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Measuring Angle of Deviation, Prism Diopter in Children-Assessing Strabismus Using Smartphone Application

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Abstract

Objective: The Objective of this study is to demonstrate the utility of a machine learning-driven smartphone application in measuring the angle of deviation (AOD) and calculating the Prism Diopter (PD, Δ) in children with strabismus. The current smartphone applications and in-office devices rely on very controlled testing requirements for factors such as position, light, subject compliance, and others. Furthermore, the cost of the devices and the apps is prohibitive for broad use by those in need. The PPEA is available for free on iOS and Android stores, allowing patients to take photos and share them with their treating clinician, whom they may not otherwise have access to. Not only will the AI-driven technology enhance follow-up and compliance with recommended vision therapy, as patients observe improvement, but it will also significantly increase access to that care. **Methods and Analysis:** The IRB approved the study. The chief of strabismus surgery and the fellow evaluated patients referred to the ophthalmology department. The study, which included both the clinical examination and the use of the PPEA to take pictures, was conducted by a single pediatric ophthalmologist. The clinical evaluation included relevant indices and measurement of (PD, Δ). Before the clinical exam, the PPEA captured images of each patient, from which measurements of (PD, Δ) were derived. The information was masked and not reported on the screen to prevent examiner bias and influence the examiner's clinical evaluation. The blinded clinical data was merged with the information stored on the encrypted server. The clinical and calculated (PD, Δ) values were matched and analyzed. The analysis included descriptive reporting and stratification, followed by matching of the blinded data solely based on assigned unique identification numbers to avoid researcher bias. For the study, patients with both esotropia and exotropia, with no vertical component, were included. **Results:**

The population was homogeneous, consisting of 43 females and 44 males, with the average age for females at 9.21 years (SD = 4.15, Range: 2.3 - 17.6) and for males at 9.16 years (SD = 3.95, Range: 2 - 17.4). The (PD, Δ) measurement for the 87 patients revealed significant differences only when the measured values exceeded 60. There was no statistical difference between the measured and calculated (PD, Δ) for those with values below 60. However, the measured values exceeded the calculated values for the seven outliers with (PD, Δ) greater than 60. **Conclusion:** The PPEA (pending App Store approval as the publication date) precisely measures Prism Diopter (PD, Δ) for pediatric patients. It is a valuable screening tool for individuals with limited or no access to specialized ophthalmology services.

Keywords

Strabismus, Amblyopia, Vision Therapy, Smartphone Application

1. Introduction

The coordination of ocular alignment is critical for visual acuity, depth perception, and vision development in pediatric patients [1]. Strabismus is an ocular condition that, while typically benign in newborns, may indicate an underlying issue with lifelong consequences. The conditions associated with strabismus negatively affect vision development, potentially leading to amblyopia if not addressed during childhood. Specifically, strabismus can result in a loss of depth perception and binocular vision, as well as a significant reduction in visual field. Previous reports have highlighted the importance of early intervention in correcting misalignment [2], primarily due to the perceived decrease in neuroplasticity of an aging brain. However, emerging evidence suggests that neuroplasticity remains intact and can occur even after what researchers have considered the critical period for vision development [3] [4]. If left undiagnosed and untreated, eye misalignment due to strabismus may lead to significant visual limitations with wide-ranging socioeconomic, psychological, and physical ramifications [5]-[7]. There are noteworthy economic, familial, and social barriers to accessing early intervention and treatment for strabismus [8]-[10].

Although digital health platforms may have exacerbated health inequalities [11] [12], the global reach and acceptance of smartphones, along with opportune app-driven technology, can help bridge the cost and access gaps [13] created by socioeconomic and structural barriers [14]-[16]. Recent literature has shown that Vision therapy (VT) is critical to the treatment of amblyopia [17] [18].

