal ganglion cells, axon atrophy, and degeneration extending to the visual areas of the brain cortex, finally leading to the characteristic optical-cup neuropathy and to irreversible visual loss.

Aims & Objectives: The aim of this study is to determinechanges in corneal curvature, axial length and IOP reduction after glaucoma filtration surgery.

Material and Methods: The present study was conducted in the department of Ophthalmology, Ananta Institute of Medical Science & Research Centre Rajsamand, Rajasthan during the period of 1 year from January 2019 to January 2020.25 diagnosed cases of glaucoma who were undergoing glaucoma surgery (trabeculectomy) of either sex, age were included in the study.

Results: TheMean values of keratometry (D) at pre-operative, 1 week, 4 week and 3 months are 1.28±0.744, 4.097±2.915,3.484±1.662 and 2.150±1.051 respectively while the mean value of axial length atpre-operative, 1 week, 4 week and 3 months are 22.537±0.786,22.390±0.783, 22.356±0.782 and 22.402±0.716.

Conclusion: Trabeculectomy is the most common surgical procedure for glaucoma management which may significantly influence ocular biometry. Change in keratometry and axial length can be significant enough to affect visual acuity and the accuracy of IOL power calculation.

Keywords: Glaucoma, Trabeculectomy, Keratometry, Axial length

Introduction

Glaucoma is a disease known since the Hippocrates time. This term indicates a number of neurodegenerative diseases having in common a progressive optical atrophy resulting from the apoptosis of retinal ganglion cells, axon atrophy, and degeneration extending to the visual areas of the brain cortex, finally leading to the characteristic optical-cup neuropathy and to irreversible visual loss. (1) In most cases, glaucoma is associated with elevated intraocular pressure (IOP); however approximately one-third of cases have optic nerve degeneration despite intraocular pressures in the normal range. (2)

Various types of glaucoma are:

- Primary open-angle glaucoma (POAG)
- PrimaryAngle-closure glaucoma (PACG)
- Secondary glaucoma (due to uveitis, trauma etc.)
- Congenital glaucoma

It is estimated that there are more than 60 million cases of glaucoma worldwide and it will increase to 80 million by 2020. (3) The estimated prevalence of glaucoma is 2.65% in people above 40 years of age. Globally, primary open-angle glaucoma (POAG) is more prevalent than primary angle closure glaucoma (PACG) and responsible for around three fourth of all glaucoma cases. Overall glaucoma is the second major cause of blindness after cataract and refractive errors. (4) More importantly it is the most common cause of irreversible blindness globally. It is estimated that more than 3 million people are blind due to glaucoma. (4)In India, the estimated number of cases of glaucoma is 12 million, around one fifth of the global burden of glaucoma. Although in the Caucasian population, around two third of cases are POAG, in the Indian population an equal proportion of open-angle and closed-angle glaucoma is seen.

Reducing intraocular pressure (IOP) by medications, surgery or laser is the only currently available treatment option for glaucoma. (5-9) Glaucoma guidelines suggest that primary surgery may be a suitable option for presentation with advanced glaucoma. (10-12) Trabeculectomy remains the conventional primary surgery, but the technique has evolvedto include the use of wide application mitomycin C (MMC), releasable sutures and extensive postoperative manipulationto improve outcomes. (13-15) Glaucoma filtration surgery performed with or without cataract extraction, results in clinically significant lowering of intraocular pressure (IOP). (16) Well known complications of hypotony that may follow filtering surgery include choroidal effusion, haemorrhage, cataract,corneal decompensation (17), and hypotonous maculopathy. (18-20) Significant IOP reduction after trabeculectomy could reduce the axial length (AL) of the eye corresponding to the amount of IOP reduction. Anterior chamber depth (ACD) and volume, as well as keratometry could also change after the surgery. These unpredictable changes may affect the accuracy of intraocular lens (IOL) power calculation in cases who need cataract surgery and IOL implantation combined with glaucoma surgery. The purpose of the current study is to evaluate the changes in corneal curvature and axial length after trabeculectomy.

Aims & Objectives-The aim of this study is to determinechanges in corneal curvature, axial length and IOP reduction after glaucoma filtration surgery.

