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Figure 1 (Haq, Afghani, and Qadir). Right eye. Histologic section of tumor, spindle-B type malignant epithelioid cells at the right upper corner, (Hematoxyline and eosin x 400).

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EDITORIAL

Navigating the Challenges of Healthcare Waste Management in Ophthalmology: Lessons to Learn

Wajid Ali Khan

The field of ophthalmology stands at the forefront of surgical specialties, witnessing a substantial rise in procedural volumes, particularly in cataract surgeries.[1] This surge, coupled with the increasing challenge of managing healthcare waste, necessitates a comprehensive exploration of waste management practices in the context of ophthalmic procedures.

In Pakistan, where a staggering 260,000 tons of healthcare waste is generated daily, the situation calls for urgent attention.[2] The inadequate implementation of waste management laws results in a significant portion of this waste ending up in regular garbage, posing threats to the health of janitorial staff and promoting the unsafe reuse of instruments, especially in smaller private clinics. Notably, Pakistan faces one of the highest rates of injection use globally, contributing to the country's elevated incidences of blood-borne infections such as hepatitis C and a swiftly spreading HIV.[3]

Globally, ophthalmology generates substantial waste, with cataract surgeries leading the pack. Sustainable waste management practices in this field not only benefit the environment but also yield economic advantages. By focusing on effective waste reduction and recycling, clinics and hospitals can cut disposal costs and minimize landfill contributions. This approach not only aligns with eco-friendly practices but also fosters a culture of responsibility and mindfulness among healthcare professionals.[4]

Ophthalmic waste can originate from various sources, including clinics, hospitals, and surgical centers, with surgical procedures contributing significantly. Single-use disposable instruments, a considerable concern, contribute to nearly 80% of the total waste generated in operating rooms. Reprocessing single-use medical devices and prioritizing environmentally friendly purchasing are identified as key strategies in reducing this waste.

However, numerous barriers impede the implementation of new medical waste protocols, such as a lack of awareness regarding proper waste segregation and inconvenient bin locations. Hospital protocols also hinder the reuse of ophthalmic medications on multiple patients, impacting both cost and patient care.

Addressing these challenges requires a concerted effort to reconsider policies, encourage sustainable practices, and explore innovative solutions. The introduction of Green Packs, tailored sets of reusable surgical instruments and supplies, has proven effective in minimizing waste during surgical procedures. Initiatives like EyeSustain provide guidance on sustainable approaches to cataract surgeries, promoting environmentally conscious practices. [5] While concerns about infection transmission remain, the potential benefits of reusable surgical equipment, including cost reduction and waste minimization, underscore the need for a balance between environmental sustainability and infection control.

In conclusion, waste management in ophthalmology demands immediate

attention, especially in regions like Pakistan facing significant waste-related challenges. Implementing effective waste reduction measures, educating healthcare professionals, and embracing sustainable practices can mitigate the industry's carbon footprint, minimize waste generation, and pave the way for a more environmentally responsible future.

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ORIGINAL ARTICLE

Air Puff Tonometer Versus Goldmann Applanation Tonometer In Glaucomatous Eyes: Comparative Evaluation Conducted At Rawal Institute Of Health Sciences

Erum Yousafzai[1], Afia Matloob Rana[2], Waseem Akhter[1]

Objective: This study aims to determine the suitability of the Air-puff tonometer as a reliable alternative to the Goldmann applanation tonometer for measuring Intraocular Pressure (IOP).
Methodology: A cross-sectional study was conducted at the Outpatient Department (OPD) of Ophthalmology, Rawal Institute of Health Sciences, Islamabad, from April 2022 to September 2022. It involved 100 patients (200 eyes) aged above 20 years with suspected raised IOP. Both genders were included in the study. IOP measurements were obtained using the Air-puff tonometer and Goldmann Applanation Tonometer (GAT) mounted on the Slit-lamp. Three measurements were obtained with each instrument on both eyes within 15 minutes, and the average was used for analysis. Data analysis was performed using SPSS version 22.
Results: Among the total 100 patients, the mean age was 44.19 years. The mean IOP was 17.108 mmHg with the Air-puff tonometer and 15.873 mmHg with the Goldmann applanation tonometer. The difference between the instruments was < 2mmHg in 131 eyes and >2-3mmHg in 69 eyes. The Mean Difference (Air-puff – Goldmann) for these 200 eyes was 1.234mmHg (<2mmHg), with a standard deviation of 1.713.
Conclusion: The study concludes that while the Air-puff tonometer lacks correspondence to the Goldmann tonometer at high or low pressures, it measures IOP that closely corresponds to the Goldmann tonometer, particularly within 10-20mmHg intervals and moderately within 20-30mmHg. The Air-puff tends to overestimate low IOP and underestimate high IOP. *Al-Shifa Journal of Ophthalmology 2022; 18(4): 136-142.*

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Introduction:

Glaucoma, a neurodegenerative disease, stands as a leading cause of irreversible blindness globally.[1] Predictions estimate its prevalence to rise to 111.8 million people by 2040.[2] In Pakistan, surveys identify glaucoma as the fourth leading cause of blindness, with a prevalence of 0.03% across all age groups.[3,4] This optic neuropathy involves the progressive loss of retinal ganglion cells and thinning of the retinal nerve fiber layer, contributing to its multifaceted pathology. Raised intraocular pressure (above 22mm Hg) remains a significant treatable risk factor for glaucoma, emphasizing the importance of

early detection and accurate monitoring to slow its progression.[5] It is a multifactorial disease with complex underlying pathophysiology which is still not clearly understood[2,5]. Most significant and treatable risk factor for developing glaucoma is raised intraocular pressure (above 22mmHg).

Early and accurate detection and monitoring of high IOP is very important as lowering of IOP can slow down progression of glaucoma[5,6]. Almost all therapeutic modalities aim toward lowering of IOP[7]. Unfortunately, glaucoma is silent killer of vision, which remained silent until the significant and noticeable damage to the vision is done. This is because ganglion cells responsible for peripheral visual field die first[8].

Gauging of IOP is very important to slow the progression of glaucoma and ultimately prevent further visual field loss[9]. The patients whose IOP is lowered, visual field loss slowed down significantly. In case of glaucoma, the eye that has higher IOP tends to have higher risk of visual field loss[10].

Goldmann applanation tonometer (GAT) is currently considered as internationally recognized gold standard to measure IOP. It uses principal of force required to flatten the cornea. GAT is widely in use from last seven decades and is largely accepted in clinical practices and also considered as reference standard in various clinical trials[11]. However, there are significant limitation of GAT. Its readings are significantly affected by examiner and patient. It needs topical anesthesia, fluoresceine staining and technical expertise. Also, if it is not properly disinfected, there is risk of transmission of various diseases such as HIV, Hep C[12].

In recent years there has been considerable interest in devising alternative instruments for measuring IOP with aim of less time-consuming measurement not being influenced by examiner and also non-contact assessment[12, 13].

Air-Puff is one such instrument. It uses high intensity column of air to flatten the cornea. It is non-contact, easier to use, not examiner biased and in addition it does not require any anaesthesia However, sensitivity and accuracy of the Air-puff tonometer compared to Goldmann applanation tonometer remain controversial[14]. In literature, studies have differed quite markedly in their conclusions about the agreement between two instruments. Some authors have suggested a close correlation other have indicated that the correlation may not be clinically acceptable[15].

This study aims to evaluate whether the Air-Puff tonometer's IOP measurements align sufficiently with those of the Goldmann tonometer, utilizing Goldmann applanation tonometry as the reference standard.

Materials and Methods:

This cross-sectional study was conducted at Ophthalmology department of Rawal institute of health sciences Islamabad, after taking ethical approval from institutional research department. Patients presented to OPD with suspicion of raised IOP, of age above 20 years and both genders were included in the study. Patients with corneal pathology, known systemic infection HIV, HCV and those within one week of ocular surgery were excluded from the study. All patients were selected by non-probability purposive sampling from the outpatient department. Complete history was taken and thorough clinical examination including visual acuity testing by Snellen's chart, pin hole testing, slit lamp examination, intraocular pressure measurements using both the Goldmann tonometer (GAT) and the air-puff tonometer (APT) and fundus examination was done on patients fulfilling the exclusion and inclusion criteria.

Patients having raised IOP were referred for further investigations. The Full auto tonometer (air-puff tonometer) and the Goldmann Applanation Tonometer Haag-Streit International AT-900 mounted on the Slit-lamp TOPCON-SL 2D was used for the IOP measurements in the study. The

same Air-puff and Goldmann tonometer were used throughout the study. Three measurements were obtained with each instrument on both eyes within 15 minutes subsequently, and the average was used in the analysis.

The data was entered and analyzed in SPSSv2022. Descriptive statistics like Mean +/- Standard Deviation (S.D) was calculated for the age of the patients. Frequencies and Percentages were calculated for the gender. Three measurements were taken on each eye with the Air-puff and Goldmann tonometer. The average of the three measurements with each instrument was calculated and used in the analysis. Mean was calculated for the IOP values with each instrument. The Difference (Air-puff---Goldmann) was calculated for each case. The Mean, Standard Deviation and 95% of Confidence Interval was calculated for the Difference between the two. Sensitivity and specificity along with the positive predictive value, negative predictive value and accuracy was calculated to prove the validity of study.