Measuring eye misalignment is a highly technical process that requires extensive training, experience, and patient cooperation to yield reliable and reproducible results. The (PD, Δ) measurement is typically performed using the alternate prism cover test (APCT). This involves aligning the position of the eyes from the examiner's viewpoint by placing a prism close to the patient's eye [19]. During the test, the patient must maintain a straight gaze with both eyes fixed on a designated object. The clinical measurement (PD, Δ) is inherently inaccurate, exhibiting wide variations in results [20] [21]. The (PD, Δ) test poses even greater challenges for the pediatric population than for adults. The (PD, Δ) exam guides the recommended treatments and progress evaluations. Therefore, obtaining reproducible and accurate measurements is essential, regardless of the examiner's level of experience.

Several smartphone applications and in-office devices [22] require controlled testing conditions for factors such as position, lighting, subject compliance, and others [23] [24]. We previously evaluated and presented the utility of this application in the adult population [25] for correct measurements of angle of deviation (AOD) and prism diopter (PD, Δ). In this study, we validate the data in the pediatric population.

2. Setting

The study was conducted at Universidad Central de Venezuela, Los Chaguaramos, Caracas, Venezuela, a tertiary university specializing in the treatment of strabismus in adults and children. The team of care providers included the chair of ophthalmology, the chair of the division of strabismus care, and an ophthalmologist specializing in strabismus surgery. A single pediatric ophthalmologist conducted the clinical examination and used the PPEA to take pictures.

2.1. Consent and Institutional Review Board

The study was evaluated and approved by the Institutional Review Board (IRB) of the Universidad Central de Venezuela and the Department of Ophthalmology.

The physician members of the research team informed all parents of the study, and consent was obtained before screening. The study information package and consent forms were translated into Spanish. The investigators' primary language was Spanish.

2.2. Confidentiality

The registration and login information for the PPEA included a username and password, as well as recovery and authentication methods to prevent unauthorized access to the application. No patient information or pictures were stored on the device. All the data collected by the PPEA was encrypted and loaded onto Amazon's Web Service (AWS) servers, which are Health Insurance Portability and Account-ability Act of 1996 (HIPAA) compliant databases. The anonymized data were tabulated using unique patient IDs, picture IDs, and server ID numbers, with no names attached to the files.

3. Method

Between August 2, 2023, and November 20, 2023, one hundred patients presented for screening for strabismus at the ophthalmology clinic of the Universidad Central de Venezuela in Caracas, Venezuela. Eighty-seven patients between the ages of 2 and 17.6 were included in this study. These patients were either self-referred or sent by their primary care provider for evaluation. The screening included a comprehensive visual examination by an ophthalmologist, which included visual acuity, refraction, visual field, and (PD, Δ) tests. The patients tested for near visual acuity better than 20/40 (corrected and uncorrected) with no prism. Cover, cover-uncover, and prism testing were performed with fixation at near and far distances, near approximately 40 centimeters and far at 6 meters. The clinical information was recorded in the patient's medical records.

Patients seen include those with both esotropia and exotropia. Due to the small number of patients with vertical deviations, we limited our analysis to the horizontal component analysis, even though some patients had a vertical component.

The PPEA was used to photograph the patient's face as the first step of the examination, typically done within a few minutes of the APCT. The photograph was analyzed, and a report was generated on the screen, including the deviated eye, the distance deviation, and the angle of deviation. The information reported on the screen was masked. It did not include the distance, angle of deviation, or prism diopter measurement, so any disparity between the PPEA measurement and the clinical assessment reading will not bias the researchers. The app's measurements were automatically saved on the servers, while the clinical information was recorded in the patient's medical records at the clinic. The information was stored in two separate databases to prevent patient identification in the event of potential data loss by the third-party cloud storage company. This data was structured so that one database contains patient demographic information and a unique identification number (patient_id). A separate database stores the image and the results (test_id), and when the PPEA is queried, the databases merge the encrypted information from the stored servers (**Figure 1**).

patient_id	test_id	userId
vKLBSKwrq2	65ADFB75-4E53-4D36-8F81-01BF469B5CB6	us-west-2:b91bddab-474a-4742-b67e-8df56a2b1a6a
FfOtDkSMJw	23BCE4B0-D5F3-4583-B640-E4092D397AF2	us-west-2:b91bddab-474a-4742-b67e-8df56a2b1a6a
Zut4CJDyFX	98E16B1A-A00E-421D-8F4C-72740E565CFF	us-west-2:b91bddab-474a-4742-b67e-8df56a2b1a6a

Figure 1. Database records.

