

Comparison of Near Point of Accommodation and Near Point of Convergence with Positive Fusional Vergence Among Young Adults, Bengaluru

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ABSTRACT:

Background: When encountered with mass screening and increased walk-in patients in outpatient departments (OPD), evaluating complete binocular vision assessment becomes time-consuming. Consequently, there is a need to streamline the testing process. This study also aims to explore if there are any correlations between Near Point of Accommodation (NPA) and Near Point of Convergence (NPC) with Positive Fusional Vergence (PFV).

Methodology: A retrospective study was carried out at Sankara Eye Hospital in Bangalore. Data from patients aged 18 to 35, who underwent binocular vision assessment between 2016 and 2020, were included. Out of 101,896 patients who visited the hospital during this period, 3,449 attended the vision therapy clinic. Among them, 1708 patients met the criteria for inclusion, while 1,741 were excluded.

Results: Out of 1708 subjects, 759 are females and 949 are males. The relationship between Near Point of Accommodation (NPA), Near Point of Convergence (NPC), and Positive Fusional Vergence (PFV) blur and break values were analysed. A positive correlation was observed between NPA and PFV blur (Spearman's rho = 0.069, p=0.004) and a negative correlation between NPC and PFV break (Spearman's rho = -0.370, p<0.001). There was a significant difference between NPA and PFV blur, as well as NPC and PFV break (p=0.000), emphasizing the importance of incorporating all three tests in a binocular vision assessment.

Conclusion: These results emphasize the necessity for complete binocular vision assessment to effectively diagnose and manage binocular vision anomalies. By accounting for the various parameters involved in this investigation, clinicians can enhance the precision and quality of their assessments and plan for appropriate treatment strategies for patients with binocular vision anomalies.

Keywords: Near Point of Accommodation (NPA), Near Point of Convergence (NPC), Positive Fusional Vergence (PFV), Binocular vision assessment

INTRODUCTION:

The visual system is a complex interplay of various components that work harmoniously to facilitate clear

and comfortable vision. Visual efficiencies like accommodation and Vergence play crucial roles in maintaining binocular vision¹. Therefore, understanding the relationship between various parameters used in assessing visual efficiency is essential for diagnosing and managing binocular vision anomalies effectively.

In the bustling urban landscape of Bengaluru, which is considered the IT hub where rapid industrialization and technological advancements characterize the environment, young adults often engage themselves in activities that demands visual efficiency². However, in mass screening initiatives like camp-screenings and in hospital-based outpatient departments (OPD), conducting comprehensive assessments of binocular vision can be challenging and time-consuming³. In response to this challenge, it is understood that there is a need to understand if the array of tests used for binocular vision assessment can be streamlined to alleviate time constraints.

Therefore, this manuscript presents a comparative analysis of two fundamental aspects of binocular vision: Near Point of Accommodation (NPA) and Near Point of Convergence (NPC) with Positive Fusional Vergence (PFV) among young adults in Bengaluru. By examining these parameters, we aim to understand if there are any potential correlations among the binocular vision assessment parameters and thus contributing to streamlining the diagnostic protocols so that individuals with binocular vision abnormalities are not overlooked, thereby enabling appropriate treatment interventions.

METHODOLOGY:

A retrospective study was conducted at Sankara Eye Hospital in Bangalore to investigate correlation of binocular vision tests. The study was conducted among the young adults aged 18 to 35. The study focused on patients who underwent binocular vision assessment in the vision therapy clinic between 2016 and 2020.

Data collection involved accessing hospital medical records to recognize eligible patients post permission from hospital authority, medical record department and head of the respective department. Over the study period from January 2016 to December 2020, a total of 101,896 patients visited Sankara Eye Hospital, Bangalore. Among them, 3,449 individuals required evaluation at the vision therapy clinic. Patients were included in the study based on inclusion criteria, which comprised age range, participation in binocular vision assessments and diagnosed as non-strabismic binocular vision anomalies (NSBVA) were considered for inclusion.

Therefore, those within normal limits (294 individuals) and those not meeting inclusion criteria (1,741 individuals) were excluded. A final dataset comprising 1708 observations was collected and analysed. The assessment of binocular vision involved several parameters, including visual acuity for distance and near vision. Additionally, dry retinoscopy, subjective refraction, and binocular vision assessments were also included. The values of Near Point of Accommodation (NPA), Near Point of Convergence (NPC), and Positive Fusional Vergence (PFV) were extracted from the collected data for further analysis. Subsequent analysis aimed to interpret potential correlations and contribute to the streamlining of diagnostic protocols for detecting and managing binocular vision anomalies among young adults in Bengaluru.

