Original Article

Exophthalmometry value distribution in healthy Lithuanian children and adolescents

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Dalia Jarusaitiene *; Julija Lisicova; Agne Krucaite; Jurate Jankauskiene

Abstract

Purpose: To determine absolute and relative ocular protrusion values for healthy Lithuanian children and adolescents and analyze the data according to the age, gender, weight, height, and outer orbital distance.

Methods: A total of 397 children and adolescents were included in this study. Measurements for the right and left eyes protrusions were done with Hertel exophthalmometer in healthy subjects aged from 5 to 18 years old. Height, weight, age and gender of subjects were recorded.

Results: The mean age for all children and adolescents was 11.5 ± 3.6 years. For all subjects, the mean (±SD) absolute ocular protrusion value of both eyes (OU) was 14.91 ± 1.68 mm. There was no significant difference in measurements between male and female subjects although female eye protrusion was higher. No individual had more than 2 mm of asymmetry between eyes. Mean exophthalmometric values for right eye were greater than the values of the left eye, and the mean relative protrusion for all participants was 0.2 mm. The mean distance between the lateral rims of the orbits was 98.7 ± 5.2 mm for all subjects. Proptosis measurements significantly correlated with the age, weight and height of children and adolescents and base measurements.

Conclusions: In the present study, we have established ocular proptosis values according to the age, gender, weight and height of healthy Lithuanian children and adolescents. The eye protrusion significantly correlated with the age, weight and height of subjects and the distance between the lateral rims of the orbits. The gender did not play significant role on the eye projection data. We believe that larger, well-design studies are necessary in future to assess the distribution of proptosis in healthy Lithuanian children and adolescents.

Keywords: Exophthalmometry, Ocular protrusion, Children, Adolescents, Hertel measurement, Proptosis

Introduction

Exophthalmometry is simple, routine clinical examination technique for the quantitative measurement of the globe position in the orbit.[1–3] It allows the examiner to assess the abnormal protrusion of the eye and is used for the early diagnosis of suspected orbital or related diseases or it may be used to monitor changes of orbital diseases in dynamics.

Protrusion of the eyeball in pediatric age may be one of the early signs of congenital craniofacial abnormalities (craniosynostosis), neurofibromatosis, ocular and orbital tumors (optic nerve glioma, rhabdomyosarcoma and retinoblastoma), inflammation (orbital cellulitis, panophthalmitis or pseudotumor), Graves' disease, trauma (blowout fracture) and other space-occupying lesions. The normal values of ocular protrusion in any population group are useful to

 * Corresponding author at: Eye Clinic of Lithuanian University of Health Sciences, Mickevicius 9, LT 44307 Kaunas, Lithuania. Tel.: +370 37 326019.
e-mail addresses: djarusaitiene@gmail.com (D. Jarusaitiene), julijalisicova@gmail.com (J. Lisicova), agnekrucaite@gmail.com (A. Krucaite), jur.jankausk@gmail.com (J. Jankauskiene).

distinguish bilateral proptosis as a sign of Graves' ophthalmopathy from other orbital diseases and syndromes.[1,4]

The cases of unilateral proptosis may be diagnosed at early age of population using diagnostic techniques (e.g., ultrasonography, magnetic resonance tomography or computerized tomography). Clinically, in the absence of other signs, orbital disorder is suspected when exophthalmometric values are outside of the normal range or when there is more than 2 mm difference between the eyes.

Normal level of protrusion could vary according to the ethnic origin, age, sex, height, weight of subjects. These variations require the determination of a normal proptosis upper and lower range and correlations for given population. The current pediatric ophthalmologic studies show a wide variation of eye position values and their correlations with the age and gender in healthy children and adolescents of different geographic locations and race. There is no exact opinion in medical studies about normal and pathological proptosis values in these age groups.

To our knowledge, there are several international studies about proptosis in healthy under-age persons. However, a review of the literature did not reveal any study where these values were presented for Lithuanian children and adolescents. We believe it is important to define a normal distribution of proptosis data and their relation to the age, gender, inter-orbital distance, height and weight in Lithuanian pediatric age population.

The purpose of this study was to determine absolute and relative ocular protrusion values for healthy Lithuanian children and adolescents and analyze the data according to the age, gender, weight, height, and outer orbital distance. Furthermore, we wanted to compare the eye protrusion values in pediatric age subjects with those obtained from other European and world countries.

