

# Application of the ICare Rebound Tonometer in Healthy Infants

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**Purpose:** To study the tolerability of the ICare rebound tonometer (RBT) and to establish reference values of the intraocular pressure (IOP) in healthy infants.

**Participants and Methods:** Forty-six children were recruited. In 6 infants aged 3 to 18 months, it was not possible to conduct the examination. Five children refused all cooperation. In 1 child, only 1 reading was obtained. In 1, partly uncooperative infant, the difference between the highest and the lowest reading exceeded 3 mm Hg (a difference of 7 mm Hg). These 7 infants were excluded. Totally 39 children, 22 girls and 17 boys, aged 1 month to 36 months were included in the study. The mean age was  $14 \pm 9$  months [mean  $\pm$  standard deviation (SD)]. One randomly selected eye of each child was examined with the ICare RBT. Three consecutive readings were made. In 10 children, IOP measurements were conducted twice with an interval of 10 to 30 minutes by 2 different ophthalmologists.

**Results:** The mean IOP value of the 39 infants was  $11.82 \pm 2.67$  mm Hg. The median value was 10 mm Hg with a range of 7.3 to 17.0 mm Hg. In 10 children, the IOP was determined by 2 examiners. The results were virtually identical with differences of 0 to 1 mm Hg in 9 out of 10 children. The mean difference between Examiner 1 and Examiner 2 (0.77 mm Hg) was not statistically significant ( $P > 0.20$ ). The examinations were very well tolerated, and no child showed any sign of discomfort during or after the examination.

**Conclusions:** The hand-held RBT in the present study is easy to use, it does not require topical anesthesia and it is very well tolerated by cooperative infants. However, 7 out of 46 infants refused cooperation.

**Key Words:** IOP, ICare, rebound tonometer

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Childhood glaucoma is a rare but serious condition often leading to visual impairment and even blindness. Diagnosis is important, as treatment can prevent visual handicap.

The diagnosis and management of glaucoma in children pose intricate problems. Clinical examination in infants is known to be difficult, particularly in the context of accurate glaucoma diagnosis. Anterior segment signs, tonometry, and optic nerve examination are often inad-

quate, and perimetry cannot be reliably done. Tonometry is a cornerstone of the diagnosis and in the management of glaucoma. For decades, Goldmann applanation tonometry (GAT) has been the golden standard for measuring intraocular pressure. However, infants are not cooperative and intraocular pressure (IOP) measurement with the Goldmann tonometer is not possible. There are several other instruments, for example the Perkins hand-held applanation tonometer and pneumatonometers, but these often require general anesthesia in small children. General anesthesia is a risk for the patient and is resource demanding and may affect the IOP.<sup>1</sup> Tonopen (Medtronic Ophthalmics, Jacksonville, FL) is used in small children without general anesthesia, but it requires topical anesthesia that often causes discomfort. Thus, there is a need for a hand-held tonometer suitable for infants. The ICare tonometer (Fig. 1) is based on the impact rebound principle (Decking and Coster 1967).<sup>2</sup> This method was modified and developed by Kontiola.<sup>3</sup> The device was tested on experimental animals, which showed good accord with manometrical IOP determinations.<sup>4</sup> The device consists of a probe with a magnetic shaft introduced into a solenoid. The probe is disposable and has a plastic cover. It is 24-mm long,



**FIGURE 1.** The rebound tonometer (ICare). The distance between the probe and the central cornea is about 5 to 8 mm.

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mate the IOP compared with the Perkins tonometer.<sup>19</sup> To our knowledge, there are no studies of the tonopen in awake infants in this age group.

Even with experienced personnel, it is often complicated and sometimes impossible to conduct IOP examination in infants without general anesthesia. In a similar agegroup, Pensiero et al<sup>20</sup> could not conduct examination with a pneumotonometer in about one third of the children. Hence, we found it necessary to simplify the procedure and therefore reduced the readings from the recommended 6 to 3 readings. The measure error is small in cooperative infants.

One source of variation is the central corneal thickness; the IOP is positively related with the corneal thickness in most tonometers.<sup>11,21,22</sup> Central corneal thickness was not measured in this study. The corneal thickness in healthy children in this age group shows small variation; so, this source of error should be of less importance.<sup>23</sup> However, in pediatric glaucoma patients, the central corneal thickness might be higher when compared with controls that should be taken into consideration when using ICare for monitoring these patients.

The interobserver repeatability was high in 9 out of 10 children with virtually identical IOP values for the 2 examiners. In 1 girl aged 8 months, there was a great difference between the IOP values obtained by the 2 examiners. In non cooperative children, reiterated examinations may be necessary. The IOP is lower in children than in adults.<sup>20</sup> There was no correlation with age in this series, probably owing to the limited age span.

There are few studies of IOP conducted in infants without general anesthesia. Pensiero et al, using a pulsair tonometer, reported mean values of 71 awake children, subdivided in groups of 0 to 1 years, 1 to 2 years and 2 to 3 years and obtained mean values of 10.6, 12.0 and 12.7 mm Hg, respectively. Thus, the IOP values in that study were of the same order as in our study. The variance was also of the same order.<sup>20</sup> The ICare was used in 152 school children.<sup>5</sup> This method was found to be highly reproducible and very comfortable. Only a few children experienced slight discomfort. The ICare was compared with Tonopen XL in 69 premature infants. The IOP values were significantly lower measured with ICare (mean 9 mm Hg) than Tonopen (mean 16 mm Hg). It was suggested that the Tonopen values were probably falsely elevated owing to discomfort reactions to the anesthetic drop installation.<sup>24</sup>

However, there is no information available on the normal IOP range of healthy infants measured with the ICare tonometer.

The main limitation of the present and similar methods is the lack of cooperation from many infants; sometimes it is not possible to conduct IOP examinations in infants without general anesthesia.

In conclusion, the hand-held rebound tonometer in the present study is easy to use; it does not require topical anesthesia and it is very well tolerated by cooperative infants.

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