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Research Article

**THE COMPARISON OF INTRAOCULAR PRESSURE
MEASUREMENT BY GOLDMANN APPLANATION
TONOMETER AND NON-CONTACT AIR PUFF TONOMETER:
A CROSS-SECTIONAL RESEARCH**¹Dr. Bushra Arooj, ²Dr. Asmarah Nadeem, ³Dr. Sobia Ali¹Lahore General Hospital Lahore**Abstract**

Objective: The aim of this particular research was to determine the accuracy and frequency of intraocular pressure which measured with the help of an Air Puff (non-contact tonometer); moreover, we also confirmed the same by Goldmann applanation tonometer.

Material and methods: Our research design was cross-sectional and it was carried out at Ophthalmology Department of Mayo Hospital, Lahore (February to July 2017) on a total of 240 patients. All the patients were in the age bracket of (10 – 70) years including males and females. The selection process included those patients who visited Eye OPD for regular intraocular pressure, refraction, glaucoma, cataract surgery and suspected glaucoma. A complete ocular assessment was mandatory for every individual participating in the research.

Results: In the age bracket of (10 – 70) years the mean age was (43.844 ± 15.434) years and the values of mean IOP was for Goldmann Applanation Tonometer as (18.92 ± 8.852) mmHg and for Air Puff Tonometer as (21.463 ± 9.456) mmHg. The different measurement ranges for Air-Puff Tonometer and Goldmann Applanation Tonometer was respectively (10 – 54) mmHg and (11 – 58) mmHg.

Conclusion: In order to measure intraocular pressure, the method of Air puff tonometer is non-contact and quick. Air Puff tonometer is effective for screening purposes; whereas, the intraocular pressure measurements are accurately measured through Goldmann applanation tonometer.

Keywords: Tonometry, Glaucoma, Goldmann Applanation Tonometer and Air Puff Tonometer.

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INTRODUCTION:

An eye is a complex sensing organ which is responsible for the vision within its protective case containing long receptors with a lens system that is responsible to focus light on receptors to the brain. The circulation of aqueous humor is important for the proper functioning and optimal shape of the eyes. Aqueous humor is responsible for the nourishment of lens and cornea. Ciliary body produces this clear fluid. It fills the eye's interior chamber by flowing through pupil which is normally absorbed by trabeculae network into Schlemm canal than passes towards episcleral veins [1]. The normal intraocular pressure range within the eye varies from a minimum of 10 mmHg to a maximum of 20 mmHg [2]. The increase of the intraocular pressure from normal range may possibly cause damage to the optic nerve which is a state known as "Glaucoma". There are possibilities of occurrence of Glaucoma even in the normal pressure which is known as "Normal Tension Glaucoma". The initiation of treatment always depends on the accurate intraocular pressure measurement. The increase in the intraocular pressure is also controllable with the help of various interventional options. Glaucoma is a primary cause blindness in about seven percent of the people of more than thirty years of age in Pakistan [3].

We can effectively treat the risk of Glaucoma with the management of intraocular pressure among patients [4 – 5]. The incidence of intraocular pressure is a single modifiable risk factor. The effectiveness of Glaucoma therapy can be gauged through intraocular pressure but we cannot be more aware of the disease progression. Therefore, in most of the patients, the trust of the ophthalmologist is totally dependent on the optic nerve head appearance and visual field testing to verify the health of vision of the patients either good or worse. It is a regular ophthalmic assessment procedure with the availability of different measurement options. As Air Puff

tonometer makes no contact so there are no chances of transmission of infection with reduced procedural time in comparison to Goldmann Applanation Tonometer. A non-ophthalmologist can also perform Air Puff tonometry quicker than Goldmann Applanation Tonometry. Numerous authors have already verified the effectiveness and accuracy of Air Puff Tonometer with different opinions about the reliability of the normal and high ranges of intraocular pressures.