Results:

In a study involving 100 patients (aged 20-63, mean age 44.19 ± 10.94), with a gender distribution of 48% male and 52% female, intraocular pressure (IOP) data was classified into five groups based on varying pressure ranges. Using the Goldmann tonometer (GAT), IOP measurements indicated 36 eyes within 1-10 mmHg, 127 eyes between 11-20 mmHg, and so forth, with only 2 eyes above 40 mmHg. In contrast, with the Air-puff tonometer, 2 eyes fell within 1-10 mmHg, 147 eyes between 11-20 mmHg, and 2 eyes above 40 mmHg, among others. The mean IOP was 17.108 mmHg (Air-puff) and 15.873 mmHg (Goldmann). Differences between instruments were mostly <2mmHg in 65.5% of cases, and within 3mmHg in 94% of cases. The mean difference (Air-puff – Goldmann) was 1.234mmHg, with a standard deviation of 1.713. Sensitivity of the Air-puff was 94.51%, specificity was 94.44%, positive predictive value was 82.93%, and negative predictive value was 98.74%.

Table 1: Demographics of Study Population

Number of Patients	**100**
Age	Age in Years
Minimum	20
Maximum	63
Mean	44.19
Standard Deviation	10.94

Table 2: Mean IOP groups (GAT versus APT)

Valid	1-10mmHg		11-20mmHg		21-30mmHg		31-40mmHg		Above 40mmHg		Total
	GAT	APT	GAT	APT	GAT	APT	GAT	APT	GAT	APT	
Frequency	36	2	127	147	29	42	6	7	2	2	200
Percent	18.0	1.0	63.5	73.5	14.5	21.0	3.0	3.5	1.0	1.0	100
Valid percent	18.0	1.0	63.5	73.5	14.5	21.0	3.0	3.5	1.0	1.0	100
Cumulative percent	18.0	1.0	81.5	74.5	96.0	95.5	99.0	99.0	100.0	100.0	

Table 3: Comparison of IOP Measurements Air-Puff vs GAT

	IOP mm Hg (Air-Puff)	IOP mmHg (Goldman)
No. of eyes	200	200
Minimum	9.3	6.0
Maximum	45.7	51.3
Mean	17.108	15.873
Difference in Mean IOP (Air puff Vs Goldman)	1.234	
Standard Deviation	1.713	

Discussion:

Estimated 3.5% of total world population of age range 40 -80years is affected with some kind of glaucoma[16].Our study consisted mostly of the middle-aged persons, mean age (44.19 years) Table 1, so most of the patients fall in this age range. We compared IOP obtained using the Air-puff and the Goldmann tonometer, considering the readings made with the Goldmann tonometer as gold standard.

Our study showed that the Mean difference in IOP readings with the two tonometers (Air-puff -Goldmann) was < 2mmHg especially between 10-30mmHg (Table 2) Thus, the reliability of the IOP

measurements with the Air-puff was comparable to that of the Goldmann tonometer especially between 10-30mmHg. In this study when the IOP was <10 mmHg the Air-puff overestimated the actual IOP and when the IOP was >30mmHg the Air-puff underestimated the actual IOP.

This study results are congruent with findings of Stock and Ströher who reported that in 180 eyes total mean IOP obtained by APT is significantly higher (p=0.0018) than GAT in extreme IOP range. However, it is similar in range of 10-15mmHg[17].

In another study conducted by Yeh SJ et al both instruments were compared r in eyes with corneal edema after penetrating keratoplasty PKP. Mean IOP measurements obtained by an Air-puff tonometer were significantly higher than with the GAT in the PKP and control groups. Poor agreement was noted between the air- puff tonometer and GAT in both groups. In PKP group Air-puff tonometer overestimate IOP. In normal corneas, the GAT and air-puff tonometers were affected by central corneal thickness (CCT) and corneal curvature (CC)[18].

Ghani MU et al reported statistically significant difference in mean IOP between both instruments in 50 vitrectomized eyes. Mean intraocular pressure measured by GAT and air puff tonometer was 14.59±2.13 mmHg and 14.93±1.88 mmHg respectively. They concluded if air puff is used for IOP measurement in post-vitrectomized cases then overestimation of IOP should be kept in mind[19].

Another study in Pakistan conducted by Shaheen S and coworkers on 500 individuals concluded that the sensitivity and specificity of APT for measuring IOP in glaucomatous eyes was 84.04% and 73.53% respectively and these results correlate with our study. It also showed that the Mean IOP in glaucomatous eyes measured by GAT and APT was 16.01+5.57 mmHg and 17.31+7.22 mmHg respectively[20].

In clinical studies, an error of less than +3mmHg has been suggested as tolerable in clinical and screening situations. But an average error of more than +3mmHg can not be tolerated in the diagnosis and treatment of vision threatening diseases when more accurate techniques are available. Discrepancies in IOP measurements by the Air-puff even in small percentage of cases could lead to incorrect clinical decisions in the detection and treatment of glaucoma[21].

However, in all these studies the authors concluded that the Air-puff was good enough for the purpose of adequate screening, presumably because in most studies the difference was small when compared with the limits of agreements.

In contrary to this study Basuony RE concluded that non-contact Air-puff tonometer yields higher IOP as compared to Goldmann tonometer and therefore requires further investigation to be used as clinical screening tool22.

Limitations of our study include readings taken by multiple observers; the investigators were not masked to the results. So intra and inter-observer bias may be present. One limitation of the present study is regarding the importance of central corneal thickness (CCT) in the accuracy of IOP measurements with instruments used. This relationship has implications on the results of the present study, and may partly help explain the variability between the two tonometers.

Conclusion:

In conclusion, the Air-puff tonometer demonstrates reliability in measuring IOP, particularly within specific intervals, but lacks consistency at extreme pressures. It serves as a viable alternative in situations where Goldmann tonometry is unfeasible, such as in pediatric or uncooperative patients. However, considering discrepancies at high and low pressures, the Goldmann tonometer remains the standard choice.

Recommendations:

While the Air-puff tonometer shows promise, its universal application in Glaucoma clinics requires further investigation. Future studies should consider corneal thickness and curvature, aiming for larger sample sizes, especially in high-pressure ranges.

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ORIGINAL ARTICLE

Comparison of the Accuracy of Phone Applications with Snellen Chart in Determining Visual Acuity

Rehan Naqaish[1], Amena Masrur[2], Sidra Naseem[3], Fatima Amjad[4] , Anum Badar[5], Mishal Batool[6]

Abstract

Objective: To correlate the visual acuity assessment as tested by smartphone application with standard Snellen visual acuity.

Methodology: A total of 136 individuals were included in this analytical cross-sectional survey conducted at Shifa Foundation Community Health Center, Islamabad between January 2022 and September 2022. Snellen's visual acuity was assessed using a standard Snellen's visual acuity chart, while the Paxos checkup by DigiSight technologies was used to assess visual acuity on smart phone using one appropriately color calibrated I-phone 7 device. Visual acuity from each assessment was noted in the decimal format. Data was analyzed through SPSS v 23.

Results: A total of 88 males and 48 females were included in the study (n=136). The mean visual acuity of right and left eyes as assessed with Snellen's chart were 0.88±0.2 and 0.86±0.22, respectively. The mean visual acuity for right and left eyes as assessed by Paxos checkup were 0.84±0.19 and 0.86±0.21, respectively. There was positive correlation was present in both eyes. The Pearson's correlation for right eyes was r = 0.66 and significant at p = 0.001, while the correlation for left eyes was r = 0.71 and significant at p = 0.001.

Conclusions: There is a strong correlation between Snellen's visual acuity assessment and assessment of visual acuity by the smartphone application. This makes the latter a viable strategy for screening at places where taking a Snellen's chart might not be feasible. *Al-Shifa Journal of Ophthalmology 2022; 18(4): 143-147.*

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Introduction:

An estimated 2.3 billion people in the world have impaired vision.[1] In a national survey conducted in Pakistan, among the moderately visually impaired, the leading cause for vision defect was refractive error.[2] It is a cause of severe visual impairment in rural settings of Pakistan as compared to the urban population.[3] One of the ways of assessing visual impairment is the visual acuity test. The use of this measurement is widespread in hospital settings.[4] Visual acuity measurement determines the clarity of near and far vision. The Snellen's chart, which was developed by Dutch ophthalmologist Dr. Hermann Snellen in the 1860s, is the clinical standard and the most common method for the visual acuity test today.[5] However, it's limitations in terms of portability and availability has

prompted the emergence of alternative means of testing visual acuity of a person. Modern technology has allowed the Snellen's chart to be readily available on smartphones as downloadable applications. The portability and availability of smartphones provides ophthalmologists a great advantage when treating patients in settings of meager facilities or in remote areas where scarcity of resources poses a big problem.[6] Use of mobile applications in health care settings has seen a rapid increase in recent years.[7] In a recent survey, the majority of physicians are using smartphones.[8] Currently there are more than a hundred applications available online to test the visual acuity of a person.[9] The application used in this study was 'Paxos Checkup by DigiSight Technologies Inc,[10] downloaded from the Apple app store, which has been investigated to be the best free app to measure visual acuity.[11] The rationale of the study was, in rural areas where there is shortage of resources, such as power outages, faulty or unavailable equipment,[12] this could be of great help to medical practitioners. This could be used as a screening tool for identifying vision defects in the general populace by ophthalmologists and opticians. This study aims to compare the accuracy of smartphone applications with a standard 6m Snellen (6SVA) visual acuity and to identify the feasibility of using smartphones in clinical/community settings in Pakistan.