RESULTS:

Out of 1708 subjects whose data has been screened 759 subjects were Female and 949 subjects were male.

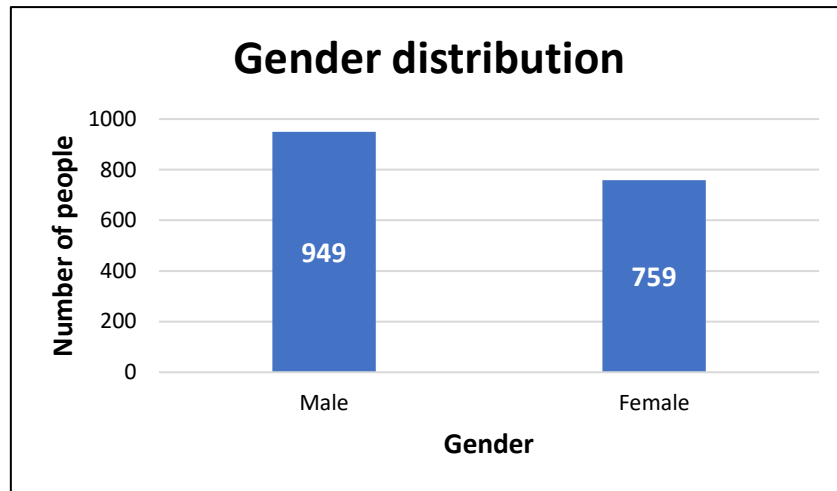


Figure 1: Gender distribution

The study aimed to investigate the relationships between Near Point of Accommodation (NPA), and Near Point of Convergence (NPC) with the blur and break values of Positive Fusional Vergence (PFV). There was a statistically significant positive correlation between NPA (in cm) and PFV blur value (converted to cm). This correlation was quantified using Spearman's rho with a coefficient of 0.069 ($p=0.004$). Therefore, this suggests that as NPA values increase, there is a corresponding increase in PFV blur value as well.

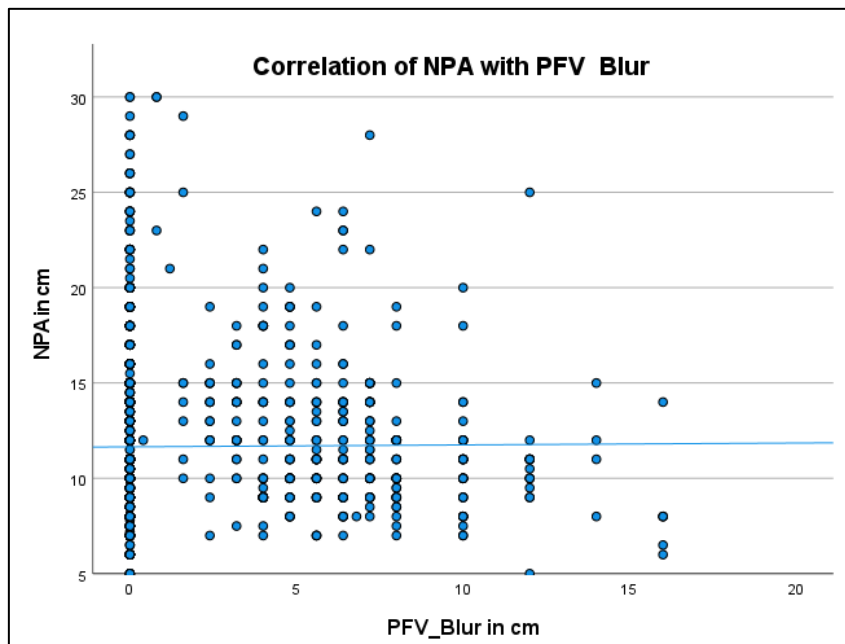


Figure 2: Correlation of Near Point of Accommodation (in cm) with Positive Fusional Vergence blur (in cm)

Similarly, the analysis also showed a statistically significant negative correlation between NPC (in meter

angle (MA)) and PFV break (in MA) with a Spearman rho coefficient of -0.370 ($p < 0.001$). This suggests that as NPC values decrease (i.e., closer to nose), there is a decrease in PFV break as well.