After the trial period, the stored images, calculated AOD, and server (PD, Δ) were identified and matched with the patient's clinic medical records, including the (PD, Δ). The clinical PD (Δ) was then compared to the PPEA-reported PD (Δ) and the reported PD.

3.1. Technology

PPEA functions on a facial pattern recognition feature. The difference between the facial features and the left and right eye positions referencing the pupils is used to calculate the AOD and (PD, Δ). To validate the LiDAR technology [26] of iOS phones (12 Pro and higher) and distance measurement on the Android platform, we used preprinted 1 cm square stickers to confirm the distance of pictures taken. This is no longer used in our latest beta release application, as we have validated the calculation for reporting AOD and PD (Δ).

As the image is taken, the examiner can zoom in or out, reposition the overlay, and override and change the pupils' locations (Figure 2). The image and the calculated information are then saved on the server. Recalling the information on the device requires 4G or better connectivity. The screenshot feature is unavailable to protect the privacy of the subjects. The images for this publication are captured from the server databases.

The PPEA reports reproducible and accurate prism diopter measurements over a broad range of distances (40 - 100 cm) and at angles of 15 degrees to the left and right of the midline at eye level. This test can be performed with minimal effort by photographing a subject's cooperation.

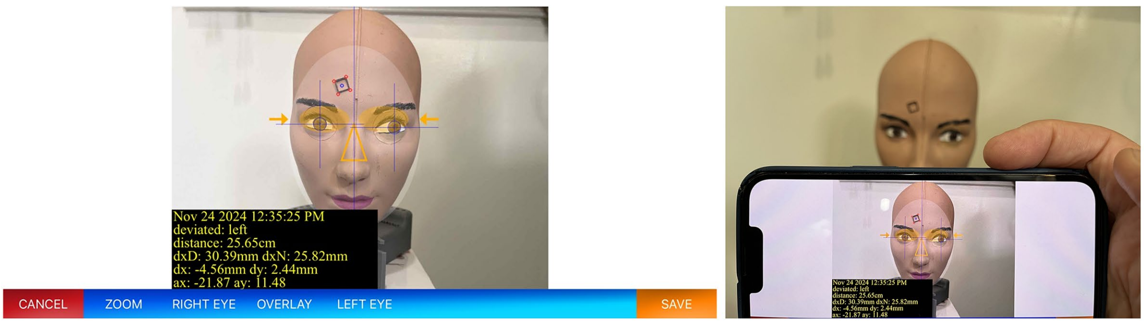


Figure 2. PPEA.

3.2. Study Inclusion and Exclusion Criteria

The inclusion criteria for this study included the following:

1) Male or female between the ages of 2 and 18 at the time of examination.

2) There is no physical limitation for a visual exam, including a (PD, Δ) test.

3) Family members consented to participate in the study, including taking a picture of their face as part of the visual examination.

The exclusion criteria for this study included the following:

1) Those with significant learning or behavioral limitations may have difficulty complying with the instructions for a vision exam, including (PD, Δ).

2) Those who would not consent to the study.

Furthermore, parents and guardians were explicitly informed that their refusal to participate in the study would not limit their access to care at the clinic.

4. Results and Data Analysis

The anonymized data, which contained "patient_id, test_id, userid," sex, date of birth, and time and date of the exam, was downloaded from the database. This information was then merged with the clinical information provided by the examining ophthalmologist, which included the patient's first and last name, date of birth, sex, and time and date of the exam. The patients were all identified in a merged table for statistical analysis based on the standard information shared between the two databases. The initial review of the merged dataset identified two patients with missing date of birth information. These were corrected by reviewing the clinical information and adding the missing data points.

The population was homogeneous, with no statistically significant difference between the male and female subsets, which consisted of 43 females and 44 males. The mean age for females was 9.21 years (SD = 4.15, Range 2.3 - 17.6), and for males, it was 9.16 (SD = 3.95, Range 2 - 17.4) (Table 1).

Table 1. Demographic.

