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# Comparison of Near Lateral Heterophoria Examination Results Using Maddox Rod and Maddox Wing

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**Abstract:** Binocular vision provides single vision, stereopsis, and a large range of view for varied tasks. Binocular vision involves sensory and motor integration. Any disruption of these fusions causes heterophoria, a visual axis deviation. Untreated heterophoria can produce diplopia, eye discomfort, blurred vision, dizziness, and headaches. Maddox Wing and Maddox Rod procedures examine near lateral heterophoria. This quantitative-comparative study involves 376 pupils. Leprindo Jakarta Academy of Refraction Opticians students make up the Slovin formula sample 100. At the ARO Leprindo Jakarta campus, observational sampling meets the inclusion criteria. Women comprise 54% of the participants, while men comprise 46%. 85 participants (85%) are 17–25, while 2 (2%) are 31–40. Most subjects had N6 (85%) and N5 (15%) habitual near vision. According to Maddox Wing exams, 74% of individuals had exophoria, and 6% had orthophoria. Maddox Rod exams showed exophoria in 67 subjects (67%) and orthophoria in 14. Prism magnitude: Maddox Wing: 4–6 Δ BI in 30%, 7–10 Δ in 6%; Maddox Rod: 4–6 Δ BI in 22%, 1–3 Δ in 13%. According to this study, the Maddox Wing and Maddox Rod approach yield different near-lateral heterophoria findings. A paired sample t-test yielded a significance value of 0.145.

**Keywords:** ARO Leprindo; Maddox Rod; Heterophoria and Maddox Wing; Focuses Solely; Binocular Vision Capabilities; Exophoria and Distorted Image; Divergence Insufficiency.

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## 1. Introduction

The eyes are one of the human sensory organs, and they are vital in absorbing various visual information used for multiple activities. However, vision disorders remain a global health concern, especially issues related to binocular vision or vision involving both eyes, which is a significant problem. Binocular vision refers to seeing with both eyes and pertains to the unique

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characteristics of seeing with both eyes open compared to just one eye [1]. Binocular vision uses both eyes simultaneously to perceive a unified image, offering advantages such as depth perception, stereopsis, and a wider field of view. Binocular vision offers many advantages, including single vision, stereopsis, and a broader field of view. For binocular vision to occur, both eyes must align properly. Sensory and motor fusion mechanisms are responsible for this alignment. If sensory fusion is disrupted, motor fusion will also be affected, leading to a deviation of the visual axis. If motor fusion compensates for the deviation when the sensory fusion obstruction is removed, the deviation is latent, known as heterophoria [2]. Motor fusion compensates for visual axis deviations by aligning the eyes to maintain binocular vision when sensory fusion is restored, ensuring single and coordinated vision.

A clinical trial conducted on 1,679 subjects aged 18 to 38 years at the University of Valencia, Spain, showed a high prevalence of binocular vision disorders. Among the subjects, 56.2% experienced binocular dysfunction symptoms, with 8.1% having lateral heterophoria [3]. Individuals with binocular dysfunction often experience diplopia, blurred vision, eye strain, headaches, and dizziness, significantly impacting daily activities and quality of life. Heterophoria may not exhibit symptoms, but poorly controlled heterophoria can cause diplopia, eye pain, blurred vision, dizziness, and headaches. Esophoria and exophoria refer to lateral dissociation of the eyes, either inward or outward, from the fixation position when fusion is interrupted [4]. To assess heterophoria, fusion must be eliminated to achieve dissociation of both eyes, which can be done by distorting one image. Maddox Rod is a red or clear lens with parallel planoconvex cylinders. It is a dissociation test where the patient views a spotlight through the Maddox Rod with one eye. Meanwhile, Maddox Wing measures only near heterophoria by presenting independent objects to the patient to achieve dissociation [5]. The Maddox Rod is a diagnostic tool used to assess heterophoria and other binocular vision anomalies by inducing dissociation between the eyes through the presentation of a distorted image, typically a line of light. Given the different mechanisms between Maddox Wing and Maddox Rod, they naturally produce different measurements. This has prompted the author to research the Comparison of Near Lateral Heterophoria Examination Results Using Maddox Rod and Maddox Wing at ARO Leprindo.

### 1.1. Problem Formulation

Is there a significant difference in near lateral heterophoria examination results between Maddox Wing and Maddox Rod?

### 1.2. Problem Scope

This study is conducted at ARO Leprindo, focusing exclusively on comparing the results of near lateral heterophoria examinations using the Maddox Wing and Maddox Rod. By centering the research on these two diagnostic tools, the study aims to evaluate their effectiveness and identify any differences or similarities in measuring near lateral heterophoria.

