COMPARATIVE ANALYSIS OF INTRAOCULAR PRESSURE MEASUREMENTS WITH DIFFERENT OPHTHALMOLOGIC DEVICES

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SUMMARY – The aim of the study was to assess accuracy and reliability of automated intraocular pressure (IOP) measurement. This prospective study was carried out at outpatient glaucoma clinic, University Department of Ophthalmology, Split University Hospital, over a 5-month period (September 2005 – January 2006). IOP measurements were performed by Goldmann’s applanation tonometry and automated non-contact tonometry (Reichert AT 555). The study included 105 patients (210 eyes). In chronic open angle glaucoma (210 eyes) under therapy, the mean IOP value measured by Goldmann’s applanation tonometry and automated non-contact tonometry was 19.85 mm Hg and 20.41 mm Hg, respectively. The difference was not statistically significant ($\chi^2=0.01215; p>0.05$). Accordingly, Goldmann’s applanation tonometry and automated non-contact tonometry yielded similar results in chronic open angle glaucoma patients, confirming the accuracy and realiability of automated IOP measurement by non-contact tonometry.

Key words: Goldmann’s applanation tonometry, non-contact tonometry

Introduction

The measurement of intraocular pressure (IOP) is one of the methods to assess the presence of risk factors in patients with glaucoma. Numerous techniques and devices of impression tonometry and since recently automated non-contact tonometry are currently available for IOP measurement.

Patients and Methods

The study was carried out at outpatient glaucoma clinic of the University Department of Ophthalmology, Split University Hospital in Split, Croatia, over a 5-month period (September 2005 – January 2006). This prospective study included 105 patients (210 eyes). IOP measurements were performed by Goldmann’s applanation tonometer (GAT) and Reichert AT 555 automated non-contact tonometer (NCT) with 10-minute between-measurement interval. Measurement results were analyzed by use of the Statistica for Windows, release 5.0 software (StatSoft, Inc., Tulsa, OK, USA), while $t^2$-test and Mann-Whitney test were employed on statistical analysis. The level of statistical significance was set at $p<0.05$.

Results

The mean IOP as measured by GAT and NCT in 210 eyes on therapy for chronic open angle glaucoma was 19.56 mm Hg and 20.60 mm Hg, with standard deviation of 5.57 and 4.57, respectively. The difference in the distribution of IOP values between the two methods was not statistically significant ($\chi^2=0.01215; p>0.05$).

Discussion

Besides the gold standard IOP measurement by Goldmann’s applanation tonometer, other techniques
have now also been introduced with variable success and 
accuracy. Automated non-contact tonometry is a promis-
ing option to find many applications, especially in stud-
ies where fast IOP measurement is required for timely 
detection of elevated IOP and glaucoma. The studies 
conducted by Stabuc Shilih et al., Tonnu et al., and Otter 
and Stodtmiester showed the accuracy of IOP mea-
surement to depend on the quality of corneal tis-
uue (the central part of the cornea in particular) and dis-
tortion, the latter exerting considerable impact on non-
contact tonometry measurements. Discrepancy be-
 tween IOP values thus obtained increases with the rise in cur-
tent IOP. The measurements of IOP in our patients 
with chronic open angle glaucoma by use of two differ-
ent techniques yielded a mean difference of 0.56 mm 
Hg, without statistically significant difference in IOP 
distribution. Differences of 0.6–1.2 mm Hg have been 
reported from other studies. Our results of IOP 
measurements were somewhat lower (at the lower lim-
it) as compared with literature data, which could be 
attributed to the older age of our study population (mean 
age 74 vs. 63 years), expected to be associated with high-
ear corneal rigidity. The study by Müller-Holz et al. was 
performed on the same instruments, Goldmann’s appla-
nation tonometer and Reichert AT 555 automated non-
contact tonometer, however, in a considerably younger 
patient population (mean age 46 years). They report on 
measurement difference of 0.6 mm Hg, slightly (by 0.04 
mm Hg) exceeding the one found in our study (0.56 vs. 
0.6). Graf et al. found a difference of 2 mm Hg between 
these two techniques of IOP measurement in 60% of 
study patients. Similar results were also obtained when 
IOP measurement was performed following keratomi-
eleusias.

Non-contact tonometry is a noninvasive, rapid and re-
liable method of IOP measurement, requiring no lo-
cal anesthetic or other eye drops, implying no risk of 
infection transmission, and is easy to perform. It is suit-
able for use in glaucoma studies and in the observation 
of glaucoma patients.