Materials and Methods:

This analytical cross-sectional study was conducted at Shifa Foundation Community Health Center, Islamabad between January 2022 and September 2022. A total of 136 individuals, aged 18 to 60 years who presented with normal vision. Those with myopia (near sightedness) and hyperopia (far sightedness) were also included if they had their corrected glasses with them. Simple random sampling was used to gather subjects in the study. Individuals with vision deprivation due to corneal opacities, cataract, glaucoma, retinal and optic nerve pathologies were excluded from the study. A consent form was given to these individuals in which they were informed about the purpose of the research itself. Anonymity was maintained by using numbered forms.

A standard 6SVA box chart was used in this study along with Paxos Checkup by DigiSight Technologies, Inc. iOS application on an i0S compatible device, namely I-Phone 7 (dimensions-138.3 x 67.1 x 7.1 mm).

The visual acuity testing by the Snellen chart was performed by the optometrist. The 6SVA box chart was placed next to the subject who was instructed to read the chart which was present at a distance of 6m. The test was conducted under proper illumination. The use of distance correction glasses was allowed during the course of examination. Both eyes were assessed. The visual acuity testing by the smartphone was done by the researchers in an adjacent room under the supervision of an ophthalmologist. The smartphone was at its full brightness. The participants were instructed to wear their reading glasses if they use them. The device was held by the participant at a distance of 36" (36cm) from their eyes. The adjacent eye was covered. The data was collected by the optometrist and the researcher in separate rooms as to eliminate any bias or discrepancies.

The data was prospectively recorded, converted to decimals and then compiled onto a database for analysis. IBM's SPSS Statistics 23 was used and the means were compared using the paired t-test. Visual acuity measured by the Snellen's chart and the phone application for both eyes were compared.

Results:

Total 136 participants (272 eyes) were enrolled in the study. In the Snellen's visual acuity, the ophthalmologist recorded the visual acuity of the 136 participants, whereas the visual acuity of the application for the same group of people was recorded. The average age for the participants listed

in the study is 29.72±9.0 years. There are more males in our study with 88 (64.71%) compared to 48 (35.29%) females.

Table-I: Visual acuity at Snellen's chart and Paxos checkup application, n = 136

	Snellen's Chart	**Paxos Checkup**
	Mean ± SD	**Mean ± SD**
Visual acuity of right eye	0.88±0.2	0.84±0.19
Visual acuity of left eye	0.86±0.22	0.86±0.21

Table-II: Correlation between the Snellen visual acuity chart and the phone application in both eyes, n = 136

Visual acuity right eye		**VAR-SN**	**VAR-APP**
VAR-SN	Pearson correlation	1	.668
	Sig. (2-tailed)	-	.001
VAR-APP	Pearson correlation	.668	1
	Sig. (2-tailed)	.001	-
Visual acuity left eye		**VAL-SN**	**VAL-APP**
VAL-SN	Pearson correlation	1	.713
	Sig. (2-tailed)	-	.001
VAL-APP	Pearson correlation	.713	1
	Sig. (2-tailed)	.001	-

Discussion:

The results of our investigation show that visual acuity as measured using a smartphone application is comparable to Snellen's visual acuity (VA). A study conducted by Pathipati et al reported smartphone-based VA assessment to have greater accuracy as compared to the traditional Snellen's VA.[13] In their study, patients who reported to the emergency department were evaluated for VA using the Snellen's chart and a smartphone application (Paxos Checkup). The application used to assess visual acuity was similar to ours.

However, not all investigations show similar conclusions. The eye phone study could not identify an application that had an optotype size that could be considered as standard.[11] Though there was no statistically significant difference between VA measurements between smartphone applications and Snellen's VA, when stratified for severity of vision impairment showed that patients with VA worse than 6/18 had the greatest difference between the mean acuities of the two measurement methodologies (smartphone vs Snellen's). This study did not include the smartphone application investigated in our research thus a comparison cannot be made.[11] However, it does imply that not all smartphone applications are equally capable when it comes to recording VA that is comparable to that of Snellen's VA.

Automated smartphone-based visual acuity apps simplify the task of measuring visual acuity for healthcare providers who are

untrained in ophthalmology.[9] The distinction between near and far assessments of visual acuity may have contributed to the observed difference in visual acuity with the introduction of the smartphone-based visual acuity app.[11] The visual acuity was first measured by the baseline methodology of visual acuity assessment on the Snellen's chart as practiced by ophthalmology residents and opticians.[14] After this step we measured the visual acuity by the smartphone-based visual acuity test, which is a test of near visual acuity at 14 inches self-administered by patients. The results suggest that automated, smartphone-based visual acuity tests have virtually the same credibility in measuring visual acuity as compared to the traditional Snellen's chart. There are other applications for automated, smartphone based visual acuity tests.[15] Efficiency of ophthalmic care can be improved by directly linking these tests into the medical record. Because these apps are self-administered, they can readily be used by patients at the comfort and ease of their homes, accessible any time. One of the cornerstones of this study is that it simulates a rural based medical setting and provides a very accurate result of what would happen in a facility deprived primary medical health setting in a third world country.[16] We suspect that our results can be reciprocated in a number of medical health settings if the instructions are carried out as per the apps instructions. We found that the use of an automated, smartphone-based, self-administered visual acuity test provides a less accurate representation of the visual acuity ultimately recorded by ophthalmologists when compared to a distance Snellen chart in the context of emergent ophthalmic care. Our results indicate that such apps may function as supplementary resources for coordinated care between patients and ophthalmologists. Further research in different settings that overcome the shortcomings and limitations of this research need to be done to refine this area of advance and modern medical technology and in particular to this medical device.[17] Furthermore, the Snellen's chart itself has been in recent times criticized as not being the most accurate test for measurement of visual acuity.[18,19] Further suggestions would be to do a three-way comparison while using EDTA LoG MAR as a gold standard. Furthermore, other fields of medicine such as pain management are evolving and accepting modern day phone apps and are benefiting from such actions.[20] Technology might have its flaws but it's the need of the hour to improve whatever deficiencies it may have than ignore it.

Conclusion:

The study concluded that there is a strong correlation between Snellen's visual acuity assessment and assessment of visual acuity by the smartphone application. This makes the latter a viable strategy for screening at places where taking a Snellen's chart might not be feasible.

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ORIGINAL ARTICLE

Comparing Posterior Capsule Opacification Incidence: Rigid Polymethyl Methacrylate vs. Foldable Acrylic Intraocular Lenses in Cataract Surgery

Mohammad Alam[1]

Abstract:

Objectives: This comparative study aimed to determine the incidence of posterior capsule opacification following cataract surgery using Acrylic foldable intraocular lenses versus Polymethyl methacrylate rigid intraocular lenses.

Methodology: This study, conducted at the Department of Ophthalmology in DHQ Teaching Hospital Kohat and the Eye Care Centre Kohat, spanned from January 2018 to December 2020. Two patient groups with age-related cataracts were carefully selected after obtaining informed consent. Group A (200 patients) underwent Phacoemulsification surgery with foldable acrylic intraocular lenses, while Group B (200 patients) underwent small incision manual cataract surgery with rigid polymethyl methacrylate intraocular lenses. Follow-up assessments occurred at intervals between 6 months and 2 years. In Group A, 132 patients (66%) completed follow-up, and in Group B, 119 patients (59.5%) completed follow-up, with subsequent assessment for Posterior Capsule Opacification (PCO).

Results: In Group A, 11 patients (8.33%) exhibited Posterior Capsule Opacification, whereas in Group B, 31 patients (26.05%) displayed this condition.

Conclusion: The incidence of Posterior Capsule Opacification was found to be significantly lower in patients who received foldable acrylic intraocular lenses compared to those with Polymethyl methacrylate intraocular lenses. *Al-Shifa Journal of Ophthalmology 2022; 18(4): 148-153.*

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Introduction:

Opacification of the natural lens, leading to the development of cataracts and subsequent vision impairment or blindness, is a pressing global issue[1]. In contemporary ophthalmology, cataract surgery is predominantly conducted through either Phacoemulsification or Small Incision Manual Cataract Surgery (SMICS), with the subsequent implantation of intraocular lenses serving as a vital rehabilitation measure[2]. Among the postoperative complications associated with cataract surgery, Posterior Capsule Opacification (PCO) stands out as a significant concern, given its potential to deteriorate vision3.