MATERIAL AND METHODS:

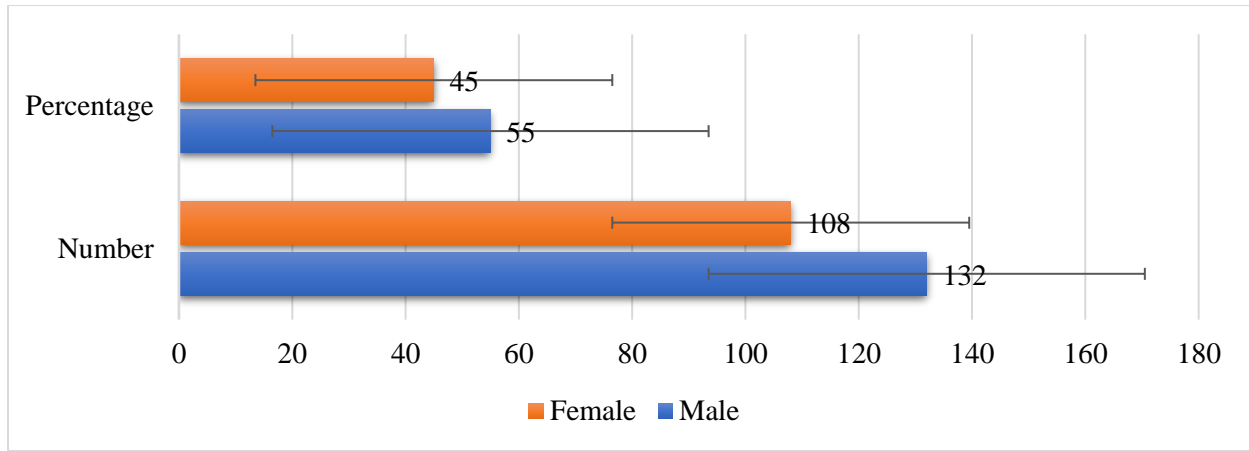
Our research design was cross-sectional and it was carried out at Ophthalmology Department of Mayo Hospital, Lahore (February to July 2017) on a total of 240 patients. All the patients were in the age bracket of (10 – 70) years including males and females. The selection process included those patients who visited Eye OPD for regular intraocular pressure, refraction, glaucoma, cataract surgery and suspected glaucoma. Whereas, we did not include any patients having corneal Opacity, corneal ulceration, disfigured cornea, inflammation, ocular infection, conjunctivitis, corneal degeneration, corneal dystrophy, pterygium, keratoconus, ocular surgery history, blepharospasm, non-cooperating and phthisis bulbi. A complete ocular assessment was mandatory for every individual participating in the research which included ocular assessment history, autorefraction, visual acuity and slit lamp assessment. An average of three readings was taken as mean reference outcomes values for both Air Puff and Goldmann methods. We analyzed the research outcomes on SPSS software and produced the outcomes figures in mean values, SD values, frequencies and percentages for all the categorical values.

RESULTS:

In the age bracket of (10 – 70) years the mean age was (43.844 ± 15.434) years. The research sample included 132 males (55%) and 108 females (45%) as shown in Table – I.

