

New Ways to Measure Intraocular Pressure in Children with Microphthalmia and Blepharophimosis

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Abstract Childhood glaucoma is a chronic vision-threatening condition that may significantly impact an individual's psychosocial well-being. The prognosis of glaucoma largely depends on early and accurate diagnosis and successful treatment, including control of increased. The purpose is to determine the effectiveness of modified tonometers (Maklakova) NGm2-"OF TP" in performing tonometry and tonography in infants and children with microphthalmos and blepharophimosis. We have proposed modified models of Maklakoff tonometers weighing 5, 10, and 15 g, made of silver, the weights on both sides have contact plates, which are made of medical plastic and have a diameter of the appplanation area $d=8$ mm. Methods: Tonometry and tonography using the simplified method of Nesterov A.P. were carried out in 30 (60 eyes) children aged from birth (0) to 16 years. Results: Our recommended design of weights showed results that do not differ from those obtained using standard Maklakoff tonometers. At the same time, modified weights provide the opportunity to determine tonometric IOP and eye hydrodynamics in newborns and patients with microphthalmia and/or blepharophimosis, which greatly facilitates the work of pediatric ophthalmologists and reduces examination time.

Keywords Childhood glaucoma, Intraocular pressure, Maklakoff tonometers

1. Introduction

The prognosis of glaucoma largely depends on early and accurate diagnosis and successful treatment, including control of increased (IOP). At the same time, it is important to carry out tonometry (study of tonometric pressure P_{10}) and tonography (determination of true IOP - P_0 , production of intraocular fluid - F, outflow of intraocular fluid - C, Becker coefficient - BC). The first reasonably accurate instrument was the Maklakoff appplanation tonometer [1]. Particularly difficult is the technique of measuring IOP with existing Maklakoff tonometers NGm2-"OFT-P" in infants and children with microphthalmia (congenital reduction of the eyeball and cornea, when the horizontal diameter of the cornea is less than 10 mm, and the vertical diameter is less than 9 mm) and/or blepharophimosis (small size of the palpebral fissure, when at maximum opening: the horizontal size of the palpebral fissure is less than 20 mm, and the vertical size is less than 10 mm), since these tonometers, having an appplanation plate diameter of 10 mm, allow their use only in adults and children with the dimensions of the cornea and palpebral fissure the same as in adult patients [2].

The well-known Goldmann tonometers and Filatov-Kalf elastotonometers NGm5-"OFT-P" also cannot be used for tonometry and tonography in newborns and in patients with reduced biometric parameters of the eyes [3].

Existing IGD devices also do not allow to determine tonometric and tonographic indicators of the eye in newborns. The use of different methods in children for measuring IOP in newborns leads to a huge range of values from relative hypotension (Icare Tiolat tonometer) to hypertension (tonometer by Maklakoff) [4].

The purpose is to determine the effectiveness of modified tonometers (Maklakova) NGm2-"OFT-P" in performing tonometry and tonography in infants and children with microphthalmos and blepharophimosis.

2. Material and Methods

To achieve this goal, we have proposed modified models of Maklakoff tonometers weighing 5, 10, and 15 g (Fig. 1), made of silver, made in the form of hollow cylindrical columns (1), ending through a neck (4) with smooth contact plates (2). Two marks (3) are applied to the cylindrical posts of the weights, corresponding to 1/3 of their height. The weights on both sides have contact plates (2), which are made of medical plastic and have a diameter of the appplanation area $d=8$ mm.

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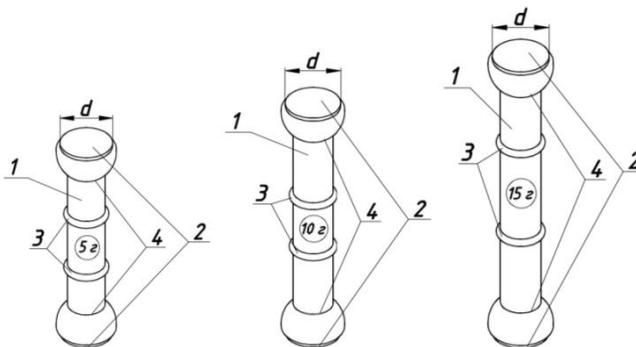


Figure 1. Modified models tonometers by Maklakov weighing 5 g (A), 10g (B) and 15g (C) (main view, isometric projection)

The compliance of the manufactured weights with the required weight of 5, 10 and 15 g was confirmed by the Department of Metrology and Standardization of Measuring Instruments (protocol No. 37 dated June 12, 2023, mass measurement department of the State Institution “UzNIM”).

Making marks on the cylindrical columns of weights corresponding to 1/3 of their height increases the accuracy of measuring IOP and hydrodynamics of the eye, because According to the standard, at the time of measurement, when the weight is on the surface of the cornea, the holder must be lowered to 1/3 of the height of the weight column, and then, raise the holder to the neck with a simultaneous lifting of the weight from the cornea, which will determine the duration of contact of the surface of the applanation area with the surface of the cornea. At the same time, the duration of contact determines the level of applanation (flattening) of the cornea and affects the accuracy of the measurement [4]. Rebound tonometry appears to correlate well with Goldmann tonometry. However, data using tonometer data is difficult to measure [5].

3. Result and Discussion

Table 1. Indicators of tonometry and tonography in the examined children (M±m)

Indicators	1 group (n=60 eyes)	2nd group (n=60 eyes)	Student's t-tests
P10 (mmHg)	20,3±1,6	20,7±1,8	t =0.17 p > 0,05
P0 (mm Hg)	18,35±4,7	18.8±2.5	t =0.08 p > 0,05
C (mm3 in 1 min mmHg)	0,89±0,03	0.91±0.01	t =0.63 p > 0,05
F (mm in 1 min mmHg)	3,96±0,5	3.55±0.65	t =0.5 p > 0,05
BC	63±3,2	64.5±2.5	t =0.37 p > 0,05

Tonometry and tonography using the simplified method of Nesterov A.P. were carried out in 30 (60 eyes) children aged from birth (0) to 16 years. Of these, 17 (34 eyes) were infants,

14 (28 eyes) had anterior microphthalmia 2, 3 degrees, and 9 (18 eyes) had blepharophimosis. The first stage was measurements with modified tonometers (group 1), then after 10-15 minutes - with standard Maklakov tonometers (group 2). The measurement results are shown in Table 1.

A comparative analysis did not reveal a statistically significant difference in the indicators of groups 1 and 2.

4. Conclusions

Thus, our recommended design of weights showed results that do not differ from those obtained using standard Maklakov tonometers. At the same time, modified weights provide the opportunity to determine tonometric IOP and eye hydrodynamics in newborns and patients with microphthalmia and/or blepharophimosis, which greatly facilitates the work of pediatric ophthalmologists and reduces examination time.

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