While various theories have been proposed to explain the underlying mechanisms of PCO, it is well-established that PCO primarily arises from the regenerative

activities and extracellular matrix production of residual lens epithelial cells[4,5]. An alarming statistic reveals that PCO develops in approximately 50% of patients' eyes following cataract surgery6. The multifaceted repercussions of PCO, spanning social, medical, and economic domains, underscore the imperative need for its prevention. The development of PCO is influenced by numerous variables, including patient age, cataract type, surgical technique, intraocular lens material, size, design, and placement, along with other potential factors that have been extensively documented in the literature as contributing factors to PCO modulation[7,8].

Traditionally, cataract surgeries performed through conventional and SMICS techniques predominantly featured Polymethyl Methacrylate (PMMA) lenses. However, with the advent of Phacoemulsification, there has been a surge in the utilization of foldable acrylic lenses, gaining favor among surgeons. It is pertinent to note that PMMA lenses are associated with a higher incidence of PCO compared to their acrylic counterparts[9,10]. In fact, one study reported a PCO occurrence rate of 19.3% in patients with PMMA lenses, as opposed to 7.1% in patients with acrylic lenses.

PCO typically manifests in two primary forms: regenerative and fibrotic. Regenerative PCO, which is more prevalent, is attributed to the proliferation and migration of epithelial cells from the lens equator, resulting in the posterior capsule's coverage. On the other hand, fibrotic PCO occurs due to the trans differentiation of anterior lens capsule cells into the posterior capsule, leading to opacification.

Notably, intraocular lenses with adhesive properties to the posterior capsule, such as acrylic lenses, exhibit a lower incidence of PCO compared to non-adhesive PMMA lenses[11,12]. This study seeks to explore and delineate the incidence of PCO in patients who have received foldable acrylic intraocular lenses as opposed to rigid PMMA lenses. By doing so, it aims to contribute valuable insights to the ongoing discourse on this critical issue.

Materials and Methods:

The study was conducted within the Eye Department at DHQ Teaching Hospital Kohat and the Eye Care Centre in Kohat, spanning the duration from January 2018 to December 2020. The study participants were carefully selected, consisting of a total of 400 patients afflicted with age-related cataracts, with an age range spanning from 50 to 77 years. Inclusive criteria for participant selection encompassed the presence of age-related cataracts, ensuring that the cataract surgery proceeded uneventfully.

To maintain the integrity of the study, specific exclusion criteria were meticulously applied. Patients with traumatic cataracts and those who experienced eventful surgeries were excluded from the study. Additionally, individuals in whom Posterior Capsule Opacification (PCO) was observed intraoperatively were also excluded from participation.

All participants underwent comprehensive assessments, and explicit informed consent was diligently obtained from each of them. To ensure accurate biometric data, biometry was systematically conducted for every patient. Subsequently, the participants were categorized into two distinct groups.

Group A encompassed 200 patients, constituting 93 males (46.5%) and 107 females (53.5%). These individuals underwent cataract surgery employing Phacoemulsification techniques, with the subsequent implantation of foldable acrylic intraocular lenses.

In contrast, Group B was composed of 200 patients, including 117 males (58.5%) and 83 females (41.5%), as outlined in Table I. For these patients, small manual incision cataract surgery techniques were employed, with the implantation of rigid Polymethyl Methacrylate (PMMA) intraocular lenses.

Following their respective surgeries, the patients were thoughtfully registered for post-operative follow-up, spanning a period extending from 6 months to 2 years. In Group A, 132 patients (66%) participated in the follow-up, with 72 males (54.5%) and 60 females (45.5%) completing the assessment. In Group B, 119 patients (59.5%) partook in the follow-up, comprising 62 males (52.10%) and 57 females (47.89%) (as shown in Table II). Subsequently, these patients were meticulously evaluated for the development of Posterior Capsule Opacification, a pivotal aspect of the study.

Results:

In this comparative study, we aimed to investigate the incidence of Posterior Capsule Opacification (PCO) in patients who underwent cataract surgery using different techniques and intraocular lenses (IOLs).

The study was conducted at the Eye Department of DHQ Teaching Hospital Kohat and the Eye Care Centre Kohat from January 2018 to December 2020. A total of 400 patients with age-related cataracts were included in the study, with ages ranging from 50 to 77 years.

The patients were divided into two groups: Group A and Group B. Group A consisted of 200 patients who underwent cataract surgery using the Phacoemulsification technique, and foldable acrylic IOLs were implanted. Of these patients, 93 were male (46.5%), and 107 were female (53.5%). In contrast, Group B included 200 patients who underwent small incision manual cataract surgery with the implantation of rigid Polymethyl Methacrylate (PMMA) IOLs. This group consisted of 117 males (58.5%) and 83 females (41.5%).

All patients were registered for follow-up, which ranged from 6 months to 2 years after the surgery. In Group A, 132 patients (54.5% male and 45.5% female) completed the follow-up. In Group B, 119 patients (52.10% male and 47.89% female) completed the follow-up.

The primary focus of the study was to evaluate the development of PCO in these two groups. In Group A, 11 out of 132 patients (8.33%) developed PCO during the follow-up period. In Group B, which underwent small incision manual cataract surgery with PMMA IOLs, 31 out of 119 patients (26.05%) developed PCO.

These results indicate a significant difference in PCO incidence between the two groups. Patients in Group A, who underwent Phacoemulsification with foldable acrylic IOLs, showed a notably lower incidence of PCO compared to those in Group B, who received small incision manual cataract surgery with rigid PMMA IOLs.

In conclusion, the study suggests that the choice of surgical technique and IOL material can influence the incidence of PCO following cataract surgery. Specifically, foldable acrylic IOLs are associated with a lower risk of PCO compared to rigid PMMA lenses. However, it's essential to acknowledge the limitations of the study, including the sample size, and further research is needed to establish the statistical significance of these findings.

Table I. Gender distribution (400 Patients)

Groups	Total patients	Male	Female
A	200	93(46.5%)	107(53.5%)
B	200	117 (58.5%)	83(41.5%)

Table II. Patients completed Follow up

Group	Patients	Male	Female
A	132	72(54.5%)	60(45.5%)
B	119	62(52.10%)	57(57.89%)

Table III. Posterior capsular opacification

Group	Number of Patients	Patients with PCO	Percentage
A	132	11	8.33
B	119	31	26.05

Discussion:

Cataract surgery is the most commonly procedure going on in ocular field. For rehabilitation two types of IOL in the form of fordable acrylic and rigid PMMA are used. PCO is most common post-operative complication of cataract surgery and its developments starts usually after 3 to 6 months. PCO results in blurred vision and glare. For rehabilitation after cataract surgery intra ocular lenses are implanted. PCO depends upon IOL design, optic material and surgical technique. Mostly rigid PMMA IOL are used after cataract surgery which has high rate of PCO. With evolution of cataract surgery by phacoemulsification foldable acrylic IOL have been made with less incidence rate of PCO.

Our study has shown PCO in 8.33% patients with foldable acrylic IOL as compared to 26.05% in PMMA IOL. There are multiple national and international studies data focusing on this issue. Moin M, Raza K, Ahmad A have reported PCO incidence of 6.2 % in acrylic IOL versus 24.3% PMMA IOL[13]. Chupra S, Gar M, Bhatiya N, Bhatti A have illustrated in their study the PCO rate of 42.86 % in acrylic IOL while 78.75% in PMMA IOL[14]. Henning etal has reported PCO rate of 23.3 % in acrylic IOL while 36.1 % PMMA IOL[15]. Material of IOL has great influence on epithelial cells. Hollick et al have reported the presence of epithelial cells on the posterior capsule of the patients with PMMA IOL was more than acrylic IOL.

The development of PCO has been affected by various factors not only the IOL material. Takkar etal have reported high incidence of PCO associated with PMMA IOL[16]. Hyashi H, Hayshi K, Nakao F, etal have reported high incidence of PCO at PMMA IOL than acrylic IOL. According to their study 2.7% of patients with acrylic IOL and 30.4% patients with PMMA IOL developed PCO[17]. Oshuka T etal have reported that high incidence of PCO in PMMA IOL is due to weak adhesion between IOL and posterior capsule as compared to acrylic IOL which has strong adhesion with posterior capsule[18]. Santos has also reported the poor adhesive quality of PMMA IOL with posterior capsule as compared to acrylic IOL[19]. Wilson,Ram and Aasusi have reported incidence rate of PCO more in PMMA IOL than acrylic IOL[20,21,22].

The variation in results may be due to many reasons like manufacturer quality, pre-existing ocular morbidity and surgical expertise. Best treatment for PCO is YAG Laser capsulotomy which is also associated with complications in form of IOL pit,

retinal detachment, macular oedema and raised intraocular pressure[23,24]. To avoid YAG laser complications it is better to practice use foldable acrylic IOLs[23-24].

Conclusion:

Based on the study results and the referenced literature, it is evident that Acrylic IOLs offer a significant advantage in preventing posterior capsule opacification (PCO), a common and troublesome postoperative complication of cataract surgery. PCO often requires treatment through YAG Laser capsulotomy, which, unfortunately, is associated with potential complications.

To mitigate these complications and ensure better postoperative outcomes for cataract patients, it is strongly recommended that the preference be given to the use of foldable acrylic IOLs. This choice not only reduces the incidence of PCO but also minimizes the need for subsequent interventions like YAG Laser capsulotomy. By adopting this approach, eye care professionals can enhance the overall quality of vision restoration and contribute to the well-being of their patients.