### 1.3. Research Objectives

The general objective of this study is to gain insights into comparing near lateral heterophoria measurements using the Maddox Wing and Maddox Rod at ARO Leprindo in 2024. This comparison aims to understand better how these two diagnostic tools assess near-lateral heterophoria. The specific objective is to identify the factors that may influence the comparison of near lateral heterophoria measurements using the Maddox Wing and Maddox Rod at ARO Leprindo in 2024. By examining these influencing factors, the study seeks to determine the consistency, reliability, and potential discrepancies between the two methods, contributing to improved diagnostic accuracy in clinical practice.

### 1.4. Research Benefits

**Theoretical Benefits**: This research is anticipated to provide valuable benefits for researchers by enabling the practical application of theories and knowledge gained during academic studies. It offers an opportunity to bridge the gap between theoretical understanding and real-world implementation. Additionally, future researchers can build upon these findings by expanding the scope of the study and increasing the number of respondents, contributing to more comprehensive and generalized insights.

**Practical Benefits**: The research findings are expected to contribute significantly to educational development by serving as a valuable reference for students, enriching their academic understanding and practical knowledge. Additionally, this research aims to enhance public awareness by providing insights into the early recognition of symptoms or disorders related to binocular vision abnormalities, promoting better eye health within the community.

## 2. Literature Review

According to the Kamus Lengkap Bahasa Indonesia (Comprehensive Indonesian Dictionary), "comparison" derives from the word banding, which means similarity, and membandingkan refers to juxtaposing two things to identify their differences and similarities. Comparison is the analysis of similarities and differences [6]. Comparison is a research method that examines two or more objects to broaden and deepen understanding of the research subjects. Comparative analysis typically involves three essential stages. The first is the descriptive stage, where information is gathered to build a foundational understanding of the subject matter. This is followed by the classification stage, where the collected data is sorted into specific categories for better organization and clarity. Finally, the analytical stage involves examining the classified data to identify patterns and relationships between variables. This process provides valuable insights into different methodologies and the underlying reasons for their differences, offering a deeper understanding of the studied subject.

Heterophoria is an ocular deviation controlled when both eyes work together binocularly. Almost everyone has some degree of heterophoria, even individuals with emmetropic eyes. It can occur if one eye muscle is longer than the other or if there is nerve paralysis in one eye [7]**.** In this article, Evans and Lee [8] explain the concept of heterophoria as an ocular deviation that can be compensated by binocular vision mechanisms, where both eyes work together to produce a single vision. Heterophoria is generally a latent condition that is not always visible unless one eye is covered. Smith and Thompson [9] also discuss various types of heterophoria based on the direction of movement (lateral, vertical, and torsional) and its causes, such as structural, refractive, and neurogenic factors. This study highlights the importance of measuring heterophoria in diagnosing and monitoring patients' binocular vision capabilities. Heterophoria can be summarized as a latent deviation of the visual axis, which is usually compensated by fusion reflexes to achieve single binocular vision. However, when one eye is covered, the covered eye deviates.

## 3. Classifications of Heterophoria

**Based on causes:** Heterophoria can be categorized into three main types based on its underlying causes. Static heterophoria is determined by structural factors such as orbital geometry, muscle alignment, and gamma angles. It reflects inherent anatomical characteristics that influence eye positioning. Kinetic heterophoria, conversely, involves accommodation effects and refractive abnormalities, where the eye's focusing ability and vision correction need to play a crucial role. Lastly, neurogenic heterophoria is caused by nerve weakness or muscle incoordination, leading to misalignment due to impaired neuromuscular control. Understanding these categories helps in diagnosing and managing binocular vision disorders effectively.

**Based on Directional Movement:** Lateral phobia refers to a horizontal deviation in the alignment of the eyes, categorized based on the direction of misalignment. Orthophoria represents a parallel alignment of the visual axes, indicating no deviation. Esophoria occurs when there is an inward deviation, causing the eyes to tend towards the nose. In contrast, exophoria is characterized by an outward deviation, where the eyes drift away from the nose. These classifications help diagnose and manage binocular vision abnormalities (Figure 1).

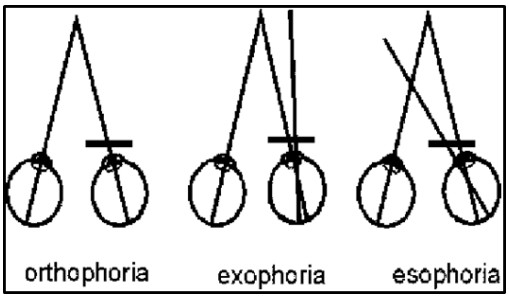


**Figure 1:** Lateral Heterophoria Diagram

**Vertical Phoria**: Vertical deviations:

- **Right/Left Hyperphoria:** One line of sight from the right or left eye is directed more upward than the other.
- **Right/Left Hypophoria:** One line of sight from the right or left eye is directed more downward than the other.

