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ORIGINAL ARTICLE

Measuring the heterophoria: Agreement between two methods in non-presbyopic and presbyopic patients

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KEYWORDS
Heterophoria;
Von Graefe method;
Cover test;
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Abstract
Purpose: To establish whether the cover test and von Graefe methods are interchangeable in a non-presbyopic and presbyopic population.
Methods: We performed a prospective study on a sample of 127 non-presbyopic subjects between 20 and 45 years old and 56 presbyopic between 40 and 78 years old. Distance and near vision phoria were measured using the von Graefe method (VG) and cover test (CT). We analyzed the significant differences between methods, their correlation and the agreement between them using the Bland and Altman method.
Results: For distance vision, heterophoria values for non-presbyopic subjects were $-0.61 \pm 1.86\Delta$ with CT and $-0.88 \pm 2.37\Delta$ with VG, and for presbyopic subjects were $-0.56 \pm 1.64\Delta$ with CT and $-0.85 \pm 1.94\Delta$ with VG. For near vision, CT yielded $-3.02 \pm 3.97\Delta$, while VG achieved $-3.49 \pm 4.70\Delta$ in non-presbyopic subjects. For presbyopic subjects these values were $-6.05 \pm 4.38\Delta$ with CT and $-6.29 \pm 4.19\Delta$ with VG, respectively. Statistically significant differences between the two methods were observed for all groups analyzed ($p < 0.05$), except for near vision in presbyopic subjects ($p > 0.05$). Coefficient of agreement for non-presbyopic was $\pm 2.97\Delta$ for distance vision and $\pm 6.74\Delta$ at near. For presbyopic patients, this coefficient was $\pm 1.59\Delta$ for distance and $\pm 1.86\Delta$ for near vision.
Conclusion: Cover test and von Graefe methods have a high level of agreement for both distance and near vision when considering presbyopic subjects. For non-presbyopic patients, the level of agreement is very low. Both methods for measuring heterophoria can only be considered interchangeable for presbyopic patients. For clinical purposes, this implies that any method can be used for measuring heterophoria in presbyopic patients.

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PALABRAS CLAVE
Heteroforia;
Método de von Graefe;
''Cover test'';
Presbicia

Medición de la heteroforia: concordancia entre dos métodos en pacientes sin y con presbicia

Resumen
Objetivo: Establecer si el ''cover test'' y el método de von Graefe son intercambiables en la población sin y con presbicia.
Métodos: Realizamos un estudio prospectivo en una muestra de 127 sujetos sin presbicia de edades comprendidas entre 20 y 45 años, y 56 sujetos con presbicia de entre 40 y 78 años de edad. Se midieron la foria de cerca y lejos utilizando el método de von Graefe (VG) y el cover test (CT). Analizamos las diferencias significativas entre ambos métodos, así como la correlación y concordancia entre ambos utilizando el método de Bland & Altman.
Resultados: Para la visión de lejos, los valores de heteroforia para los sujetos sin presbicia fueron de -0,61 ± 1,86Δ con CT y de -0,88 ± 2,37Δ con VG y, para los sujetos con presbicia, de -0,56 ± 1,64Δ con CT y de -0,85 ± 1,94Δ con VG. Para la visión de cerca, los valores de CT fueron de -3,02 ± 3,97Δ, mientras que los valores de VG fueron de -3,49 ± 4,7Δ en sujetos sin presbicia. Para los sujetos con presbicia, los valores fóricos fueron de -6,05 ± 4,38Δ con CT y de -6,29 ± 4,19Δ con VG. Se observaron diferencias estadísticamente significativas entre los dos métodos para todos los grupos analizados ($p < 0,05$), excepto para la visión de cerca en sujetos con presbicia ($p > 0,05$). El coeficiente de concordancia para los sujetos sin presbicia fue de ±2,97Δ para la visión de lejos, y de ±6,74Δ para la de cerca. Para los pacientes con presbicia, dicho coeficiente fue de ±1,59Δ para la visión de lejos, y de ±1,86Δ para la de cerca.
Conclusión: El ''cover test'' y el método de von Graefe tienen un alto nivel de concordancia para la visión de lejos y cerca, en relación a los sujetos con presbicia. Para sujetos sin presbicia, el nivel de concordancia es muy bajo. Ambos métodos de medición pueden intercambiarse para medir la heteroforia únicamente en pacientes con presbicia. A efectos clínicos, esto implica que puede utilizarse cualquiera de los dos métodos para medir la heteroforia en pacientes con presbicia.

Introduction

Under normal visual conditions, the interaction between the accommodative and vergence systems allows us to see objects focused and fused, allowing the balance of patient's visual function. If an anomaly is present in any of both systems, the operation of the other can be significantly affected, emerging the accommodative and binocular dysfunctions.[1,2] To diagnose these binocular disorders, it is essential to know the patient's heterophoria, both distance and near, as an important part of any ocular examination for the management of accommodative and vergence disorders.

There are several ways to measure heterophoria, including the cover test (CT) and the von Graefe method.[3–11] Several studies have shown that each test presents different constraints that must be taken into account when administered. Some authors have shown that the minimum detectable ocular deviation in the cover test is two prism diopters (Δ). However, an experienced examiner is able to detect smaller differences.[12,13] Indeed, although the heterophoria measurement by the CT depends largely on the skill of the examiner to detect eye movements, it has been found that the alternating CT using prism neutralization provides excellent repeatability, both within and between examiners.[3,14–18] It has also been shown to be a reliable measure even when examiners are inexperienced.[19] On the other hand, the technique usually used in clinical practice by several authors is the von Graefe method, which is a subjective test that depends on the subject's response. Several studies on the repeatability of this test compared with other techniques have shown that the von Graefe method is less repeatable than other methods such as the modified Thorington test or the CT.[3,8,10,11,17,18,20]

Some authors have shown that the CT tends to yield lower heterophoria values than the von Graefe method,[21] whilst others have reported that the von Graefe method yields higher esophoric values than the cover test.[22] Antona et al.[17] and Cebrián et al.[18] showed that the difference between CT and von Graefe method increases as mean horizontal phoria increases, both for distance and near vision for non-presbyopic subjects.

Few studies have analyzed the level of agreement between both methods to consider them interchangeable. Antona et al.[17] obtained an excessively high coefficient of agreement between CT and von Graefe for both distance and near vision for non-presbyopic subjects. Recently, Cebrián et al.[18] have obtained similar results, showing the poor level of agreement between both methods, although they only studied distance vision for non-presybyopic subjects. However, it has not been proven at date if this poor agreement should also be established in a presbyopic population. In fact, most of the available information about heterophoria

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