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ORIGINAL ARTICLE

Assessment of Low Vision Aids for Low Vision Patients

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Abstract:

Purpose: To evaluate assessment of low vision aids for low vision patients.

Methodology: All patients with VA less than 6/18 in the better eye after medical or surgical treatment and / or best available correction were included in the study. Low vision devices including telescopes stand magnifiers, hand magnifiers and closed-circuit television (CCTV) were used during the low vision assessment. Specific type and design of low vision device was selected to meet the activities according to the specific and professional needs of each case.

Results: Total number of patients included in this study were 126, in which 65.07% were males and 34.93% were females. About 58.74 % patients were improved to WHO category I (6/18 or better) with low vision devices, 23.81 % patients improved to category II, 9.52 % improved to category III and 7.93 % to category IV. Considering near VA, with low vision devices, about 75.50 % improved to category I (1M or better), while 20.74 % improved to WHO category II (<1M to 3.2M) and 3.76 % to category III (<3.2M).

Conclusion: Low vision aids if selected according to the needs of low vision patients are useful tools to help low vision patients in terms of some improvement in vision to carry out some specific daily works and are an effective means of providing visual rehabilitation. *Al-Shifa Journal of Ophthalmology 2022; 18(3): 154-161.*

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Introduction:

The National Eye Institute United States of America defines low vision as a visual impairment not correctable by standard glasses, contact lenses, medication or surgery, which interferes with the ability to perform activities of daily living.[1]

WHO defines low vision as people having vision worse than normal but better than legal blindness.[2] WHO working definition of LVA (Bangkok, 1992) defined low vision as "A person with low vision is one who has Impairment of visual functioning even after treatment and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception, or a visual field less than 10 degrees from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task". [3]

A visual impairment can cause disabilities by significantly interfering with one's ability to function independently, to perform activities of daily living and/or to

travel safely through the environment.[4] An impairment of the visual system can present at birth, or develop shortly thereafter.[5] Visually impaired children are often developmentally delayed in the areas of gross and fine motor skills and perception.[6] The common causes of low vision are uncorrected refractive errors, corneal dystrophies, macular dystrophies, glaucoma, diabetic retinopathy, retinal detachment, macular degeneration, albinism and retinitis pigmentosa which have severe social and economic effects on individual's life.[7]

Because low vision cannot be improved by more traditional methods (i.e., the use of glasses, contact lenses, etc.) persons with low vision often rely on the use of a number of different instruments, called low vision devices, and tailored equipment for improving vision.[8].Only about 20-25% of those who could benefit from these treatment options present to low vision Optometrist.[9]

Low vision devices are categorized as optical, non-optical and electronic. Low-vision non-optical devices include a number of adaptations, such as reading stands, absorptive sunglasses, supplemental lighting, typoscopes, and tactile locator dots. They are often recommended as part of a low vision examination. They can be used in combination with magnifiers and other low vision optical devices that can help with reading and a variety of tasks. Optical low vision devices involve the use of one of many types of lenses e.g. magnifying eyeglasses, hand magnifiers and magnifying lamps to improve vision. Hand-held or spectacles-mounted telescopes are useful for seeing longer distances, such as across the room, to watch television and can also be modified for near (reading) tasks. Closed circuit television or CCTV involves enlarged images display on screens. Electronic devices are available in portable and desk formats. They combine a camera and a screen to magnify printed pages, pictures or other small objects. [10]

This study has been done in order to find the low vision devices as a helping tool in terms of vision improvement in patients with low vision. Many studies have been done regarding low vision, its causes and prevalence but before this study not much work has been done on visual outcome of low vision devices in low vision patients in our population.

Materials and Methods:

It was a hospital based descriptive, cross-sectional study and was carried out at eye OPD, Qazi Hussain Ahmad Medical Complex, Nowshera. The population under study was those visiting Eye OPD, whose presenting visual acuity was less than 6/18 in the better eye with best available correction and not correctable by standard glasses, contact lenses, medication or surgery. The duration of the study was one year i.e. 1st Jan 2019 to 31st Dec 2019. All the consecutive patients of both genders and any age were included in the study. All patients with VA ≥6/18, mentally retarded, patients who didn't communicate and severely ill patients were excluded from the study.

First the Visual Acuity was taken on standard retro-illuminated Log MARChart at 4m and, if necessary, at 3m or 2m in each eye separately. Near reading cards, FEINBLOOM chart for the partially sighted, the THUMBLING E, and the LEA CARDS were used for measurement of near vision and in patients who could not read English, depending on the level of cooperation. If VA could not be measured with these charts, then a sequential approach was used with the following tests e.g. counting fingers, hand movement, light perception. For the purpose of this study, WHO definition for low vision was used to categorize the far vision as: mild or category I (visual acuity worse than 6/12 to 6/18), moderate or category II(6/60 < VA < 6/18, 10°< VF < 20°), severe vision impairment or category III (3/60 < VA< 6/60, 5° < VF < 10°), and blindness or profound vision impairment or category IV

(VA < 3/60, VF < 5°).While near acuity data was presented in three groups. Ist group 1M (newspaper print size) or better which would allow access to most printed materials, 2nd group < 1M to 3.2M (display materials); which will allow only limited access to ink print and 3rd group <3.3 M. All of these Visual acuities were converted into equivalent Snellen acuities in order to follow WHO categories.

Retinoscopy was performed on all patients, followed by subjective refraction using standard techniques. The best corrected distance and near acuity, the refractive error and the eye to chart distance was recorded for the better eye. Detailed anterior and posterior segment examination by slit lamp and indirect ophthalmoscopy was carried out for all patients by consultant ophthalmologist to make a diagnosis of underlying condition responsible for low vision. The major predisposing condition for each person in the better eye was assigned as the cause of visual impairment. All patients were then assessed with low vision devices using the better eye. Low vision devices including telescopes stand magnifiers, hand magnifiers and closed-circuit television (CCTV) were used during the low vision assessment. Specific type and design of low vision device was selected to meet the activities according to the specific and profession needs of each case. Visual functions specifically improvement in near and far visual acuity was assessed after applying specific low vision aid in each patient. The participants who were already using the low vision devices were reassessed for any possible improvement with same or new low vison devices.

After complete examination we collect the whole information that included details of objective assessment and subjective assessment for low vision patients. All the information was recorded in a specially designed proforma. Data was analyzed using SPSS version 20.0. Descriptive statistics were calculated for all variables. Frequencies and percentages were calculated for categorical variables like gender. Mean + Standard deviation were concluded for numeric variable like Age. AP-value of <0.05 was considered as significant. All the results were presented in the form of tables.

Results:

In this study, the total number of patients examined were126 whose VA was less than 6/18 with best correction. In which 82 were males and 44 were females.

In age wise distribution of low vision, in age group 5-10 years there were 11 (64.70%) males and 6 (35.30%) female, in age group 11-16 years there were 15 (68.18%) males and 7 (31.82%) females, in age group 17-39 years there were 31 (67.39%) males and 15 (32.61%) females and in age group 40 and above there were 25 (60.97%) males and 16 (39.03%) female. (table No: 1)

While considering un-aided VA 58.73 % patients were visual impaired WHO category II (< 6/18 to 6/60), 22.22% were sever visual impaired in WHO category III (<6/60 to 3/60) and 19.05% were blind in WHO category IV (<3/60). With refraction in 61.90% patients VA improved to WHO category II, 19.05% patients remained in WHO category III and 19.05 % patients in WHO category IV. About 58.74 % patients were improved to WHO category I(6/18 or better) with low vision devices,23.81 % patients improved to category II, 9.52 % improved to category III and 7.93 % to category IV.P value < 0.05.(Table No: 2).

Considering near VA, with low vision devices, about 75.50 % improved to category I (1M or better), 20.74 % improved to WHO category II (<1M to 3.2M) and 3.76 % to category III (<3.2M).P value < 0.05.(Table No: 3).

Percentage of patients using different types of low vision devices for far and near is shown in table No: 4 and table No: 5.