VAR	*N*	*Mean*	*Std Dev*	*Variance*	*Minimum*	*Maximum*
Female	43	9.21497	4.19581	17.60481	2.30137	17.60274
Male	44	9.16196	3.95646	15.65358	1.96438	17.38904
Means Report						
VAR	*Mean*	*95% LCL*	*95% UCL*			
Female	9.21497	7.92369	10.50625			
Male	9.16196	7.95908	10.36483			
Mean Difference (1 - 2)	0.05302	−1.68502	1.79106			
H1: Mu1 - Mu2 ≠ 0/Not equal (two-tailed)						
t Critical Value (5%)	1.98827	*p-value*	0.95178	*H*1 (5%)	Rejected	Statistically not significant
H1: Mu1 - Mu2 < 0/Less than (lower-tailed)						
t Critical Value (5%)	−1.66298	*p-value*	0.52411	*H*1 (5%)	Rejected	
H1: Mu1 - Mu2 > 0/Greater than (upper-tailed)						
t Critical Value (5%)	1.66298	*p-value*	0.47589	*H*1 (5%)	Rejected	

The patients examined included both those with esotropia and exotropia. However, the incidence of each group varied due to factors such as ethnicity and patient accessibility to the clinic [27]. Our study classified patients into two categories based on these criteria at the time of examination. This classification was recorded both during the clinical exam and during analysis using the PPEA. For a few patients with intermittent deviation, it was confirmed that both the clinical exam and the PPEA detected the deviation beforehand. No patient showed non-deviation on one exam and intermittent findings on the other. This simplified classification was designed to facilitate the study of the PPEA's accuracy. Given the nature of the research and the ethnic population, its location, and accessibility factors, the demographics of the patients seen may have differed from those reported in other publications [28] [29].

The data was not tested for normal distribution, given the large sample size (N = 87, >30).

The measured and calculated (PD, Δ) were compared using paired Two-Sample T-tests for all subjects. The mean difference between the measured and calculated (PD, Δ) values for the 87 subjects was 5.3 (P = 0.011, Table 2). This difference, however, was due to the group where the measured PD (Δ) was greater than the calculated value (Mu1-Mu2 > 0). This raised the question of the relative validity of the larger measurement (PD, Δ), whether clinical or computed.

Table 2. Measured vs. Calculated (PD, Δ) (*All patients*).

VAR	*N*	*Mean*	*Std Dev*	*Variance*	*Minimum*	*Maximum*
Measured (PD, Δ) (1)	87	30.5977	20.91926	437.61534	0	95
Calculated (PD, Δ) (2)	87	25.30332	17.68591	312.7915	1.06201	88.26944
Means Report						
VAR	*Mean*	*95% LCL*	*95% UCL*			
Measured (PD, Δ) (1)	30.5977	26.1392	35.0562			
calculated (PD, Δ) (2)	25.30332	21.53394	29.0727			
Mean Difference (1-2)	5.29438	1.23945	9.34932			
H1: Mu1 - Mu2 ≠ 0/Not equal (two-tailed)						
t Critical Value (5%)	1.98793	*p-value*	0.0111	*H1* (5%)	Accepted	
H1: Mu1 - Mu2 < 0/Less than (lower-tailed)						
t Critical Value (5%)	−1.66277	*p-value*	0.99445	*H1* (5%)	Rejected	Statistically not significant
H1: Mu1 - Mu2 > 0/Greater than (upper-tailed)						
t Critical Value (5%)	1.66277	*p-value*	0.00555	*H1* (5%)	Accepted	

Limiting the analysis to those with a measured (PD, Δ) of less than 60 (N = 80) reveals no statistical difference between the measured and calculated (PD, Δ) values (Table 3).

Table 3. Measured ((PD, Δ) <60) vs. Calculated (PD, Δ).