Methods

A total of 397 subjects of this cross-sectional study were randomly selected from children and adolescents who arrived to the pediatric outpatient department at the Clinic of Lithuanian University of Health Sciences for prophylactic inspection. Children and adolescents come to this Clinic from over the country; therefore, evaluation of the exophthalmometric readings may reflect these data of pediatric population of the whole country. Subjects between 5 and 18 years of age without history of an orbital disease or trauma, craniofacial anomaly, thyroid disease, myopia or hyperopia of more than 3 diopters spherical equivalent and ability to tolerate the measurement were included to this study.

Hertel exophthalmometry was performed by the same physician with the same instrument in order to reduce intra- and inter-observer variations. Examiner also collected information about subjects' age, gender, weight and height.

Written consent for participation was obtained from the parents of participants or participants (according to the age). The study was conducted in accordance with the Declaration of Helsinki and the protocol of the study was reviewed and approved by the Ethics Committee of Lithuanian University of Health Sciences.

Statistical analysis was performed to describe the data of ocular protrusion and base (outer orbital distance), the mean, standard deviation (SD) using statistical software package (version 20, SPSS Inc., Chicago, IL, USA). We used Kruskal–Wallis test to compare age groups and Mann Whitney U test for comparing gender groups. Also we used Wilcoxon test for evaluation of the difference between the right and left eye protrusion values. Spearman correlation coefficient was performed to determine the degree of linear relationship between exophthalmometric values and age, gender, height, weight of subjects, base (outer orbital distance). All p values were considered statistically significant when the values were <0.05.

Results

The mean age for all subjects was 11.5 ± 3.6 (mean ± SD) years, and 235 (59.2%) of them were male (boys) and 162 (40.8%) female (girls). Subjects were divided into four age groups (5–7, 8–11, 12–15 and 16–18 years) and also divided by gender.

The lowest recorded exophthalmometric measurement for an eye was 8 mm, and the highest measured value was 20 mm. For all our subjects, a mean of both eyes (OU) was 14.91 ± 1.68 mm. For 5–7 year children proptosis value was 13.2 ± 1.63 mm, 8–11 year – 14.87 ± 1.7 mm, 12–15 year – 15.55 ± 1.5 mm, 16–18 year – 16.02 ± 1.9 mm (see Fig. 1).

Mean exophthalmometric measurements increased with age (the difference between groups was statistically significant, $p < 0,001$), (Kruskal–Wallis test) (Fig. 2). The proptosis measurements difference was not significant in accordance with the gender, although female eye protrusion was higher. Exophthalmometric measurements data of analyzed age and gender groups are summarized in Table 1.

Symmetrically both eyes position was in 132 (33.2%) cases. In 265 (66.7%) asymmetric cases, left eye measurements were higher than right in 96 (24.2%) individuals, and right eye measurements were higher than left in 169 (42.6%) subjects. The highest asymmetry of 2 mm occurred in 7 (1.8%) subjects. No individual had more than 2 mm of asymmetry. As the mean right eye (OD) protrusion was significantly greater than the mean left eye (OS) protrusion ($p < 0.001$) (related-samples Wilcoxon signed rank test), the mean relative protrusion for all subjects was 0.2 mm (see Fig. 3).
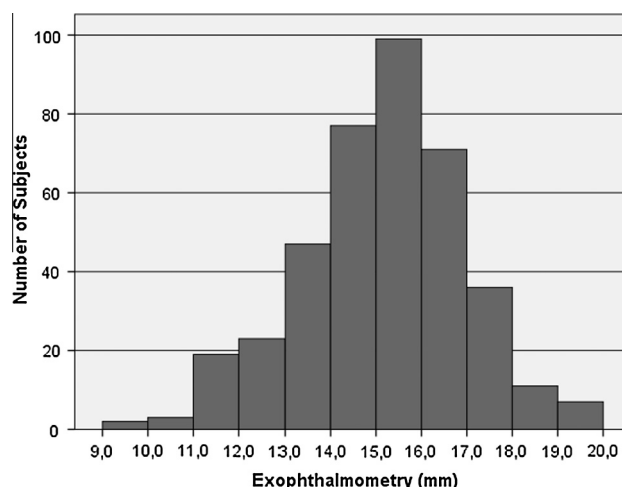

Figure 1. Distribution of mean exophthalmometry measurements of both eyes in all subjects.