Table-I Age wise distribution of low vision among different age groups

Sr.	Age group (years)	Males	Males%	Females	Females %	Total
1	5-10	11	64.70%	6	35.30%	17
2	11-16	15	68.18%	7	31.82%	22
3	17-39	31	67.39%	15	32.61%	46
4	40 & above	25	60.97%	16	39.03%	41
Total		82	65.07%	44	34.93%	126

Table-II Comparison of unaided distance VA, VA with glasses, and VA with LVDs

VA	Unaided V A(n%)	VA with glasses after refraction (n%)	V A with LVDs (n%)
6/18 or better	0 (0.00%)	0 (0.00%)	74 (58.74%)
<6/18 to 6/60	74(58.73%)	78 (61.90%)	30 (23.81%)
<6/60 to 3/60	28 (22.22%)	24(19.05%)	12 (9.52%)
<3/60	24 (19.05%)	24 (19.05%)	10 (7.93%)
Total	126 (100%)	126 (100%)	126 (100%)

P Value: 0.045

Table-III Comparison of presenting near VA and Near VA with LVDs

VA	Presenting near VA n%	Near VA with LVDs n%
1M or better	25 (19.84%)	95 (75.50%)
<1M to 3.2M	81 (64.28%)	26 (20.74%)
<3.2 M	20 (15.88%)	4 (3.76%)
Total	126 (100%)	126 (100%)

P Value 0.024

Table-IV Patients using different types of LVDs for distance

Types of LVDs for distance	Patients used LVDs for distance n%
Telescope	92 (73.01%)
Ocutech telescope	34 (26.99 %)
Total	126 (100 %)

Table-V Patients using different types of LVDs for near

Type of LVDs for near	Patients n%
Glasses (including FONDA glasses)	64 (50.79 %)
Stand magnifier	15 (11.91 %)
Hand held magnifier	12 (9.53 %)
CCTV	18 (14.28 %)
Ocutech telescope with cap	17 (13.49 %)
Total	126 (100 %)

Discussion:

The majority of patients with Low vision can have their visual functions enhanced by a combination of environmental modification and low vision devices. Environmental modifications include placing patients near window to give them better light while reading, or encouraging them to wear hats and caps to prevent glare especially when outdoor.[11]

Basic principle of all low vision devices is to magnify the objects. This principle of magnification is used in different ways to help low vision patients.[12] Some devices cause relative size enlargement of the objects e.g. large print text books. Other causes relative distance magnification by moving the object of interest closes to the eyes so to subtend a larger image on the retina. Some devices cause angular magnification in which there is apparent change of size of the object of interest, by using a magnifier or telescope systems.[13]Most important factor to improve the visual function is to increase the illumination. 90% of patients with low vision showed improvement in visual acuity by adjusting the illumination.[14]

The low vision devices available can be grouped into 3 main categories as optical, non optical and electronic. This study mainly concern with optical devices and that how many low vision patients can be improved with these devices. Various studies have found that optical low vision devices are an effective means of providing visual rehabilitation.[15]

Different types of magnifiers are used in different ways to improve the near visual acuity in patients with low vision. These can either be used with near vision spectacles where these have a longer working distance as compared to near spectacles. However greater the distance smaller will be the visual field.[16] Magnifiers are available as stand, hand-held, fibre-optic, illuminated, and dome-bar magnifiers. Hand-held magnifiers have the benefit that these are portable, have longer working distances and are not expensive. These are also helpful in eccentric viewing although these have limited field of view. On the other hand, stand magnifiers have both angular magnification and relative distance magnification. They can be used as fixed focus, focusable, with or without illumination and rest on a rigid mount.[17]As these devices are technically simple to use so are better choice for patients with paralysis, hand tremors, arthritis, or poor hand-eye coordination.[18]Omaret al. in their study prescribed hand held magnifiers as most frequent near low vision devices with percentage 54.2% of cases.[19] Gopalakrishnan S et al. in their study used handheld magnifier in 11%, pocket magnifier in 2%, and portable video magnifier in 4% low vision patients for spotting tasks. Bifocal spectacles were prescribed for 28% of patients to improve the clarity of vision.[20] In their study patients with healed choroiditis and healed retinitis showed a statistically significant improvement in near VA after the use of LVDs (52.2% and 71.7%, respectively) ($P< 0.05$).20 In our study FONDA glasses were prescribed in 50.79 % patients, stand magnifier in 11.91 % and hand-held magnifier in 9.53 % patients with significant improvement in near vision. Majority of patients were having visual improvement in the range of 1M to 3.2M.

Telescopic systems can be prescribed for near, intermediate and distant tasks. These work on the principle of angular magnification and magnify the apparent size of distant objects. Field of view decreases with magnification of objects.[21] Telescopes are not widely used by low vision patients because these devices are difficult to use, are expensive and are cosmetically unacceptable. Telescopes can be prescribed for one eye or both eyes. These are either hand-held, clip-on or spectacle-mounted.[22] Different designs telescopes include fixed focus, focusable, or autofocus. Focusable telescope can be used for near, intermediate distance and far.[23] Patients with retinitis pigmentosa have peripheral visual loss and

magnification with telescope may reduce their existing vision. Such patients may benefit from reverse telescopes that expand the visual field. This Field expansion can also be achieved by prisms.[24] Tremblay et al. designed a telescopic contact lens in 2013 that causes a shift from normal to magnified vision using 3D glasses and electrical polarization.[25] Rania GE et al. used spectacle-mounted Galilean telescopes as distance low vision aid in their study. Binocular telescopes were given to seven patients (46.7%) and monocular telescopes were given to eight patients (53.3%).BCVA in the better eye was markedly improved in all patients with four patients (26.7%) had vision near normal, eight patients (53.3%) had vision in moderate range and three patients (20%) had vision in severe range.[26] In our study we prescribed telescope to 92 (73.01 %) patients for far vision and Ocutech telescope with cap for near to 17 (13.49 %) patients. Majority of patients have their far vision improvement in the range of 6/60 to 3/60 while near vision improvement was in the range of 1M to 3.2M. However, compliance for use of telescope was poor as compared to magnifiers because these devices are difficult to use and patients found it cosmetically unacceptable.

Regarding electronic category of low vision devices, the primary electro-optical device is a standard closed-circuit television (CCTV). It uses a camera to capture and then display enlarged images on a computer screen.[27] Benefit of such devices is that magnification, brightness, contrast, change of polarity from black to white and voice command can also be controlled in these devices. While most CCTVs are desktop units, portable which may be hand-held or head mounted are also available. Smallfield S et.al showed in their study that electronic devices were administrated less frequently because they were more costly, their standby times were short and they were hard to repair if damaged.[28] In our study CCTV was prescribed only to18 (14.28 %) patients who were educated or students. Majority of these patients have their near vision better than 3.2 M with CCTV.

Conclusion:

Low vision aids if selected according to the needs of low vision patients are useful tools to help low vision patients in terms of some improvement in vision to carry out some specific daily works and are an effective means of providing visual rehabilitation.

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ORIGINAL ARTICLE

Effect Of Prophylactic Use Of Fixed Combination Of Topical Dorzolamide And Timolol On Intraocular Pressure Spike After Intravitreal Bevacizumab

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Abstract:

Background: Intravitreal injections are common in ophthalmology practice and rapidly increasing with new indications. This study aims to identify the rise in the intraocular pressure following intravitreal Anti VEGF bevacizumab.

Objective: To evaluate mean changes in IOP among patients given intravitreal bevacizumab injection with topical dorzolamide and timolol fixed combination prophylaxis as compare to controls.

Methodology: It was a randomized control trial, conducted at ophthalmology department, Rawalpindi medical university and allied hospitals from March 2021 to December 2021. Patients were divided in two groups by lottery method. Group A was control group in which only intraocular pressure was measured before and after administration of intravitreal bevacizumab. While in Group B, cases given topical dorzolamide and timolol fixed combination prophylaxis before intravitreal anti VEGF bevacizumab were included. IOP in both groups was measured before and immediately after the procedure in supine position by hand held Perkin's tonometer. IOP was repeated immediately after injection, at 30 min and 60 min in both groups.

Results: Mean Intraocular pressure in Group-A before injection was 14.1+3.04 and in Group-B was 13.57+3.78 with p value 0.49. At 0 minute, it was 32.73+7.31 in Group A and 24.4+3.42 in Group B, p value was 0.0001. At 30 minutes, it was reduced to 22.57+5.38 in Group-A and 16.93+3.88 in Group-B, p value was 0.0001. At 60 minutes, IOP was 17.67+2.47 in Group-A and 14.9+3.30 in Group-B, p value was 0.001.

Conclusion: Mean changes in IOP in patients having intravitreal bevacizumab injection, with topical dorzolamide and timolol fixed combination prophylaxis, was significantly lower when compared to controls. *Al-Shifa Journal of Ophthalmology 2022; 18(4):162-171.*

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Introduction:

Intravitreal Anti vascular endothelial growth factors (Anti VEGFs) are widely used in different posterior segment diseases and injection numbers are rapidly increasing with new indications.[1]

Anti VEGF used in the treatment of vitreoretinal diseases are ranibizumab, aflibercept and bevacizumab. FDA approved anti vascular endothelial growth factors are ranibizumab and aflibercept for posterior segment diseases but bevacizumab is a widely used off label anti

VEGF and is cost effective and shows similar results.[1] Bevacizumab (Avastin) is used off label for various vitreoretinal diseases such as diabetic macular edema, choroidal neovascularization, proliferative diabetic retinopathy, retinopathy of prematurity and edema related to Central retinal vein occlusion.[1] There is an immediate rise in intraocular pressure after intravitreal anti VEGF agents [1,2]. The immediate rise in the intraocular pressure after intravitreal injection can cause blockage of the juxtapapillary retinal and optic nerve head axonal flow proportional to its quantitative rise and this can cause damage to retinal ganglion cell layer.[2.] Studies have shown that acute rise in the intraocular pressure blocks the axonal flow.[3] With these intravitreal injections; a transient IOP elevation occurs which normalizes about one hour after intravitreal injection.[4]Patients given prophylactic topical dorzolamide-timolol fixed combination get a significant decrease in IOP spikes during this 1st hour .[4] Similarly Brinzolamide was found to have IOP lowering effect when given prophylactically in patients who received intravitreal Ranibizumab.[5]

There are many international studies to find the effect of prophylactic use of fixed combination of topical dorzolamide and timolol on intraocular pressure spike after intravitreal bevacizumab, showing a significant decrease in IOP spikes. After literature review , we decided to conduct this study. Our study will help to find the effect of topical dorzolamide and timolol fixed combination prophylaxis on intraocular pressure spike after intravitreal bevacizumab injection in Pakistani population. As we hope that this measure will reduce the spike, so it will help to make the use of this prophylaxis mandatory so that marked post injection IOP rise can be prevented and so optic nerve blood flow cannot be compromised. This study was conducted to evaluate mean change in IOP in patients having intravitreal bevacizumab injection with topical dorzolamide and timolol fixed combination prophylaxis as compare to controls.

