Original Article

The opportunistic screening of refractive errors in school-going children by pediatrician using enhanced Brückner test

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Aim: The aim of this study was to compare the results of enhanced Brückner test (EBT) performed by a pediatrician and an experienced pediatric ophthalmologist. **Subjects and Methods:** In this prospective double-masked cohort study, a pediatrician and a pediatric ophthalmologist performed the EBT in a classroom of a school in semi-dark lighting condition using a direct ophthalmoscope. The results of the test were compared using 2 × 2 Bayesian table and kappa statistics. The findings of the pediatric ophthalmologists were considered gold standard. **Results:** Two hundred and thirty-six eyes of 118 subjects, mean age 6.8 ± 0.5 years (range, 5.4–7.8 years), were examined. The time taken to complete this test was <10 s per subject. The ophthalmologist identified 59 eyes as ametropic (12 hyperopic and 47 myopic eyes) and 177 as emmetropic compared to 61 eyes as ametropic and 175 emmetropic by pediatrician. The prevalence of the test positive was 25.9%. The sensitivity of the pediatrician was 90.2%, specificity was 97.7%, predictive value of the positive test was 93.2%, and predictive value of the negative test was 96.6%. The clinical agreement (kappa) between the pediatric ophthalmologist and the pediatrician was 0.9. **Conclusion:** The results of the EBT performed by pediatrician were comparable to that of an experienced pediatric ophthalmologist. Opportunistic screening of refractive errors using EBT by a pediatrician can be an important approach in the detection of ametropia in children.

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The prevalence of refractive errors, especially myopia, in urban India is high and demonstrates an increasing trend.[1-4] The magnitude as well as the prevalence of myopia increases with age.[4,5] School screening programs are effective and well-established methods for the detection and treatment of refractive errors, yet with all the limitations of population-based programs.[5-7] Myopia is the most common refractive error in school-going children in India and constitutes >60% of the total refractive errors.[8]

Increased levels of outdoor activities and reduced exposure to screen-based or near activities can be effective in the prevention or slowing the pace of progression of myopia.[9-12] Atropine eye drop is also well established in its role to arrest or slow down the progression of myopia.[13-15] Other refractive errors such as hypermetropia, astigmatism, as well as anisometropia are amblyogenic and can cause significant visual impairment. They can be corrected easily with spectacles. In that context, it makes sense to detect the refractive errors, specifically myopia (which may not be amblyogenic in a majority but is still an important cause of visual impairment in children) at an early age.

The Brückner test and the enhanced Brückner test (EBT) can be performed by transilluminating the pupil using a direct ophthalmoscope from an arm length distance while the patient fixates at the ophthalmoscope light. The location and the size of the bright pupillary crescent give observer an indication regarding the presence of any significant refractive error [Fig. 1].[4,16] Previous investigators have reported that EBT is a simple, rapid, reliable, and objective test for the purpose of screening of refractive errors in children, especially when used by an experienced pediatric ophthalmologist or an optometrist.[4,16] However, its reliability is not compared when used by a pediatrician.

In this study, we have compared the results of the EBT performed by a pediatrician with a pediatric ophthalmologist well versed with EBT. Good interobserver agreement and quick learning may make EBT a useful test for the opportunistic screening of refractive errors in children by pediatricians.

Subjects and Methods

This prospective observational study was conducted by the Department of Pediatric Community Ophthalmology

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of a Tertiary Teaching Pediatric Eye Centre of urban India. Two masked investigators (a pediatrician and a pediatric ophthalmologist) performed EBT in a semi-darkened room of a municipal school.

The EBT[4,17] was performed from a distance of 1 m from the subject. Both eyes of the subject were simultaneously illuminated using a direct ophthalmoscope (Heine, Beta 200, Optotechnik, Germany) with the subject looking directly into the ophthalmoscope light. The observer looked through the peephole of the direct ophthalmoscope and adjusted the lens dial until the pupillary reflex was sharply focused. The size and location of the pupillary crescent were noted and reported as ametropic (inferior crescent or decentered crescent or >2 mm size superior crescent) or emmetropic (≤2 mm superior well centered to 12 o'clock position) crescent [Fig. 1].