Table – I: Gender Distribution

Gender	Number	Percentage
Male	132	55
Female	108	45

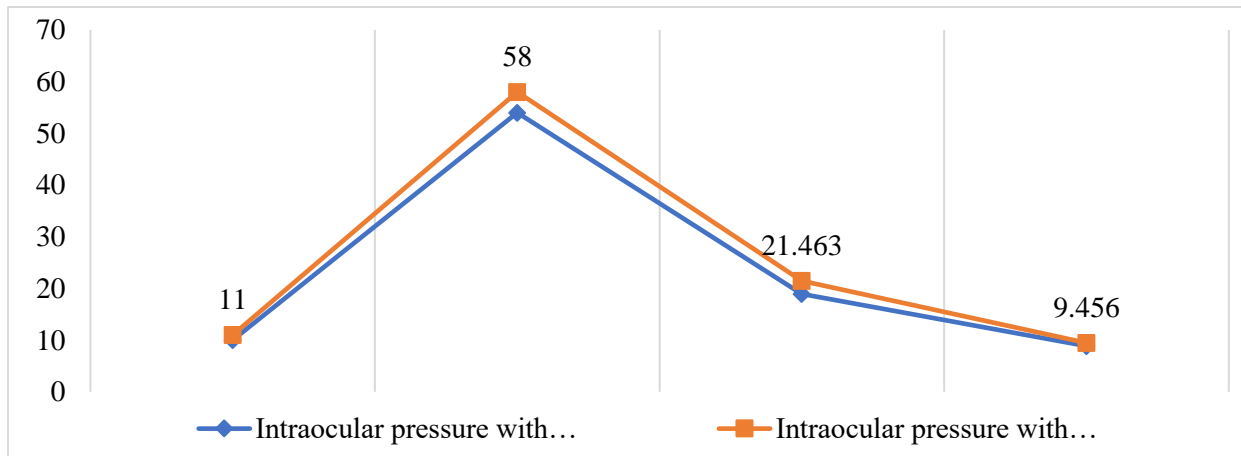


The values of mean IOP was for Goldmann Applanation Tonometer as (18.92 ± 8.852) mmHg and for Air Puff Tonometer as (21.463 ± 9.456) mmHg. The different measurement ranges for Air-

Puff Tonometer and Goldmann Applanation Tonometer were respectively $(10 - 54)$ mmHg and $(11 - 58)$ mmHg as shown in Table – II.

Table – II: Intraocular Pressure

Total	Minimum (mmHg)	Maximum (mmHg)	Mean (mmHg)	SD (mmHg)
Intraocular pressure with Goldmann applanation tonometer	10	54	18.92	8.852
Intraocular pressure with air puff tonometer	11	58	21.463	9.456

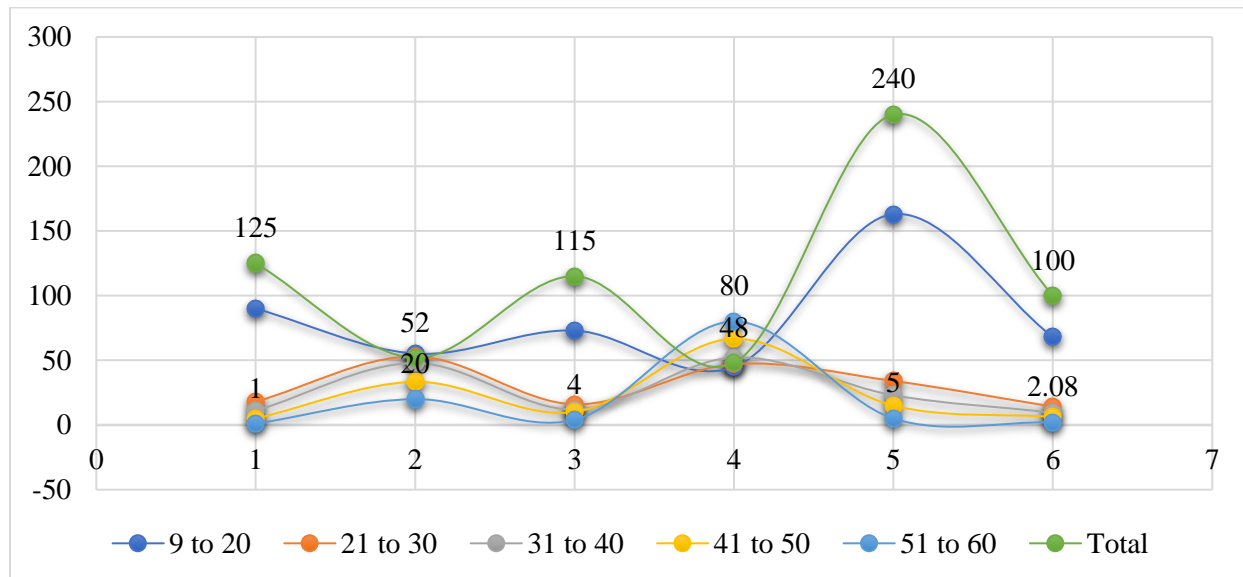


An overall air-puff tonometer accuracy was seen in 125 patients (52%) within a limit of (± 2) mmHg from the other method of Goldmann applanation tonometer which was stratified for varying intraocular pressure ranges including $(10 - 20, 21 - 30, 31 - 40, 41 - 50)$ and $(51 - 60)$ mmHg. There was

a decrease in the accuracy with an increase in the range as the most accurate ranges was $(10 - 20)$ mmHg. Only twenty percent accuracy left at the intraocular range of $(51 - 60)$ mmHg as shown in Table – III.