Materials and Methods:

This study was conducted in Benazir Bhutto Hospital, Rawalpindi medical university on patients having intravitreal bevacizumab injection for various indications, from 16-03-2021 to 31-12-2021. It was a randomized controlled trial. Patients were selected by non-probability convenient random sampling technique. Sample size was calculated by WHO calculator version 122.6 according to which 60 eyes were included in study. Patients were divided into two groups. Group A (Patients without prophylaxis, n=30), Group B (Patients who were given prophylactic topical dorzolamide-timolol combination n=30)

Patients included in study were those who were having any indication of intravitreal injection with age range 18 years to 80 years. Pseudophakic patients for less than 3 months, who underwent intravitreal injection of steroid less than 3 months, who underwent intravitreal antibiotic in less than 3 months and patients having glaucoma were excluded from study.

Before initiation of the study, approval was sought from the institutional ethics research forum of Rawalpindi Medical University. After an informed written consent from the patients, detailed history and ophthalmological examination were done for intravitreal injection and those fulfilling the criteria were included in study. Patients were divided in to two groups with lottery method. Group A was control group in which only intraocular pressure was measured before and after the administration of intravitreal bevacizumab and Group B were of cases whom topical dorzolamide and timolol fixed combination prophylaxis was given two hours before intravitreal bevacizumab.

Group A was control group, before procedure intraocular pressure was measured through hand held Perkin's

tonometer in the supine position on OT table and Group B was study group and include cases in which fixed combination of topical dorzolamide and timolol was instilled two hour before the procedure and Intraocular pressure was measured through hand held Perkin's tonometer pre-injection in the supine position on table.

After that, data collection procedure of both group was same. Patient was instilled with topical anesthesia Proparacaine, 5% povidone iodine was instilled into the conjunctival sac and around the eye lid. After scrub and drape under proper aseptic measures, eye speculum was applied. Eye was marked with the caliper 3.5mm from the limbus in pseudophakic and 4mm from the limbus in phakic eye in inferotemporal region. Injection bevacizumab of dose 1.25mg in 0.05ml was injected through pars-plana into the vitreous cavity and cotton bud was applied at the injection site for few seconds. At the end, 0.5% moxifloxacin was instilled in the conjunctival sac. After the procedure, immediately intraocular pressure was measured in supine position by hand held tonometer. It was repeated at 30 min and 60 min.

Statistical analysis was performed with SPSS version 20. Categorical variable such as gender, was expressed as frequency and percentage of patients and continuous variables such as age and intraocular pressure were expressed as mean +SD. Independent sample t test was used to make comparison between two groups and 'p' value less than 0.05 was considered as significant. Effect modifiers like age and gender was controlled by stratification. Post stratification independent sample t test was applied. P value <0.05 was considered as significant.

Results

A total of 60 cases (30 in each group) fulfilling the selection criteria were enrolled to evaluate mean change in IOP in patients having intravitreal bevacizumab injection with topical dorzolamide and timolol fixed combination prophylaxis as compared to controls.

Age distribution shows that 23.33% (n=7) in Group-A and 30%(n=9) in Group-B were between 18-50 years of age whereas 76.67%(n=23) in Group-A and 70%(n=21) in Group-B were between 51-80 years of age, mean age was 56.60+7.58 and 56.6+6.99 years respectively.

Gender distribution shows that 46.67%(n=14) in Group A and 36.67%(n=11) in Group B were male while 53.33%(n=16) in Group A and 63.33%(n=19) in Group-B were females.

Mean Intraocular pressure in Group-A was 14.1+3.04 and 13.57+3.78 in Group B, p value was 0.49. Mean IOP at 0 minute was 32.73+7.31 in Group A and 24.4+3.42 in group B, P value=0.0001.Mean IOP at 30 minute was 22.57+5.38 in Group-A and 16.93+3.88 in Group-B, p value was 0.0001, and Mean IOP at 60 minute was 17.67+2.47 in Group-A and 14.9+3.30 in Group-B , P value= 0.001. Results are shown in table 1,2 and 3.

Table-I: Stratification of Mean IOP at baseline and 0-minute post injection of both groups with respect to effect modifiers (gender, age,)

Variables	IOP time	Group A			Group B			P value
		Mean IOP	N	SD	Mean IOP	N	SD	
Males	Baseline IOP	12.21	14	1.76	11.91	11	1.92	0.68
	IOP at 0minute	30.71	14	8.14	25.45	11	2.84	0.05
Females	Baseline IOP	15.75	16	3.00	14.53	19	2.99	0.24
	IOP at 0minute	34.50	16	6.22	23.79	19	3.65	0.0001
Age 18-50 years	Baseline IOP	12.57	7	2.76	13.22	9	2.82	0.65
	IOP at 0minute	29.71	7	5.22	25.56	9	3.57	0.07
Age 51-80 years	Baseline IOP	14.57	23	3.03	13.71	21	3.00	0.36
	IOP at 0minute	33.65	23	7.69	23.90	21	3.32	0.0001

Table-II: Stratification of Mean IOP at baseline and 30-minute post injection of both groups with respect to effect modifiers (gender, age)

Variables	IOP time	Group A			Group B			P value
		Mean IOP	N	SD	Mean IOP	N	SD	
Males	Baseline IOP	12.21	14	1.76	11.91	11	1.92	0.68
	IOP at 30minute	21.93	14	4.27	17.36	11	2.62	0.004
Females	Baseline IOP	15.75	16	3.00	14.53	19	2.99	0.24
	IOP at 30minute	23.13	16	6.28	16.68	19	2.38	0.0002
Age 18-50 years	Baseline IOP	12.57	7	2.76	13.22	9	2.82	0.65
	IOP at 30minute	20.00	7	3.83	17.56	9	1.88	0.11
Age 51-80 years	Baseline IOP	14.57	23	3.03	13.71	21	3.00	0.36
	IOP at30minute	23.35	23	5.61	16.67	21	2.65	0.0001

Table-III : Stratification of Mean IOP at baseline and at 60-minute post injection of both groups with respect to effect modifiers (gender, age)

variables	IOP time	Group A			Group B			P value
		Mean IOP	N	SD	Mean IOP	N	SD	
Males	Baseline IOP	12.21	14	1.76	11.91	11	1.92	0.68
	IOP at 60minute	18.00	14	15.09	2.48	11	2.12	0.005
Females	Baseline IOP	15.75	16	3.00	14.53	19	2.99	0.24
	IOP at 60minute	17.38	16	2.50	14.79	19	1.93	0.001
Age 18-50 years	Baseline IOP	12.57	7	2.76	13.22	9	2.82	0.65
	IOP at 60minute	16.57	7	1.90	15.11	9	1.36	0.09
Age 51-80 years	Baseline IOP	14.57	23	3.03	13.71	21	3.00	0.36
	IOP at60minute	18.00	23	2.56	14.81	21	2.20	0.0001

Discussion

The intravitreal injections of anti-VEGF agents is now a common procedure performed by ophthalmologist for various vitreoretinal diseases such as diabetic macular edema , age related macular disease and choroidal neovascularization and other retinal pathologies. Anti VEGF agents include bevacizumab (Avastin; Genentech, Inc), ranibizumab (Lucentis; Genentech, Inc, South San Francisco, CA), pegaptanib (Macugen; Bausch & Lomb Inc., Rochester, NY), and aflibercept (Eylea; Regeneron, Tarrytown, NY) and they have provided significant benefit to patient with vitreoretinal diseases.[1,2,3]

There are many complications associated with Intravitreal anti VEGF injection in which Increase in IOP is a significant concern to ophthalmologist. Jong Wook Lee[2] in a prospective case series evaluated the Short-term changes of intraocular pressure and ocular perfusion pressure after intravitreal injection of bevacizumab or ranibizumab. Trial included 42 patients (65 eyes), who underwent intravitreal anti VEGF injection and IOP was measured just before the injection, immediately after the injection, at 30 min, 1 day, and 1 week after the injection. Their study showed that Pre-injection mean IOP was 16.66 ± 3.50 mmHg, and mean IOP was 43.81 ± 9.69 mmHg immediately after the injection. At 30-minute mean IOP was 17.57 ± 4.44. mean IOP at day 1 was 15.00 ± 4.21 mmHg, and mean IOP at week 1 was 15.90 ± 3.63 mmHg. IOP immediately after injection was significantly different from the pre-injection . In our study,we also observed the same transient increase in IOP elevation in the control group who receive intravitreal injection without prophylactic IOP lowering drops and 30 patients (30 eyes) were included in the control group A. Intraocular pressure in this group was 14.1$\pm$3.04, p value 0.49 before procedure and at 0 minute it was 32.73$\pm$7.31 and p value was 0.0001, which show that significant IOP spike occurred in the patients who received intravitreal Anti VEGF bevacizumab but this rise was quite less in group B who received prophylactic IOP lowering drops.