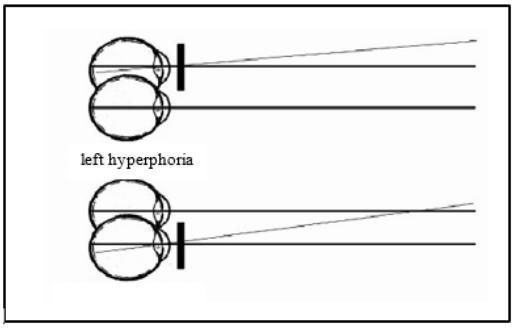


**Figure 2:** Hyperphoria Diagram

Torsion phobia refers to rotational deviations of the eyes. Extorsion occurs when the upper part of the eye rotates outward or temporally, while intorsion or torsion occurs when the upper part rotates inward or nasally (Figure 2). Levotorsion is observed when the upper part of the eye rotates to the subject's left, whereas dextrotorsion occurs when it rotates to the right. The measurement of heterophoria magnitude in both distance and near vision often shows significant differences due to the influence of convergence, which is accompanied by accommodation when focusing on near objects. Thus, the ability of binocular eye convergence during near and distant vision is a useful indicator for identifying symptoms of heterophoria. The relationship between these two aspects provides valuable insights into understanding and diagnosing torsional eye deviations. The relationship between near and distance vision can reveal different types of binocular vision disorders. In convergence insufficiency, exophoria is more pronounced during near vision than in distance vision, indicating difficulty maintaining proper eye alignment when focusing on close objects. Conversely, convergence excess is characterized by greater esophoria in distance vision than near vision, reflecting overactive convergence.

Divergence insufficiency presents as more significant esophoria in near vision, suggesting a struggle to diverge the eyes properly. On the other hand, divergence excess occurs when exophoria is more noticeable in distance vision than near vision, indicating difficulty maintaining alignment when viewing distant objects. These patterns help in diagnosing specific binocular vision disorders. From the explanation above, it can be concluded that vision with convergence or divergence insufficiency will experience heterophoria symptoms when viewing near objects. In contrast, vision with convergence excess or divergence excess will experience heterophoria symptoms when viewing distant objects. The assessment of heterophoria magnitude is important for evaluating an individual's ability to maintain fusion, thus achieving binocular vision. Prisms are used to compensate for eye misalignment. If the phone falls within the following parameters, the likelihood of symptoms caused by heterophoria is small (Table 1).

**Table 1:** The magnitude of phoria that can be compensated

| Jarak | Heterophoria | Besaran |
|---|---|---|
| 6 meter | Exophoria | < 12Δ BI |
| | Esophoria | < 6Δ BO |
| | Hyperphoria | < 2Δ BD |
| 40 cm | Exophoria | < 12Δ BI |
| | Esophoria | < 6Δ BO |
| | Hyperphoria | < 2Δ BD |

### 3.1. Maddox Wing Method

The Maddox Wing is an instrument designed for close-range heterophoria measurement. It employs independent visual objects for each eye to eliminate fusion incentives. The Maddox Wing is an instrument consisting of a black frame with a supporting handle, with a 30 cm distance from the back plate for the visual object in this test. This test is specifically used to measure heterophoria during near fixation. This instrument is designed so that the right eye focuses on an object with a white vertical arrow and a red horizontal arrow. In contrast, the left eye focuses on a series of horizontal and vertical numbers. The instrument is placed on the surface of the nose, with both eyes viewing through the eyepiece. The patient's right eye sees the white arrow, and the left eye sees the arrows (Figure 3).

**Figure 3:** Maddox Wing

The number on the scale traversed by the white arrow indicates the magnitude of horizontal heterophoria, while the numbers on the vertical series indicate the magnitude of vertical heterophoria. The Maddox Wing measures near heterophoria by presenting independent objects to the patient to induce deviation, as the objects are similar, eliminating the fusion stimulus. The Maddox Wing method for measuring heterophoria offers both advantages and disadvantages. Its main advantages are simplicity and efficiency, making it a quick and practical tool for clinical use. However, it also presents notable disadvantages. The scale numbers on the Maddox Wing are relatively large, which may lead to improper eye accommodation. This can result in exaggerated exo deviations or diminished eso deviations. Additionally, the device is designed with a standard pupil distance, which may not match the actual pupil distance of individual patients, potentially affecting the accuracy of the measurements.