VAR	*N*	*Mean*	*Std Dev*	*Variance*	*Minimum*	*Maximum*
Measured (PD, Δ) (1)	80	26.7125	16.48797	271.85301	0	60
Calculated (PD, Δ) (2)	80	24.70606	17.9037	320.54262	1.06201	88.26944
Means Report						
VAR	*Mean*	95% *LCL*	95% *UCL*			
Measured (PD, Δ) (1)	26.7125	23.04328	30.38172			
Calculated (PD, Δ) (2)	24.70606	20.72179	28.69033			
Mean Difference (1 - 2)	2.00644	−1.45215	5.46503			
H1: Mu1 - Mu2 ≠ 0/Not equal (two-tailed)						
t Critical Value (5%)	1.99045	*p-value*	0.25168	*H1* (5%)	Rejected	
H1: Mu1 - Mu2 < 0/Less than (lower-tailed)						
t Critical Value (5%)	−1.66437	*p-value*	0.87416	*H1* (5%)	Rejected	Statistically not significant
H1: Mu1 - Mu2 > 0/Greater than (upper-tailed)						
t Critical Value (5%)	1.66437	*p-value*	0.12584	*H1* (5%)	Rejected	

This observation in our study population is consistent with the error rate reported on large (PD, Δ) in the literature [30]. Even those who use Plus lenses, which act like a base-to-base prism, and minus lenses with apex-to-apex prisms would not account for the difference noted in those with large PD (Δ) [31]. A closer look at the data, however, did show some variability based on the sex of the subject examined. Our analysis showed no statistically significant difference between the measured and calculated (PD, Δ) in the male population (**Table 4**).

Table 4. Measured (PD, Δ) vs. Calculated (PD, Δ) (*Male*).

VAR	*N*	*Mean*	*Std Dev*	*Variance*	*Minimum*	*Maximum*
Measured (PD, Δ) (1)	44	27.97727	18.28138	334.20877	0	70
Calculated (PD, Δ) (2)	44	25.61796	19.11425	365.35452	2.33848	88.26944
Means Report						
VAR	*Mean*	95% *LCL*	95% *UCL*			
Measured (PD, Δ) (1)	27.97727	22.41923	33.53532			
Calculated (PD, Δ) (2)	25.61796	19.80669	31.42922			
Mean Difference (1 - 2)	2.35932	−2.85648	7.57511			
H1: Mu1 - Mu2 ≠ 0/Not equal (two-tailed)						
t Critical Value (5%)	2.01669	*p-value*	0.36673	*H1* (5%)	Rejected	
H1: Mu1 - Mu2 < 0/Less than (lower-tailed)						
t Critical Value (5%)	−1.68107	*p-value*	0.81663	*H1* (5%)	Rejected	
H1: Mu1 - Mu2 > 0/Greater than (upper-tailed)						
t Critical Value (5%)	1.68107	*p-value*	0.18337	*H1* (5%)	Rejected	

However, data analysis for female groups shows a statistically significant difference when the measured PD (Δ) is larger than the calculated value readings (**Table 5**).

Table 5. Measured (PD, Δ) vs. Calculated (PD, Δ) (*Female*).

VAR	*N*	*Mean*	*Std Dev*	*Variance*	*Minimum*	*Maximum*
Measured (PD, Δ) (1)	43	31.65116	19.72898	389.23256	0	70
Calculated (PD, Δ) (2)	43	24.98136	16.31608	266.21455	1.06201	85.37928
Means Report						
VAR	*Mean*	95% *LCL*	95% *UCL*			
Measured (PD, Δ) (1)	31.65116	25.57948	37.72285			
Calculated (PD, Δ) (2)	24.98136	19.96001	30.00271			
Mean Difference (1 - 2)	6.6698	1.11786	12.22175			
H1: Mu1 - Mu2 ≠ 0/Not equal (two-tailed)						
t Critical Value (5%)	2.01808	*p-value*	0.01972	*H1 (5%)*	Accepted	
H1: Mu1 - Mu2 < 0/Less than (lower-tailed)						
t Critical Value (5%)	−1.68195	*p-value*	0.99014	*H1 (5%)*	Rejected	
H1: Mu1 - Mu2 > 0/Greater than (upper-tailed)						
t Critical Value (5%)	1.68195	*p-value*	0.00986	*H1 (5%)*	Accepted	

We found no statistically significant differences in measured (Table 6) or calculated (Table 7) (PD, Δ) between the male and female subgroups. The data review identified seven patients with measured PD (Δ) values ranging from 65 to 95. The mean difference between the measured and calculated (PD, Δ) values for these seven patients was 43, and for the remaining 80 patients, it was 12.