There are certain mechanism of actions suggested for the significant rise in the IOP after Anti VEGF injection. These include direct toxic effect of anti VEGF on trabecular meshwork, an inflammatory response to Anti VEGF, mechanical blockage of Trabecular meshwork by protein aggregates. Therefore, it remains an important clinical question about the relationship between Anti VEGF and Increase IOP after its use[3]. Timely recognition may postpone the onset or progression of Glaucoma and so prevents the visual loss.[3]

In many studies,[4,5,6] pre-treatment with topical dorzolamide and timolol fixed combination prophylaxis , brimonidine , acetazolamide , brimonidine or timolol and Anterior chamber tap before intravitreal injection have shown to help lower the IOP after Intravitreal anti VEGF. Anterior chamber tap is an invasive method and because of its risk of complications clinician have preferred to use topical prophylactic antiglaucoma medicine for clinical trial.[6]

Studies on prophylactic antiglaucoma medication before intravitreal injections are now being popular and few studies reported their results. Sehnaz Ozcaliskan[4] studied the effect of dorzolamide-timolol fixed combination prophylaxis on intraocular pressure spikes after intravitreal bevacizumab injection and evaluated the short term IOP changes after intravitreal bevacizumab injection in patients with and without dorzolamide-timolol fixed combination prophylaxis. They used Dorzolamide-timolol combination because of its effectiveness than either dorzolamide or timolol and because the fixed combination reduces IOP more than conventional use [4]. The dorzolamide-timolol fixed combination's effective peak time is 2 hours and it reduces IOP about 30%-35% after the application[6,7]. In our

study, we also used prophylactic dorzolamide and timolol fixed combination due to this advantage and we have also taken account of its availability in the hospital and its peak time effect of 2 hour which is convenient in our hospital setting and we have got the similar results.

Several drugs are used for prophylaxis in different protocols for reducing IOP after intravitreal anti VEGF. El Chehab [8] applied the brinzolamide-timolol and dorzolamide-timolol fixed combinations two hours before the injection in their study. Kim JN, et al [9] applied brinzolamide-timolol fixed combination for prophylaxis and noted that prophylactic administration of anti-glaucoma drugs prior to intravitreal anti-VEGF injection effectively reduced the initial intraocular pressure rise and concluded that his approach was also safe and could be performed accurately. Kim JE[10] applied brinzolamide-timolol and dorzolamide-timolol fixed combinations one hour before the injection. All of them found these prophylactic drugs effective as we found in our study.

Going into detail of Sehnaz Ozcaliskan's[4] study, the effect of dorzolamide-timolol fixed combination prophylaxis on intraocular pressure spikes, after intravitreal bevacizumab injection, was noted. In his study, patients were divided in to two groups. Group 1 consists of 75 patients who had topical dorzolamide-timolol medication two hours before injection and Group 2 consists of 76 patients without prophylaxis. Demographic data, IOP measurements was done prior to the injection and IOP was measured at one minute, 30-minute, 60 minute and 24 hours after the intravitreal avastin. He reported that there was no significant difference between two groups in age, gender distribution and indications for injections. The mean IOPs in Group 1 and Group 2 prior to the injection (T_0) were 17.84±0.43 and 18.15±0.43 mm Hg respectively, one minute after the injection (T_1) were 29.75±1.6 and 34.44±1.59 mm Hg, 30min after the injection (T_{30}) were 20.06±0.6 and 21.71±0.59 mm Hg respectively. The mean IOP was 18.26±0.56 mm Hg in Group 1 and 19.78±0.56 mm Hg in Group 2 sixty minutes after the injection (T_{60}). All IOP values after the injection were compared between two groups, there was a significant difference between two groups only on T_1; one minute after the injection (P=0.04). There were a statistically significant difference between the baseline values and other recorded values; except on T_{60}, in Groups 1 and 2 (P<0.05).

In our study, there was no significant difference of age, gender distribution between two groups. Although, in our study intraocular pressure in Group-A was 14.1±3.04 and in Group-B was 13.57±3.78, p value was 0.49. At 0 minute, mean IOP was 32.73±7.31 in group A and 24.4±3.42 in group B, p value was 0.0001.At 30 minutes, it was reduced to 22.57±5.38 in Group-A and 16.93±3.88 in Group-B, p value was 0.0001, and at 60-minute mean IOP was 17.67±2.47 in Group-A and 14.9±3.30 in Group B, p value was 0.001.

Present study's results show that there is significant decrease in IOP elevation at O minute in group B who received prophylactic anti glaucoma topical dorzolamide and timolol fixed combination .Also there is significant difference between the mean IOP at 30 minute in both group. However, the difference in mean IOP at 60 minute in both group is 2.77mmhg which is insignificant.

Information on short term IOP changes after intravitreal injections in patients with glaucoma is very limited. Kim JE[10] reported IOP normalized later in patients with glaucoma than without glaucoma after intravitreal injection while Frenkel[8] found similar normalization curves. For having reliable results, we excluded patients with glaucoma in the study groups. Many studies revealed number of injections is a risk factor for sustained IOP elevations[5,11,12]. Short-term IOP changes are mostly developed by injected volume so that previous injections were not considered in

our study.
Sehnaz ozcaliskan[4] used a portable tonometer, TonoPen AVIA for the measurement of IOP. Tonopen was used for all measurements. In our study, we used Perkin's tonometer which is a portable tonometer and works on the same principle as Goldmann applanation Tonometer. It gives much more reliable IOP readings than tonopen and measures IOP greater than 55mmHg whereas tonopen measures between 5 and 55mmHg. Perkins tonometer was readily available in our hospital setting, easy to use and has reliable results.

Shoeib N, et al told that although it is advisable to prevent IOP spikes but use of prophylactic pressure-lowering medications with every mechanism of action has no effect in IOP spikes following intravitreal bevacizumab injections in non-glaucomatous eyes[13] which is against our study results. Two more studies revealed results contrary to our study. One is study of Farhood Q, et al, which shows that as IOP reverts back to safe range (25 mmHg) within 30 minutes after injection, so there is no need of any prophylactic topical medication [14] . 2nd is study of Mendez PC, et al who concluded that prophylactic topical IOP lowering medications are not helpful in reducing IOP when instilled 5 minutes before intravitreal bevacizumab injection[15] but on the other hand, results of Arjuman P et al's study again support our results where they checked the effect of prophylactic acute chamber paracentesis in some patients and topical pressure lowering medications in other patients and have concluded that these measures are quite effective in controlling the IOP rise after intravitreal Bevacizumab injection. [16]

Mirshahi A et al's study suggested that adjuvant topical timolol–dorzolamide in combination with IVB reduced post injection IOP spike and along with that also reduced the macular thickness in eyes with diabetic macular edema.[17]
Study of Chehab HE, et al showed the same results as ours showing that Intraocular pressure spike was high but transient and topical prophylactic medications were helpful in lowering the post injection spikes in glaucomatous as well as non glaucomatous eyes.[18]

Felfeli T et al used topical brimonidine tartrate prophylaxis for intravitreal injection of anti-VEGF agents and found it very effective in reducing the IOP spikes in non-glaucomatous eyes.[19] As studies confirm that eyes receiving first-time intravitreal bevacizumab injections show a significant increase in IOP within five minutes to two hours after intravitreal anti VEGF injections [20.] So, use of prophylactic topical IOP lowering medications was thought of a very good measure to reduce this pressure spike and this is what we have discussed in above of studies which supported the effectiveness of these topical medications.

All of above studies were about topical prophylaxis but Murray CD, et al. conducted a study where they used oral Acetazolamide 500mg 60-90 min before intravitreal injection and found the statistically significant effectiveness as of topical medications. They suggested the use of this prophylaxis to minimise neuro-retinal rim damage in high-risk glaucoma patients who are being given repeated intravitreal injections of ranibizumab.[21]

After analyzing the results of our study, we observed that there are IOP spikes after intravitreal injections and when given with dorzolamide-timolol fixed combination prophylaxis 2 hours prior to injection, these elevations were significantly reduced and this justified our hypothesis.

Conclusion

We observed that there is a transient IOP elevation in patients who receive intravitreal bevacizumab and prophylactic use of topical fixed combination dorzolamide and timolol 2 hour before procedure significantly reduces the IOP spike at 0 minute and 30 minute after

injection whereas at 60-minute difference is insignificant. The appropriate approach and more clinical trials will help to decrease the onset or progression of glaucoma in patient receiving intravitreal bevacizumab.

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Authors Index

Subject Index