Conclusion

Goldmann’s application tonometry and automated 
non-contact tonometry produce comparable results in 
chronic open angle glaucoma, thus proving the accuracy 
and reliability of IOP measurement by the latter tech-
nique.

References

1. STABUC SHILIH M, HAWLINA M. Influence of corneal 
thickness on comparative intraocular pressure measurements 
with Goldmann and non-contact tonometers in keratoconus. 

2. TONNU PA, HO T, NEWSON T, EL SHIEKH A, SHORMA 
K, WHITE E, BUNCE C, GARWAY-HEATH D. The influence 
of central thickness and age on intraocular pressure measured 
by pneumotonometry, non-contact tonometry, the Tono-Pen 
XL, and Goldmann application tonometry. Br J Ophthalmol 

3. TONNU PA, HO T, SHORMA K, WHITE E, BUNCE C, 
GARWAY-HEATH D. A comparison of four methods of tono-
metry: method agreement and interobserver variability. Br J Oph-


5. STODTMIEISTER R. Application tonometry and correction 

6. MUNKWITZ S, THIEME H, BERCHRAIS NE, FOERSTER 
MH. Comparison between the Nidek NT-4000 non-contact 
tonometer (with pulse synchronized IOP measurement) and 
the Goldmann application tonometer in patients with normal 
and elevated intraocular pressure (IOP). Berlin: Charite Campus Benjamin Franklin.

7. REGINE F, SCUDESI GL, CESAREO M, RICCI F, CE-
DRONE C, NUCCI C. Validity and limitations of the Nidek 
NT-4000 non-contact tonometer: a clinical study. Ophthalmic 

8. HANSEN MK. Clinical comparison of the XPERT non-con-
tact tonometer and conventional Goldmann application to-

9. SONY PS. Applanation tonometer correlations. Am J Opton 

10. POPOVICH KS, SHIELDS MB. A comparison of intraocular 
pressure measurements with the XPERT noncontact tono-
tometer and Goldmann application tonometry. J Glaucoma 

11. MÜLLER-HOLZ MF, SPANIER J, SCHMIDT E, BOEHM 
AG, PILLUNAT LE. Comparison of IOP measurements ob-
tained by the non-contact tonometer AT 555 and Goldmann 

12. GRAF M, HOFFMANN OE. Reproducibility of results of two 
non-contact tonometers. Comparison with the Goldmann 
application tonometer. Klin Monatsbl Augenheilkd 1992;11:678- 
82.

13. PANY ZHONG Y, LIAN J, WANG K. Analysis of intraocular 
pressure and corneal thickness after laser in situ keratomileus-

14. EL DANASONSY MA, EL MAGHSABY A, CORPENDER 
SJ. Change in intraocular pressure in myopic eyes measured 
with contact and non-contact tonometer after laser in situ 

Sažetak

USPOREDNA ANALIZA MJERENJA OČNOG TLAKA RAZLIČITIM OFTALMOLOŠKIM UREĐAJIMA

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Cilj studije bio je provjeriti točnost i pouzdanost mjerenja očnog tlaka (IOT) automatskom metodom bez dodira. Studija je provedena u Klinici za očne bolesti Kliničke bolnice Split, u Ambulantni za glaukom, a obuhvatila je bolesnike s glaukomom liječene u razdoblju od 5 mjeseci, od rujna 2005. do siječnja 2006. godine. U ovoj prospektivnoj studiji ispitano je 105 bolesnika (210 očiju). Mjerenja IOT izvedena su Goldmannovom aplanacijskom tonometrijom i automatikom mjerenjem IOT bez dodira tonometrom Reichert AT 555, s međuvremenom u mjerenjima od 10 minuta. Mjerenjem IOT pod terapijom za kronični glaukom otvorenog kuta (210 očiju) Goldmannovom aplanacijskom tonometrijom dobivena je srednja vrijednost od 19,85 mm Hg, a automatikom mjerenjem IOT bez dodira 20,41 mm Hg. Nije bilo statistički značajne razlike između ovih rezultata (t=0,01215; p>0,05). Dakle, mjerenje IOT kod kroničnog glaukoma otvorenog kuta Goldmannovom aplanacijskom tonometrijom i automatikom metodom bez dodira pokazalo je statistički slične vrijednosti, što potvrđuje točnost i pouzdanost mjerenja IOT tehnikom automatikog mjerenja bez dodira.

Ključne riječi: Goldmannova aplanacijska tonometrija, automatsko mjerenje IOT bez dodira