### 3.2. Examination Procedure

The patient should use optimal near refractive correction to achieve 6/6 vision to ensure accurate results. The room light and additional lighting for the Maddox Wing should be turned on to maintain proper illumination. The patient is instructed to look through the horizontal gap on the chart, which features horizontal and vertical scales and arrows. The right eye should focus on the arrows, while the left should focus on the scales. Initially, the arrows are positioned at zero on the scale, but any deviation from orthophoria will be revealed by the movement of the arrows along the scale due to dissociation. Some patients may find it challenging to see the arrows and scales simultaneously, requiring assistance in correctly positioning the instrument. If needed, it can be demonstrated that one eye perceives the arrows while the other sees the scale. If both elements are not visible simultaneously, suppression may be present, and additional testing should be performed. To measure horizontal heterophoria, the patient is asked, "What number does the white arrow indicate on the white scale?" The number indicated on the scale reflects the magnitude and direction of the deviation. Similarly, to measure vertical heterophoria, the patient is asked, "What number does the red arrow indicate on the red scale?" The scale's corresponding number shows the vertical deviation's magnitude and direction. This approach provides a reliable method for assessing both horizontal and vertical heterophoria.

### 3.3. Maddox Rod Method

Maddox Rod is a lens made of a set of planoconvex cylindrical lenses that are either red or clear. The Maddox lens is placed on one eye to create distortion, disrupting the fusion of both eyes and revealing symptoms of heterophoria (Figure 4).

**Figure 4:** Maddox Rod at Phoropter

The Maddox lens will refract light to form a perpendicular line from the direction of the Maddox lens. The patient will use the Maddox Rod in one eye, and a prism will be placed in the other to correct the occurring heterophoria [10]. Heterophoria examination using the Maddox Rod method can be performed through a phoropter with Maddox features and rotary prism accessories (Figure 5).

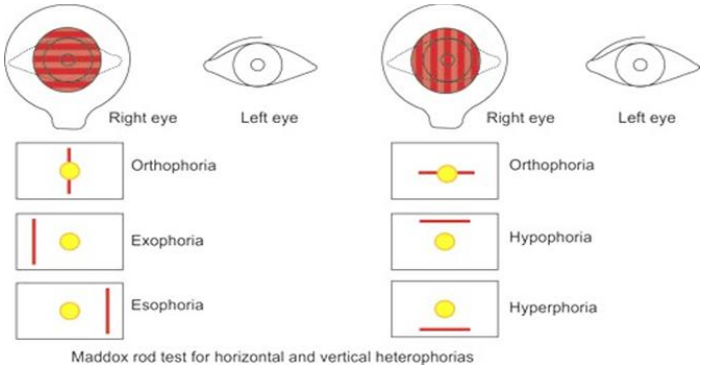


**Figure 5:** Method Maddox Rod Diagram

The Maddox Rod method for measuring heterophoria offers several advantages and disadvantages. One of its key advantages is its versatility, as it can be easily used with a phoropter, trial frame, or the patient's glasses. Additionally, it is a widely recognized and commonly used method among optometrists. However, there are some drawbacks. Some doctors believe that the light used in this method can negatively impact eye accommodation, potentially affecting the accuracy of the results. It is also considered more effective when applied to patients with limited accommodation ability, such as those with presbyopia.

## 4. Examination Procedure

### 4.1. Method for measuring horizontal deviation

The room lights should be dimmed during the clinical test, allowing only one visible light source to create an ideal testing environment. For near testing, the patient is instructed to focus on the light source positioned at a distance of 33 cm at eye level. In distant testing, the focus is shifted to a light source 6 meters away. The patient must focus on the light source throughout the procedure with both eyes open. The Maddox rod is then placed over the eye that is being tested. For measuring horizontal deviation, the rod is positioned in front of the right eye (tested on both eyes) with a horizontal cylinder, causing the red line to appear vertical. The patient is then asked to report whether the white light overlaps with the red line or appears to the left or right of it. If the patient perceives the red line to the right and the white light to the left, this indicates esotropia or esophoria (uncrossed diplopia). In such cases, base out (BO) prisms with gradually increasing strength are used until the red line aligns with the light. Conversely, if the patient sees the red line to the left and the white light to the right, it suggests exotropia or exophoria (crossed diplopia). In this situation, base in (BI) prisms with increasing strength are applied until alignment is achieved. This process helps accurately determine the type and extent of horizontal deviation in the patient's binocular vision.