Table 6. Compare Means-Measured (PD, Δ) *Male-Female.*

VAR	*N*	*Mean*	*Std Dev*	*Variance*	
Male (1)	44	27.98	18.28	334.1584	
Female (2)	43	31.65	19.27	371.3329	
Means Report					
VAR	*Mean*	*95% LCL*	*95% UCL*		
Male (1)	27.98	22.42237	33.53763		
Female (2)	31.65	25.71957	37.58043		
Mean Difference (1 - 2)	−3.67	−4.34007	11.68007		
Degrees of Freedom	85				
H1: Mu1 - Mu2 ≠ 0/Not equal (two-tailed)					
t Critical Value (5%)	1.98827	*p-value*	0.36489	*H*1 (5%)	Rejected
H1: Mu1 - Mu2 < 0/Less than (lower-tailed)					
t Critical Value (5%)	−1.66298	*p-value*	0.81756	*H*1 (5%)	Rejected
H1: Mu1 - Mu2 > 0/Greater than (upper-tailed)					
t Critical Value (5%)	1.66298	*p-value*	0.18244	*H*1 (5%)	Rejected

Table 7. Compare Means-Calculated (PD, Δ) Male-Female.

VAR	*N*	*Mean*	*Std Dev*	*Variance*	
Male (1)	44	25.62	19.11	365.1921	
Female (2)	43	24.98	16.31	266.0161	
Means Report					
VAR	*Mean*	95% *LCL*	95% *UCL*		
Male (1)	25.62	19.81003	31.42997		
Female (2)	24.98	19.96052	29.99948		
Mean Difference (1 - 2)	0.64	−6.93014	8.21014		
H1: Mu1 - Mu2 ≠ 0/Not equal (two-tailed)					
t Critical Value (5%)	1.98896	*p-value*	0.86687	*H*1 (5%)	Rejected
H1: Mu1 - Mu2 < 0/Less than (lower-tailed)					
t Critical Value (5%)	−1.66342	*p-value*	0.56656	*H*1 (5%)	Rejected
H1: Mu1 - Mu2 > 0/Greater than (upper-tailed)					
t Critical Value (5%)	1.66342	*p-value*	0.43344	*H*1 (5%)	Rejected

The seven patients included three males and four females. The top three measured patients (PD, Δ) were females 4, 3, and 13 (**Table 8**). A review of the clinical medical records did not reveal any changes in the recorded information, nor did they provide any information on difficulties with the examination for the possible reading. Similarly, the images for the seven patients were re-examined in the PPEA, and no changes were noted. We choose not to remove these patients from the database as outliers, as we believe that the significant difference may be more likely related to the difficulty in the clinical measurement of large (PD, Δ), as reported in the literature.

Table 8. Information on 7 outlier patients.

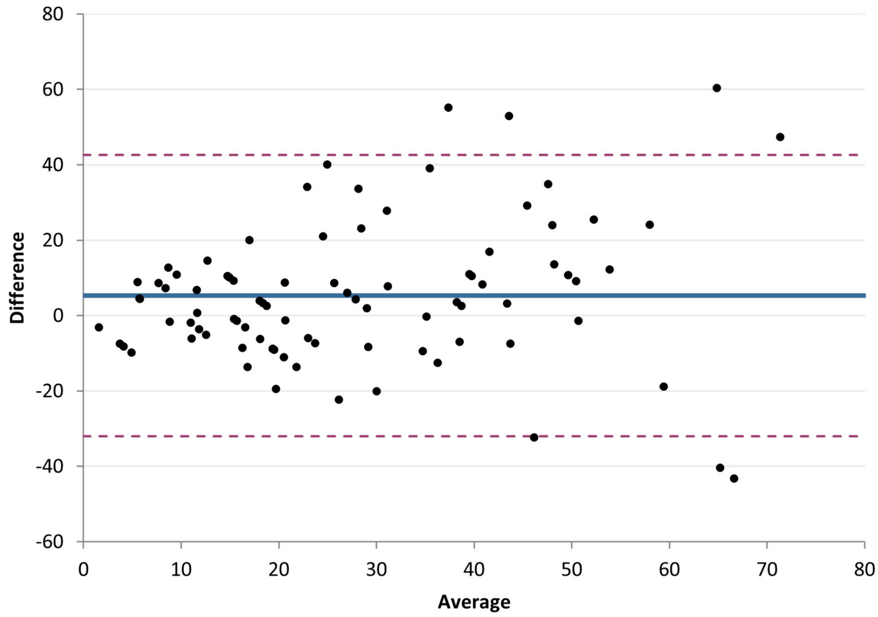
Sex	Age	Measured	Calculated	Difference
M	4.06 yrs	65	40	25
F	12.23 yrs	65	30	35
M	10.73 yrs	65	10	55
M	10.44 yrs	70	46	24
F	4.32 yrs	70	17	53
F	13.63 yrs	95	48	47
F	3.09 yrs	95	35	60