Table – III: Accuracy range of IOP (Positive and Negative)

Accuracy: Range of IOP (mmHg)	Positive		Negative		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
9 to 20	90	55.21	73	44.79	163	67.92
21 to 30	18	52.94	16	47.05	34	14.17
31 to 40	11	47.83	12	52.17	23	9.58
41 to 50	5	33.3	10	66.67	15	6.25
51 to 60	1	20	4	80	5	2.08
Total	125	52	115	48	240	100



DISCUSSION:

The use of Air-Puff and Goldmann Applanation Tonometer is common among clinical practice of ophthalmology. In the common prevalent thought, Goldmann is reliable and better for intraocular pressure measurement and may be taken as a Gold standard [8 – 9]. Goldmann applanation tonometry has two associated disadvantages including a direct cornea contact which poses infection transmission risk and the other disadvantages are the use of local anaesthesia especially among children who are not willing or do not tolerate the instillation of drug. In the genuine consideration of such factors, few other non-contact tonometer methods are also developed with accuracy and reliability with portable and desktop facilities. These methods can also measure the intraocular pressure among both glaucoma patients and non-glaucoma patients [10].

In the age bracket of (10 – 70) years the mean age was (43.844 ± 15.434) years and the values of mean

IOP was for Goldmann Applanation Tonometer as (18.92 ± 8.852) mmHg and for Air Puff Tonometer as (21.463 ± 9.456) mmHg. The different measurement ranges for Air-Puff Tonometer and Goldmann Applanation Tonometer was respectively (10 – 54) mmHg and (11 – 58) mmHg. Ahmad reported the age bracket of (10 – 72) years with mean age of (42.96) years with mean IOP value of Goldmann as (19.692 ± 9.952) mmHg and Air Puff as (22.562 ± 10.35) mmHg [2]. Ahmad reported similar outcomes comparable to the outcomes of our research. Mahsud reported a mean range of Air Puff as (10 – 47) mmHg with a mean value of (18.17 ± 8.25) mmHg and Goldmann mean range as (10 – 41) mmHg with a mean value of (15.59 ± 7.75) mmHg [11].

In the present study, an overall air-puff tonometer accuracy was seen in 125 patients (52%) within a limit of (± 2) mmHg which is also comparable with the outcomes of Ahmad as he reported an accuracy of

49.7% in his series [2].

The Goldmann applanation tonometer was stratified for varying intraocular pressure ranges including (10 – 20, 21 – 30, 31 – 40, 41 – 50 and 51 – 60) mmHg. There was a decrease in the accuracy with an increase in the range as the most accurate range was (10 – 20) mmHg. Only twenty percent accuracy left at the intraocular range of (51 – 60) mmHg. Most accurate range with an accuracy of 55.21% was of (10 – 20) mmHg. Furthermore, accuracy decreased with an increase in the intraocular pressure range.

Total 147 eyes were with an IOP range of (10 – 20) mmHg (73.50%) as reported in the outcomes of Air Puff non-contact tonometry. The mean value of (18.17 ± 8.25) was found in Air Puff intraocular pressure measurement with a range of (10 – 47) mmHg; whereas, in the Goldmann applanation tonometry the mean value was (15.59 ± 7.75) mmHg in the range of (10 – 41) mmHg [11].

CONCLUSION:

As Air Puff tonometer makes no contact so there are no chances of transmission of infection with reduced procedural time in comparison to Goldmann Applanation Tonometer. A non-ophthalmologist can also perform Air Puff tonometry quicker than Goldmann Applanation Tonometry. Numerous authors have already verified the effectiveness and accuracy of Air Puff Tonometer with different opinions about the reliability of the normal and high ranges of intraocular pressures. In order to measure intraocular pressure, the method of Air puff tonometer is non-contact and quick. Air Puff tonometer is effective for screening purposes; whereas, the intraocular pressure measurements are accurately measured through Goldmann applanation tonometer.

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