### 4.2. Method for Measure Vertical Deviation

The Maddox rod is positioned in front of the patient's right eye with a vertical cylinder, causing the red line to appear horizontal. The patient is then instructed to observe whether the white light passes through the red line or appears above or below it. If the red line is perceived below the white light, it indicates a hyper-deviation and a base-down prism is applied to measure and correct the deviation. Conversely, if the red line appears above the white light, it signifies a hypo-deviation and a base-up prism is used for measurement and correction. If the white light passes directly through the red line, it confirms the absence of any vertical deviation. This method effectively helps diagnose and quantify vertical ocular misalignments.

### 4.3. Hypothesis

The research hypothesis is an initial assumption or temporary answer to the research question formulated in the research plan. After being tested through the research results, the hypothesis can be proven true or false, accepted or rejected. Statistical tests are used to verify the truth of this hypothesis [11]. Based on the variables, background, and theoretical framework in this study, the hypothesis formulated by the researcher is as follows:

- **H0:** There is no significant difference between the Maddox Wing and Maddox Rod methods in examining near-lateral heterophoria.
- **H1:** There is a significant difference between the Maddox Wing and Maddox Rod methods in examining near-lateral heterophoria.

## 5. Methodology

**Type of Research:** In this study, the researcher uses a comparative strategy with a quantitative approach. The comparative method is a type of research that compares the presence of one or more variables in two or more different samples. Quantitative research is a research method based on the philosophy of positivism, used to study a certain population or sample, aiming to describe and test the hypotheses that have been formulated [12]. This study uses only independent variables. The variables are defined as objects related to other objects in the research. Independent variables (free variables) influence or cause changes or the emergence of dependent variables [13].

**Research Location and Time:** The research will take place at the Academy of Optometry Refraction Leprindo, located in Ciputat Molek Selatan Block F No. 1C, Pisangan Village, Ciputat Timur District, South Tangerang City, Banten Province. The study is scheduled to be conducted from February 2024 to May 2024.

### 5.1. Population and Sample

**Population:** The population refers to the entire set of elements that will be the basis for generalization, consisting of objects or subjects with specific quantities and characteristics determined by the researcher to be studied [14]. This study's population comprises 376 students from the Leprindo Optometry Refraction Academy in Jakarta.

**Sample:** A sample is a part of the quantity and characteristics of the research population [15]. To determine the sample size in this study, Slovin's formula is used with a 10% margin of error to account for sampling errors. The Slovin's formula for determining the sample size is as follows:

$$n = \frac{N}{1 + Ne^2}$$

n = Sample size
N = Population size
e = Margin of error (10%)

The sample calculation using Slovin's formula is as follows:

Sample calculation:

$$n = \frac{376}{1 + 376\ (10\%)^2}$$

$$n = \frac{376}{4{,}76} = 78{,}9 \sim$$

The sample for this study consists of 100 students from the Leprindo Optometry Refraction Academy in Jakarta who are willing to undergo lateral near heterophoria examination.

### 5.2. Data Source

In this study, the researcher uses primary data sources. Primary data refers to original data collected directly by the researcher using prepared research instruments [16]. The primary data in this study are obtained directly from the results of the examination and observation of the respondents.

### 5.3. Sampling Technique

**Observation Technique:** The sampling technique employed in this study is the observation technique, which involves direct observation and recording of results. This method allows data collection by closely monitoring the subject or activity under study. There are two main types of observation used in this approach. Participatory observation involves the observer actively participating in the activity, such as attending meetings or training sessions as a participant. In contrast, non-participatory observation requires the observer to remain uninvolved, simply observing the activity unfolding without direct participation. Concerning observation in quantitative research, the researcher prepares a detailed guideline for conducting observations and uses a checklist. It is necessary to consider including an assessment on a scale as ordinal data. Observation is conducted because it is useful to support the research. Observation is highly beneficial in strengthening the data obtained from other techniques.

This study uses the observation technique intended to reinforce the data collected. This study uses a structured observation technique guided by an organized instrument. The observation in this study is focused solely on measuring and recording the results using two lateral near heterophoria examination methods. During the research process, the observation is also used to assess the respondents' responses, i.e., students from ARO Leprindo. Several factors, including the researcher's and the respondents' skills, can influence this.

**Purposive Sampling:** This study also uses the purposive sampling technique. Purposive sampling is a method of selecting samples based on specific criteria. This means that the sample is chosen based on considerations or specific criteria that have been established beforehand by the researcher [17], which include:

**Inclusion Criteria:** The study's respondents include ARO Leprindo students with habitual near vision, both monocular and binocular, measuring N5 and N6 at a distance of 40 cm. Additionally, participation is limited to students who willingly consent to be respondents in the study.

**Exclusion Criteria:** The exclusion criteria for this study consist of ARO Leprindo students whose habitual near vision, whether monocular or binocular, is not equal to N5 and N6 at 40 cm. Additionally, students unwilling to participate as respondents are excluded from the study.