For the interchangeability of the results between the clinical and PPEA measurements, the Bland-Altman plot for all subjects demonstrates that, except for the seven outliers in **Table 8**, all measured and calculated (PD, Δ) values fall within the upper and lower limits of agreement. This shows that the two methods of measuring (PD, Δ) are in 95% agreement (**Table 9**, **Graph 1**).

Table 9. Bland-altman plot.

Descriptive Statistics				
	Mean	*Std Dev*	*LCL*	*UCL*
Measured PD	30.5977	20.91926	26.1392	35.0562
Calculated PD	25.30332	17.68591	21.53394	29.0727
Pearson R		0.52494		

Summary				
	Value	*Std Dev*	*LCL*	*UCL*
Bias (Mean Difference)	5.29438	19.02573	1.23945	9.34932
Lower Limit of Agreement	−31.99605	3.49935	−38.95252	−25.03958
Upper Limit of Agreement	42.58482	3.49935	35.62835	49.54128
Coefficient of Repeatability	38.50032			



Graph 1. Bland-altman plot.

5. Discussion

Early treatment of strabismus, which may be critical to preserving depth perception and an intact visual field, is primarily attributed to neuroplasticity, which is reported to deteriorate with age [32]. Early treatment of strabismus begins with an accurate diagnosis, which requires an assessment by a vision care specialist, ophthalmologist, or optometrist with training and experience in measuring (PD, Δ) [33]. This specialized care is primarily limited to large urban cities, often associated with academic or large healthcare delivery institutions [34]. The majority of those afflicted with strabismus as children may have limited or no access to early diagnosis and fewer treatment options. Our study showed that the PinpointEyes™ App accurately and non-invasively measures the AOD and calculates the (PD, Δ) with a smartphone camera. This significantly expands access to specialists for the early diagnosis of strabismus. The limitation was noted for (PD, Δ) > 60. The measurement of (PD, Δ) is highly technical and requires experience.

Our candid discussion should also include the comparative nature of this study. The function of the PPEA and the reporting of the (PD, Δ) measurement are in comparison to clinical measurements. This clinical measurement varies widely and depends on the examiner's training, experience, the subject's cooperation, the presence and absence of optical corrective lenses, and other factors [20]. It can be argued, however, that the PPEA measurement, which is based on vector analysis and machine learning facial recognition analytics, produces results with far greater accuracy and reproducibility and little or no impact on the operators' ability to take pictures. This results in a research conundrum: should the clinical measurement be the standard, or should the calculated (PD, Δ) be viewed as the most precise [35]? Notably, the calculated (PD, Δ) is mathematically produced based on measurements taken at "pixel" levels. This also raises the issue that there is a practical limit to the value of the measurements' accuracy; however, at this level of precision, the result may not have any practical implications. Further studies are needed to validate the accuracy of the facial recognition app used for measuring (PD, Δ) based on known platforms with engineered measurements as the template for calibration.

6. Conclusion

The PPEA generates reproducible and accurate prism diopter measurements in children with high accuracy. This broadens access to those with minimal resources, such as a smartphone and connectivity, to seek advice. Further studies are needed to validate the results of the PPEA when pictures are taken in non-clinical settings.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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