

# Comparison of Measurement of Intraocular Pressure between Goldmann Applanation Tonometer and Non-Contact Air Puff Tonometer

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**Purpose:** To compare measurement of intraocular pressure between Goldmann Applanation Tonometer and Non-Contact Air Puff Tonometer.

**Study Design:** Clinical Observational Study.

**Place and Duration of Study:** This study was carried out at outpatient Department of Ophthalmology, Khairpur Medical College Hospital, Khairpur from January 2017 to March 2017.

**Material and Methods:** In this study intra ocular pressures of 400 eyes of 200 patients, Male 125 (250 eyes) and Female 75 (150 eyes) with age ranging from 20 to 70 years, were measured by Goldmann Applanation Tonometer (GAT) and Non-Contact Air Puff Tonometer (APT), results and differences were noted.

**Results:** The mean IOP was 16 mm Hg (SD = 6 mm Hg) measured by APT and 13 mm Hg (SD = 3 mm Hg) measured by GAT. The calculated difference between APT and GAT was  $3 \pm 2.5$  mm Hg. Pressure taken by APT was slight high (i.e. around 3 mm Hg).

**Conclusion:** Air Puff tonometry gives slightly higher results (about 3 mm

Hg) but is safe and easy than Goldmann Applanation tonometer. There is no fear of spread of infection and can be used easily in mass screening programs.

**Key Words:** Goldmann Applanation Tonometer, Air-Puff non-contact Tonometer, Intraocular pressure, Glaucoma.

Increase in intraocular pressure is one of the risk factors in the development and progression of glaucoma<sup>1-2</sup>. Control and reduction in IOP is the main goal in treatment of glaucoma<sup>3</sup>. There are various methods to measure IOP like Schoitz tonometer, Goldmann applanation tonometer (GAT), Perkins applanation tonometer, air puff non-contact tonometer, Tonopen, Pascal dynamic contour tonometer, I Care tonometer. GAT is worldwide used for measurement of IOP and is Gold standard.<sup>4</sup>

GAT has many factors to affect its accuracy like thickness of central cornea<sup>5</sup>, however normal central corneal thickness (CCT) has been documented from 427µm to 670 µm<sup>6</sup>, if we consider 520 µm as standard<sup>7</sup>. If central corneal thickness is more than 520 µm, it overestimates IOP and if it is thinner than 520 µm, it underestimates<sup>8-9</sup>. Various corrective factors have been proposed ranging from 0.19 to 0.7 mm for each 10 µm difference in central corneal thickness from mean value<sup>8-10</sup>. This relationship between CCT and IOP has clinical implications especially in the diagnosis of ocular hypertension (OHT). Researchers have documented thicker CCT in OHT subjects and suggested that some are misclassified due to thicker cornea producing an artificially raised IOP<sup>11,12,13</sup>. Conversely, subjects with thicker corneas have been shown to have a lower rate of progression to glaucomatous damage<sup>14</sup>.

GAT has double prism and 3.06 mm area of cornea is applanated using Imbert Fick principle. It is done under local anesthesia and also requires slit lamp.<sup>15</sup>APT is based on principle of applanation, but instead of using prism, the central part of the cornea is flattened by a jet of air. The time acquired to sufficiently flatten the cornea relates directly to the level of IOP. In APT, there is no need of local anesthesia and no contact with cornea, so it prevents spread of infection. It may be portable and non-portable<sup>16</sup>. This study was conducted to find out the accuracy of APT to the gold standard GAT.

**MATERIAL AND METHODS**

A comparative randomized study conducted in the ophthalmology department of Khairpur Medical College Hospital. There were 400 eyes of 200 patients (125 males and 75 females) with age ranging from 20 to 70 years. Adult co-operative patients visiting the outpatient department were included. Uncooperative patients and patients with severe vision loss, who were unable to keep fixation of eye ball and patients with history of refractive surgery were excluded from the study.

IOP using APT was taken using tonometer NCT-10 SHIN-NIPPON (made in Japan) and later IOP was measured using GAT with CSO model: A 900 tonometer (made: in Italy). Proparacaine eye drops were put in eyes for anesthesia and fluorescein strips were used for staining of cornea.