**6. Data Analysis**

**Normality Test:** The normality test is a test that aims to identify whether, in a regression model, the disturbance variable or residual follows a normal distribution or not [18]. Normality in this study is tested using the Kolmogorov-Smirnov test, processed with SPSS version 25 [19].

**Comparative Statistical Test:** The comparative statistical or comparison test compares or observes the differences between two variables. In this study, a test will be conducted on the results of two different methods but from the same respondents. The comparative or comparison test that will be used to determine the hypothesis of this study is between the parametric statistical test, the paired sample t-test, or the non-parametric statistical test, Wilcoxon. These two tests have roughly the same function and purpose but are used for different data types. If the normality test results show that the data is normally distributed, the parametric statistical test and paired t-test will be used. On the other hand, if the data is not normally distributed, Wilcoxon will be used as the non-parametric statistical test (Table 2).

**Table 2:** Operational Definitions

| Variable | Definition | Dimension | Indicator | Tools measurement | summarize | Scale |
|---|---|---|---|---|---|---|
| **Independent Variable** | | | | | | |
| Heterophoria | Heterophoria is a deviation of the eyes that can be corrected with binocular vision. | Near Lateral Heterophoria | Near Lateral Heterophoria | Maddox Wing Maddox Rod | 1 = Orthopria 2 = Exophoria 3 = Esophoria | Ordinal |

The research findings indicate that out of 100 respondents, the majority were female, accounting for 54 individuals (54%), while the remaining 46 individuals (46%) were male. In terms of age distribution, most respondents were within the 17–25 age group, totalling 85 individuals (85%), followed by 13 individuals (13%) in the 21–30 age group and two individuals (2%) in the 31–40 age group. This demographic breakdown highlights a predominantly younger participant population. Regarding near habitual visual acuity measurements, the most commonly recorded value was N5 @40 cm, observed in 85 individuals (85%), while N6 @40 cm was recorded in 15 individuals (15%). These findings suggest that the majority of respondents had relatively good near-visual acuity.

Lateral near phoria measurements using the Maddox Wing revealed that exophoria was the most prevalent condition, identified in 74 individuals (74%). This was followed by esophoria, observed in 20 individuals (20%), while Orthophoria was the least common, found in six individuals (6%). These results provide valuable insights into the distribution of binocular vision anomalies within the study population.

**Table 3:** Distribution of Prism Magnitudes with Maddox Wing

| Phoria Lateral Dekat | Besaran Prisma | Jumlah Reponden |
|---|---|---|
| Esophoria | 1-3 Δ BO | 12 |
| | 4-6 Δ BO | 4 |
| | 7-10 Δ BO | 3 |
| | >10 Δ BO | 1 |
| Exophoria | 1-3 Δ BI | 29 |
| | 4-6 Δ BI | 30 |
| | 7-10 Δ BI | 6 |
| | >10 Δ BI | 9 |

Table 3 shows the research results for esophoria show that 12 individuals had 1-3 Δ BO, four individuals had 4-6 Δ BO, three individuals had 7-10 Δ BO, and one individual had >10 Δ BO. Meanwhile, for respondents with exophoria, 29 individuals had 1-3 Δ BI and 30 individuals.

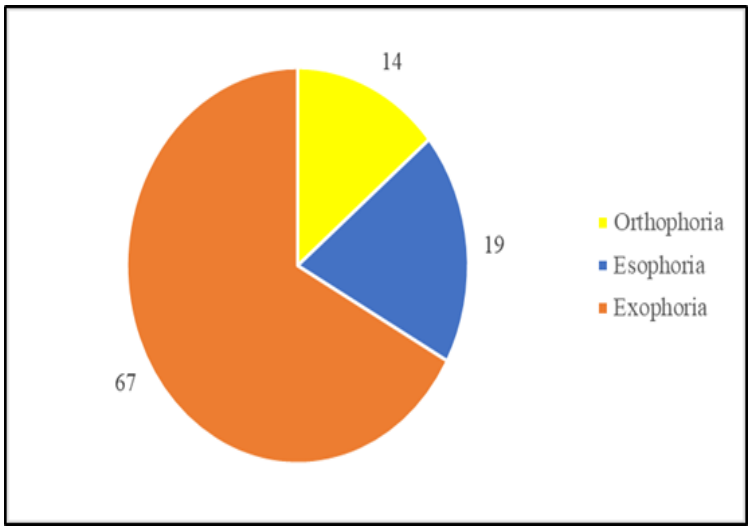


**Figure 6:** Results of Maddox Rod Examination

Based on Figure 6, the lateral near phoria measurements using the Maddox Rod showed that 14 respondents had orthophoria, 19 had esophoria, and 67 had exophoria.