All the children >5 years age, from the first standard of the school class were included. Children with any ocular comorbidity, namely, media opacities, cataract, nystagmus, and squint were excluded.

The pediatric ophthalmologist first described the optical principle of photorefraction (EBT) to the pediatrician followed by a demonstration of pupillary crescents in different refractive conditions using +3.0D lens, −3.0D lens, and +3.0D cylinder held in front of an emmetropic eye and using standard photographs [Fig. 1].

The pediatrician then performed the test (EBT) on ten consecutive children, verified by the pediatric ophthalmologist. This exercise of teaching was immediately followed by examination of the study population, first by the pediatrician and then followed immediately by the pediatric ophthalmologist (masked to the observations of the pediatrician) using a direct ophthalmoscope (Heine Beta® 200, Herrsching, Germany).

The data were categorized in a 2 × 2 Bayesian table [Table 1] and analyzed to get the prevalence, sensitivity, specificity, and predictive values. The clinical agreement between the two observers was calculated using kappa statistics.

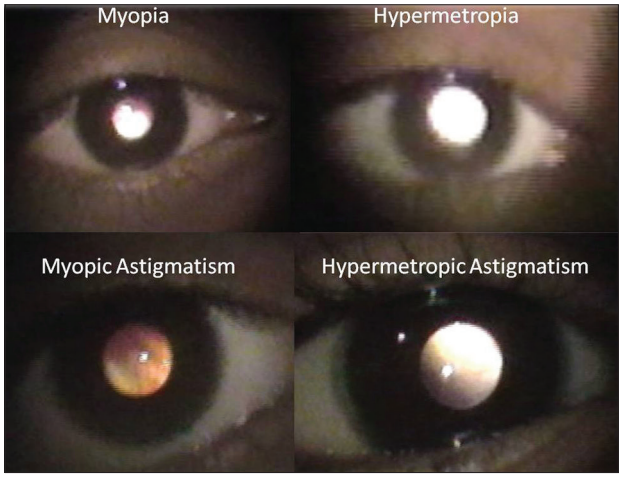

Figure 1: Photograph demonstrating the location and appearance of pupillary transillumination on enhanced Brückner test in different refractive errors

Results

Two hundred and thirty-six eyes of 118 subjects, mean age 6.8 ± 0.5 years (range, 5.4–7.8 years), were examined. The time taken to complete this test was <10 s per subject. The ophthalmologist identified 59 eyes as ametropic (12 hyperopic and 47 myopic eyes) and 177 as emmetropic compared to 61 eyes as ametropic and 175 emmetropic by the pediatrician [Table 2]. At the prevalence of 25.9%, the sensitivity of the EBT [Table 1] by the pediatrician was 90.2%, specificity was 97.7%, predictive value of the positive test was 93.2%, and predictive value of the negative test was 96.6%. The clinical agreement (kappa) between the ophthalmologist and the pediatrician was excellent (0.9). None of the children was already having spectacles.

Discussion

This study from urban India demonstrated a high prevalence of significant refractive errors using a screening test that was reported to have high negative predictive value and specificity.[4,16] The clinical agreement, specificity, and negative predictive value of the test when compared between a

Table 1: Results of enhanced Brückner test by pediatrician for screening of ametropia in children

Test	Value (%)	95% CI
Sensitivity	90.16	79.80-96.28
Specificity	97.71	94.25-99.36
Positive predictive value	93.22	83.53-98.08
Negative predictive value	96.61	92.76-98.74
Disease prevalence	25.85	20.39-31.93

CI: Confidence interval

Table 2: 2×2 Bayesian table comparing the results of enhanced Brückner test performed by the pediatrician in comparison to the gold standard (pediatric ophthalmologist)

Pediatrician's observation	Pediatric ophthalmologist's observation		
	Ametropic	Emmetropic	Total
Ametropic	55	4	59
Emmetropic	6	171	177
Total	61	175	236