**RESULTS**

The study included 400 eyes of 200 patients i.e. males 125 (250 eyes) and females 75 (150 eyes), with mean age of 54.12 ± 13.56 years (range 20 - 70 years (table 1). In 40 (10%) eyes, IOP taken by APT was equal to GAT. In 20 eyes (5%), IOP with APT was below GAT and in 340 (85%) eyes IOP was higher than GAT. The mean IOP measured by APT was 16 ± 6 mm Hg and mean IOP measured by GAT was 13 ± 3 mm Hg. The calculated difference between APT and GAT was 3 ± 2.5 mm Hg (table 2).

**Table 1:** Characteristics of Study Population (n = 400).

Age in Years	
Range	20 - 70 years (mean 54.12 ± 13.56 years)
Male	125 (250 eyes)
Female	75 (150 eyes)

**Table 2:** IOP values measured by GAT as related to IOP measured by APT.

IOP Measurement by Air puff Tonometer	Patients %
Equal to GAT measurement	40 (10%)
Higher than GAT measurement	340 (85%)
Lower than GAT Measurement	20 (5%)

## DISCUSSION

Air puff tonometer and Goldman applanation tonometer are common devices to measure IOP. Pressure recorded by AP tonometer is slightly higher. Many studies have compared IOP between GAT and APT<sup>17-18</sup>. Friat et al<sup>17</sup> study revealed that GAT results are slight lower than non-contact tonometer. Martinez-de-la-casa et al<sup>19</sup> concluded that results of AP tonometer were higher than GAT. Tonnuet al<sup>20</sup> showed that difference in IOP between two methods was 0.7 mm Hg. Rao<sup>21</sup> states that when IOP was < 20 mm Hg, it was more accurate with APT. Lagerlof<sup>21</sup> revealed that IOP > 20 and 30 mm Hg measured by APT is unreliable.

A study was conducted by Bang et al, comparing intraocular pressures, measured by three different non-contact tonometers and Goldmann applanation tonometer, for non-glaucomatous subjects. They stated that there was statistically significant correlation between three non-contact tonometers and Goldmann applanation tonometer. They said that IOP measured with Nidek NT-530P was lower than GAT while IOP taken by Topcan CT-IP and canon T x 20P was higher than Goldmann applanation tonometer<sup>22</sup>. Study conducted by Javed Ahmed et al revealed that Goldmann applanation tonometer was more accurate but air puff tonometer was good and easy for screening purposes<sup>23</sup>. Study conducted by Josphine Wachtl et al proved that IOP taken by GAT in thin corneas and advanced glaucoma gave unpredictable measurement errors<sup>24</sup>. Study conducted by Sana Naeem et al, showed that measurement of intraocular pressure by three different tonometers was comparable with good relation in normal adults. APT can be used as a good screening device to rule out glaucoma in patients<sup>25</sup>. Study conducted by Dibaji et al stated that non-contact air puff tonometer was quick for screening purposes but measurement should be confirmed by Goldmann applanation tonometer<sup>26</sup>. Study conducted by Toprak et al showed that IOP

values obtained by NCT 1 (non-contact tonometer with 1-puff) and NCT 3 (3- puffs) appeared to be similar with GAT measurement. Wide range of LoA might limit the use of this NCT (both 1-puff and 3-puffs) and GAT interchangeably in primary open angle glaucoma patients<sup>27</sup>. Sood A and his colleague studied the clinical estimation of intraocular pressure with a non-contact tonometer and Goldman applanation tonometer as a tool for mass screening and its correlation with central corneal thickness. Both the methods of IOP measurement showed positive correlation with central corneal thickness. The NCT was more influenced by CCT than GAT for every 10 micron CCT change. The IOP change expected with NCT was 0.47 mm Hg and GAT was 0.29 mm Hg<sup>28</sup>.

## CONCLUSION

IOP with APT is slight higher about 3 mm Hg but is safe and easy than GAT tonometry. There is no fear of spread of infection and it can be used in mass screening program

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