**Table 4:** Prism Size Distribution with Maddox Rod

| Phoria Lateral Dekat | Besaran Prisma | Jumlah Responder |
|---|---|---|
| Esophoria | 1-3 Δ BO | 4 |
| | 4-6 Δ BO | 7 |
| | 7-10 Δ BO | 4 |
| | >10 Δ BO | 4 |
| Exophoria | 1-3 Δ BI | 13 |
| | 4-6 Δ BI | 22 |
| | 7-10 Δ BI | 18 |
| | >10 Δ BI | 14 |

Based on Table 4, for respondents with esophoria, there were four individuals with 1-3 Δ BO prism, seven individuals with 4-6 Δ BO prism, four individuals with 7-10 Δ BO prism, and four individuals with >10 Δ BO prism. For respondents with exophoria, there were 13 individuals with 1-3 Δ BI prism, 22 individuals with 4-6 Δ BI prism, 18 individuals with 7-10 Δ BI prism, and 14 individuals with >10 Δ BI prism.

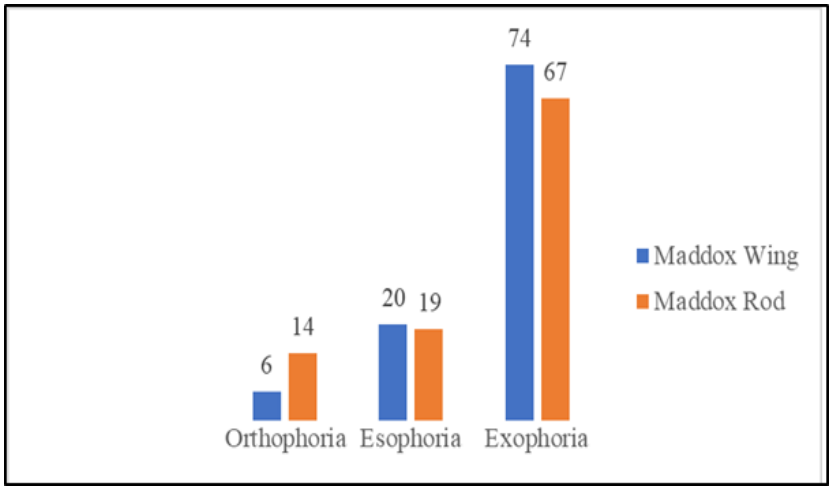


**Figure 7:** Results of Maddox Wing vs. Maddox Rod Examination

Based on Figure 7, in the case of orthophoria, six individuals were found using the Maddox Wing measurement and 14 individuals using the Maddox Rod measurement. In the case of esophoria, 20 individuals were found using the Maddox Wing measurement and 19 individuals using the Maddox Rod measurement. In the case of exophoria, 74 individuals were found using the Maddox Wing measurement and 67 individuals using the Maddox Rod measurement.

**Table 5:** Prism Distribution of Maddox Wing and Maddox Rod

| Phoria Lateral Dekat | Besaran Prisma | Jumlah Responden | |
|---|---|---|---|
| | | Maddox Wing | Maddox Rod |
| Esophoria | 1-3 Δ BO | 12 | 4 |
| | 4-6 Δ BO | 4 | 7 |
| | 7-10 Δ BO | 3 | 4 |
| | >10 Δ BO | 1 | 4 |
| Exophoria | 1-3 Δ BI | 29 | 13 |
| | 4-6 Δ BI | 30 | 22 |
| | 7-10 Δ BI | 6 | 18 |
| | >10 Δ BI | 9 | 14 |

Based on Table 5 above, in the case of esophoria, 12 individuals were found from the Maddox Wing measurement, and four individuals from the Maddox Rod measurement for the 1-3 Δ BO prism. Four individuals were found from the Maddox Wing measurement and seven from the Maddox Rod measurement for the 4-6 Δ BO prism. Three individuals were found from the Maddox Wing measurement and four from the Maddox Rod measurement for the 7-10 Δ BO prism. One individual was found from the Maddox Wing measurement, and four individuals from the Maddox Rod measurement for the >10 Δ BO prism.

Meanwhile, in the case of exophoria, 29 individuals were found from the Maddox Wing measurement and 13 individuals from the Maddox Rod measurement for the 1-3 Δ BI prism. Thirty individuals were found from the Maddox Wing measurement and 22 from the Maddox Rod measurement for the 4-6 Δ BI prism. Six individuals were found from the Maddox Wing measurement and 18 individuals from the Maddox Rod measurement for the 7-10 Δ BI prism. Nine individuals were found from the Maddox Wing measurement and 14 individuals from the Maddox Rod measurement for the >10 Δ BI prism.