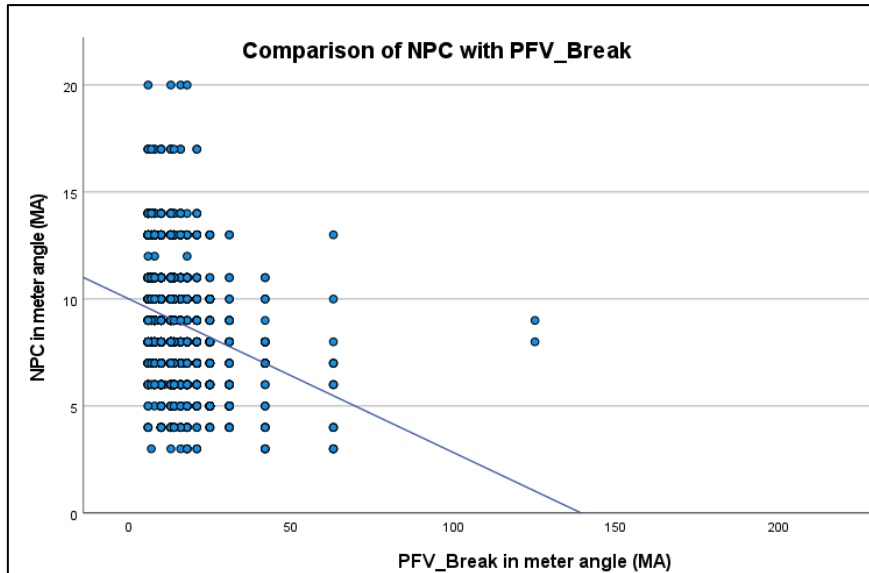


Figure 3: Correlation of Near Point of Convergence with Positive Fusional Vergence in meter angle(MA)

Additionally, the study found a statistically significant difference between NPA and PFV blur, as well as NPC and PFV break with Z values of -35.532 and -21.026 respectively with p-values of 0.000 further indicating the necessity to include and perform all the 3 tests as a part of binocular vision assessment for an appropriate diagnosis and management of an individual with binocular vision disorder.

Table 1: Comparison of Near Point of Accommodation (NPA) and Near Point of Convergence (NPC) with Positive Fusional Vergence (PFV):

Comparison of NPA, NPC with PFV		
Parameters	Z score	P value
NPA and PFV	-35.532	0.00
NPC and PFV	-21.026	0.00

DISCUSSION:

Many studies have explored the associations among various methods for assessing near point of accommodation which revealed a strong agreement between the push-up and push-down techniques⁴. Another study proved that dynamic retinoscopy yielded more consistent results as compared to the conventional push-up method⁵. Additionally, investigations into the correlations between near point of convergence (NPC), near heterophoria, and near fusional vergence in relation to myopia severity, as well as NPC in relation to age. However, as far as we are aware, there hasn't been any research examining the connection between near point of accommodation (NPA), near point of convergence (NPC), and positive fusional vergence (PFV).

In the current study, a comparison of Near Point of Accommodation (NPA) and Near Point of Convergence (NPC) with Positive Fusional Vergence (PFV) was carried out which provides vital understandings into the visual dynamics and probable clinical applications with the same. The findings of this study revealed a weak negative correlation between NPA, NPC, and PFV. This suggests that individuals with closer NPC Break values (in cm) may exhibit greater PFV Break (in prism diopter), and those with better accommodative ability, may have greater fusional reserves to blur. These findings align with previous research demonstrating the interdependence of NPA, NPC, and PFV in various populations. Studies by Scheiman and Wick (2008) and Borsting *et al.* (2003) have reported similar correlations between these parameters in young adult populations, stressing the importance of these parameters in assessing visual function across different demographic groups⁶⁻⁷.

Moreover, the implications of these findings outspread beyond research to clinical practice. Assessing NPA, NPC, and PFV can benefit in identifying individuals at risk of binocular vision dysfunction and in turn allowing appropriate interventions to improve visual efficiency and indeed the visual comfort as well⁸. Interventions such as vision therapy or corrective lenses tailor-made to address specific deficits in accommodation or vergence may be beneficial in optimizing vision⁹.

In conclusion, this study contributes to our understanding of the relationships between NPA, NPC, and PFV among young adults in Bengaluru, highlighting their significance in assessing the status of binocular vision and planning appropriate clinical management strategies. Further research exploring these correlations in diverse populations is necessary to enhance visual health in this demographic.

CONCLUSION:

The study concludes that there is a subtle negative association between NPA, NPC and PFV. This underscores the importance of employing all the tests to accurately evaluate accommodation and vergence parameters for the diagnosis of binocular vision anomalies. These findings emphasize the nuanced nature of visual assessments and advocate for a comprehensive approach to effectively diagnose and manage visual disorders.

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