Table 3: Vision-threatening ocular morbidity associated with high myopia in children

Type of ocular morbidity	Risk increase
Risk of retinal detachment[18,19]	200 times higher (3.2% for myopia >−6.00D vs. 0.71%, in emmetropic)
Risk of CNVM[20,21]	9 times higher with myopia between −5.0D and −6.0D
Risk of early cataract[21,22]	2.8 times higher with myopia
Risk of retinal detachment after cataract surgery[22]	2.4 times higher chances with myopia
Risk of open-angle glaucoma[23]	3.3 times for myopia >−3.0 D

CNVM: Choroidal neovascular membrane

Table 4: Advantages of opportunistic screening versus population-based screening of refractive errors in preverbal children

	Opportunistic screening	Population-based screening
Location of screening	Pediatrician's office	School
The health personnel involved	Done by pediatrician	Done by optometrists/ophthalmologists/teachers
Sustainability	Can be done on daily and ongoing basis in the pediatrician's office	Can be done on specified and dedicated days
Reliability for referral	Patients may tend to rely more on the pediatrician	Patients may not rely much on the advice by a visiting personnel
Instrument required	Ophthalmoscope is a routinely used, cheap, and essential instrument used by any physician in medical practice	A photo screener is an expensive, out of the shelf instrument that is specially dedicated to the population-based screening of refractive errors
Cost of the screening	Low opportunity cost	High cost and human resource intensive

pediatrician and a trained pediatric ophthalmologist were very high. The pediatrician understood the principle and learned how to perform and record the results of the EBT rapidly.

Since childhood myopia has a trend of increasing prevalence and rapid progression in the Asian children living in urban area, an early detection and referral are warranted. This is particularly important when a pharmacological and environmental modification can potentially prevent or slow down the progression of myopia.[9-15]

It is well known that myopia is an important cause of visual impairment in children, especially in the urban area of Asian countries. An unchecked progression of myopia can be associated with myopia of more than −6.0D which is associated with multiple long-term ocular morbidities in the lifetime of a child as well as high spectacle dependence [Table 3].[18-23]

A red reflex testing is an essential component of the neonatal, infant, and child physical examination by a pediatrician using an ophthalmoscope.[24] It is prudent to teach them to do an EBT for an easy and early referral of the child suspected to have a refractive error.

In fact, this approach of case detection which is called opportunistic screening has many advantages over a population-based screening (using photo screeners) in children [Table 4][25] and it can be adopted as a first step toward the elimination of childhood visual impairment due to refractive errors. Training in performing the EBT should be included as a part of the curriculum in the pediatric residency program and should be considered a mandatory examination in the pediatrician's office.

As opposed to population-based screening, case detection relies on detection of disease in patients who present to physicians for various complaints or for routine immunization as in this case.[25] Population-based screening for refractive errors is especially inappropriate for developing countries without an adequate infrastructure, especially when the screening tests are expensive, difficult to administer, and disease prevalence and associated visual disability are low as seen with most refractive errors in preverbal age group. Currently, one of the methods for detection of refractive errors in preverbal children is to perform an EBT during a routine comprehensive pediatric examination. The feasibility of this would, however, depend on the willingness of pediatrician and the performance of the EBT.

Although, in this study, we have not performed cycloplegic refraction of the children, the sensitivity, specificity, and predictive values of the EBT in comparison to cycloplegic refraction are already reported in the literature.[16,17] The sole purpose of this study was to compare the screening of children with EBT by a pediatrician with a trained pediatric ophthalmologist who was very well versed with the EBT.

We found that the results of the EBT performed by pediatrician were comparable to that of an experienced pediatric ophthalmologist. Future studies are required to assess the effect of opportunistic screening of refractive errors in preverbal children by the pediatricians on the rate of reduction of the visual impairment due to ametropia in children. Studies are also required to evaluate the validity of EBT in children <1 year when the fixation to distance target is poor.

Conclusion

Opportunistic screening of refractive errors using EBT by pediatrician can be an important approach in the detection of ametropia in children.

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Conflicts of interest

There are no conflicts of interest.

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