### 6.1. Method with Dominant Heterophoria

Based on the data, it was found that 47 individuals had larger heterophoria with the Maddox Rod method, 41 individuals had larger heterophoria with the Maddox Wing method, and 12 individuals showed no difference between the two methods (Table 6).

**Table 6:** Difference in Results Between Maddox Wing and Maddox Rod Examinations

| Besaran Selisih | Jumlah Reponden |
|---|---|
| 1-3 Δ | 44 |
| 4-6 Δ | 19 |
| 7-10 Δ | 15 |
| >10 Δ | 9 |

Based on the results of the difference between Maddox Wing and Maddox Rod, 44 individuals had a difference of 1-3 Δ, 19 individuals had a difference of 4-6 Δ, 15 individuals had a difference of 7-10 Δ, and nine individuals had a difference of >10 Δ.

### 6.2. The Normality Test

The normality test aims to determine whether the data in the research variables follow a normal distribution. In this study, the normality test will use the non-parametric Kolmogorov-Smirnov method because the sample size of the variables is greater than 50 (Table 7). The decision-making criteria in the normality test can be based on the significance value with the following conditions:

- The data is normally distributed if the significance value (sig.) > 0.050.
- If the significance value (sig.) < 0.050, the data is not normally distributed.

**Table 7:** Kolmogorov-Smirnov Normality Test Results

| One-Sample Kolmogorov-Smirnov Test | | |
|---|---|---|
| | | Unstandardized Residual |
| N | | 100 |
| Normal Parameters[a,b] | Mean | .0000000 |
| | Std. Deviation | 4.39332774 |
| Most Extreme Differences | Absolute | .106 |
| | Positive | .092 |
| | Negative | -.106 |
| Test Statistic | | .106 |
| Asymp. Sig. (2-tailed) | | .007[c] |
| **Exact Sig. (2-tailed)** | | **.194** |
| Point Probability | | .000 |

The results of the normality test show that the significance value is 0.194, which is greater than 0.05. Therefore, it can be concluded that the data in this study are normally distributed.

### 6.3. T-Test Comparatif

Based on the previous test, it was found that the data are normally distributed. Therefore, the next statistical test conducted was the paired t-test. The paired t-test compares the results of two methods on the same group of respondents. The decision-making criteria for the paired t-test are as follows:

- There is a significant difference if the significance value (sig.) < 0.050.
- There is no significant difference if the significance value (sig.) > 0.050.

**Table 8:** Test result Paired Sample Correlations

| Paired Samples Correlations | | | | |
|---|---|---|---|---|
| | | N | Correlation | Sig. |
| Pair 1 | MR & MW | 100 | .615 | .000 |

Based on the results (Table 8), the correlation value between the Maddox Wing and Maddox Rod examinations from the 100 samples studied was above 0.05. It can be concluded that there is a difference between the two methods examined.

**Table 9:** Paired Sample Test Results

| Paired Samples Test | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | MR - MW | -.070 | .477 | .048 | -.165 | .025 | - 1.468 | 99 | .145 |

Based on Table 9 above, the significance value from the paired sample t-test results is 0.145 > 0.05. It can be concluded that there is a significant difference between the Maddox Wing and Maddox Rod methods in the lateral near phoria examination.

## 7. Conclusion

This study involved 100 respondents, comprising 45 males and 54 females. In the near lateral heterophoria examination using the Maddox Wing, 74 respondents were found to have exophoria, 20 had esophoria, and 6 had orthophoria. Meanwhile, in the Maddox Rod examination, 67 respondents showed exophoria, 19 had esophoria, and 14 had orthophoria. The results of the paired sample test showed a significance value greater than 0.05, specifically 0.145. Based on the data analysis, it can be concluded that there is a significant difference between the Maddox Wing and Maddox Rod methods in near lateral heterophoria examination. This difference may be attributed to several factors, including Different examination distances: The Maddox Wing uses a distance of 33 cm, while the Maddox Rod uses 40 cm, resulting in different accommodation levels and, thus, different phoria outcomes—unidentified refractive errors in the study, such as variations in the refractive measurements of the eyes. Based on the research results and conclusions, the researcher provides suggestions for the parties involved in this study as well as for future researchers conducting similar studies, as follows: For Institutions, the research findings are expected to contribute to the development of the educational field and serve as a useful reference for students in the academic literature. This study is expected for the community to enhance public understanding of binocular vision, particularly heterophoria. It is hoped that the knowledge gained will raise awareness of the importance of binocular vision examinations. For Future Researchers The researcher hopes that future studies will explore different binocular vision disorders and include conditions other than heterophoria. Additionally, future research is encouraged to investigate other variables related to determining the status of binocular vision disorders.

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