Material and Methods:- The present study was conducted in the department of Ophthalmology, Ananta Institute of Medical Science & Research Centre Rajsamand, Rajasthan during the period of 1 year from January 2019 to January 2020.25 diagnosed cases of glaucoma who were undergoing glaucoma surgery (trabeculectomy) of either sex, age were included in the study. Cases who had corneal opacity or any other ocular pathology and any past history of ocular surgery were excluded from the study. Patients were admitted in the ophthalmology ward and complete ophthalmological examination including intraocular tension measurement (using Schiotz tonometer), fundus examination by direct and indirect ophthalmoscope and syringing were done in all cases. IOL power calculation by A scan ultrasonography, general systemic examination and routine blood investigations were done. Keratometry reading were measured by Shinnippon autorefractokeratometer a day before surgery, local antibiotic drops and anti-inflammatory drops were instilled in eye one hourly a day before surgery in glaucoma patients. Glaucoma surgery was done by trabeculectomy. Patients were followed up on 1 week, 1 month and 3 months after the surgery. Keratometry and axial length measurement was done during each follow up.

Results:-

Total 25 cases were included in the study out of which 9 were male and 16 were female. Age of the patients ranges from 30 to 80 years with the mean age of 64.7 years. 20 cases (80%) were diagnosed with POAG while 5 cases (20%) were diagnosed with PACG. Patients were followed up on 1 week, 4 weeks and 3 months after the surgery. Keratometry, IOP and axial length measurement was done at each follow up. Values of keratometry, axial length and IOP are depicted in table 1

Table1: Mean values of keratometry, axial length and IOP at each follow up

S.No.	Ocular biometrics (Mean±SD)	Pre-op	1 week	4 week	3 months
1	Keratometry (D)	1.28±0.744	4.097±2.915	3.484±1.662	2.150±1.051
2	Axial length (mm)	22.537±0.786	22.390±0.783	22.356±0.782	22.402±0.716
3	IOP (mmHg)	28.862±3.275	16.996±2.183	15.198±1.453	12.332±1.944

Discussion:

Preoperative astigmatism in all the cases was less than 3D. 14 cases had against the rule astigmatism while 11 cases had with the rule astigmatism. The mean astigmatism was 1.28±0.744 D. Postoperatively at 1 week, there was sharp increase in astigmatism. The mean astigmatism was 4.097±2.915 D. 21 cases had against the rule astigmatism. At 4 postoperative weeks, astigmatism decreased (mean- 3.484±1.662 D) and 24 cases had against the rule astigmatism. At 3 months postoperatively, astigmatism continues to fall (mean- 2.150±1.051 D) and 23 cases had against the rule astigmatism.The study shows a sharp increase in astigmatism postoperatively in 1st week but thereafter it continuously falls till last follow up at 3 months. At every follow up, changes were approximately similar (about 0.6 D decrease). This shows that although there was statistically significant increase in surgically induced astigmatism at 3 months but it continuously falls at a stable rate. Against the rule astigmatism increased from 56% cases preoperatively to 92% cases at 3 postoperative months, thus a shift towards against the rule astigmatism. Similar results were obtained in various studies done in the past. (21-28) Axial length decrease at 1st postoperative week was

about 0.10-0.13. At 4th postoperative week the decrease in axial length was about 0.15 to 0.17 while after 3 months of follow up the axial length decrease was 0.6 to 0.4. Similar studies done in the past concluded that there is significant axial length reduction postoperatively which become stable nearly 3 months after the surgery. (29-33) The reduction in IOP following trabeculectomy surgery was statistically significant ($p<0.001$) at all the points when compared with preoperative findings. The mean IOP preoperatively was 28.862±3.275, which was reduced to 16.996±2.183, 15.198±1.453 and 12.332±1.944 at 1st week, 4th week and 3months postoperative period respectively.There are several situations where clinical decision making may be affected by our results. The most important and common condition is combined cataract extraction and glaucoma filtering surgery, where the axial length decrease can result in a significant postoperative hyperopic error.This would be especially important in severe or normal tension glaucoma patients where the target IOP is in the single digit or in young myopes where the risk of hypotony may be higher. The second condition is where glaucoma surgery is to be performed after cataract extraction, which may again result in a significant hyperopic shift. Finally, the patients in whom glaucoma surgery is to be performed followed by cataract extraction, the axial length and IOL calculations should be performed after glaucoma surgery when the IOP is stable. However, if the eye is hypotonous and a return to normal IOP is anticipated following the cataract surgery, this must also be taken into account. Future studies should focus on which patients are at a higher risk for axial length changes with IOP fluctuations. This risk can b determined by adding other anatomical indices in the study such as corneal and sclera thickness and elasticity and choroidal thickness.

Conclusion:

Trabeculectomy is the most common surgical procedure for glaucoma management which may significantly influence ocular biometry. Change in keratometry and axial length can be significant enough to affect visual acuity, the accuracy of IOL power calculation and refractive outcomes after combined or future cataract surgery. To achieve the best refractive outcome in these patients, it is better to delay cataract surgery and lens implantation if possible until axial length and keratometry changes stabilize.

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