Nott and MEM dynamic retinoscopy: Can they be used interchangeably?

Turki AlMubrad, Kelechi C. Ogbuehi

Department of Optometry, College of Applied Medical Sciences, Riyadh, Kingdom of Saudi Arabia

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Corresponding author:
Turki AlMubrad, PhD
Department of Optometry
College of Applied Medical Sciences
P.O. Box 10219
Riyadh 11433
Kingdom of Saudi Arabia
Phone: +966 1 4358479
Fax: +966 1 2741694
E-mail: Turkimm@hotmail.com

Abstract

Introduction: Previous studies suggest that monocular estimate method (MEM) and Nott retinoscopy yield identical results in the assessment of the accommodative lag. However, two recent studies suggested that the accommodative lag measured with MEM retinoscopy is twice that with Nott. This study was designed to re-evaluate the agreement of MEM and Nott retinoscopy techniques.
Material and methods: One hundred and thirty (130) subjects aged between 18 and 30 years (22±3 years – mean ±SD), with no history of contact lens wear, ocular and systemic disease or ocular surgery, participated in the study. Nott and MEM Retinoscopy were used to assess the lag of accommodation through the Corrected Ametropia Most Plus (CAMP) subjective refraction at 40 cm.
Results: The mean difference between both sessions for Nott retinoscopy was 0.01±0.1 D (mean ±SD). The mean difference between both sessions for MEM retinoscopy was – 0.002±0.11 D (mean ±SD). The mean difference between Nott and MEM dynamic retinoscopy was 0.01±0.13 D (mean ±SD) with 95% limits of agreement ranging between +0.26 and -0.25 D. For both Nott and MEM, there was no significant difference (P>0.05) of the measured lag between the four measurement sessions and no significant difference (P>0.05) was found between both methods.
Conclusions: We conclude that in normal healthy subjects with normal accommodative and binocular function, MEM and Nott dynamic retinoscopy techniques may be used, interchangeably, to assess the lag of accommodation at 40 cm.

Key words: Nott retinoscopy, MEM retinoscopy, accommodative lag, dynamic retinoscopy, accommodation.

Introduction

For objects at distance, the normal emmetropic (or fully corrected Ametropic) pre-presbyopic eye remains in an over-accommodated state and relies on the depth of focus to see these distance objects clearly [1]. For objects close to the eye however, the eye consistently under-accommodates – by 0.50 to 0.75D [2] – to bring these targets into clear focus, a phenomenon referred to as an accommodative lag. The accommodative lag increases as the target distance from the eye decreases. An unusually large lag of accommodation in the emmetropic or fully corrected ametropic eye is indicative of the presence of an accommodative dysfunction. The assessment of the accommodative response is therefore important for the diagnosis of certain types of accommodative dysfunction.

The accommodative response may be assessed by subjective or objective techniques.

The subjective techniques include the dynamic cross cylinder and near red-green duochrome tests. Objective techniques include dynamic retinoscopy techniques (Nott retinoscopy and MEM retinoscopy) and open-field autorefractometry.

Open-field autorefractometry is now the method of choice for the objective assessment of the accommodative response and it has been demonstrated to be accurate and reliable in children and adults [3-4]. However, dynamic retinoscopy also provides a quick objective assessment of accommodative response in the clinical setting and it has been shown to be comparable, in its assessment of accommodative response, to open-field autorefractometry [5-6].

A number of clinical studies provide data on the accuracy and reliability of dynamic retinoscopy techniques. Locke and Somers (1989) compared 4 techniques including Nott and MEM, and concluded that Nott, MEM and Cross retinoscopy could be used interchangeably to assess the accommodative response of young adult subjects [7].

Rosenfield et al. (1996) reported an agreement of ±0.65D between the Nott dynamic retinoscopy and an open-field autorefractometer, compared with an agreement of ±0.91 D between the open-field autorefractometer and a technique similar to MEM [6].

In a study of 41 subjects covering a wide age range from juveniles to presbyopes, McClelland and Saunders (2003) found that Nott dynamic retinoscopy was accurate and reliable when compared to an open-field autorefractometer [5]. Both techniques demonstrated good repeatability (reliability) at the three target distances tested and there was good agreement between both techniques for two out of the three target distances.

Two earlier studies reported poor agreement between the MEM retinoscopy and Nott retinoscopy in visually normal subjects [8] and in subjects with disorders of vergence and accommodation [9], such that the accommodative lag measured with the MEM retinoscopy was approximately twice that measured with the Nott retinoscopy.

The purpose of this study was first to re-evaluate the findings of Cacho et al. (1999) [8] not just by assessing the agreement between MEM and Nott, but also by assessing the repeatability for each technique to help identify the source of any discrepancy between the accommodative lags measured by both techniques.

Material and methods

The subjects used for this study were 130 subjects selected from an Optometry clinic in Riyadh, Saudi Arabia, whose ages ranged from 18 to 30 years (22±3 – mean ±SD). Only the right eye of each subject was assessed for the accommodative lag.

All subjects had a negative history for ocular dysgenesis, ocular and systemic disease and ocular surgery. None of the subjects had a history of contact lens wear. A comprehensive optometric exam was carried out on each patient to rule out accommodative or binocular dysfunction. Eighteen subjects were excluded from the study due to different oculo-visual abnormalities. Informed consent was obtained from each subject before the measurements were carried out and the study was carried out in strict conformance to the tenets of the 1964 Declaration of Helsinki (as modified in Edinburgh 2000).

All subjects had a best corrected acuity of 20/20 or better and Nott and Monocular Estimate Method (MEM) Retinoscopy were used to assess the lag of accommodation through the Corrected Ametropia Most Plus (CAMP) subjective refraction which, in cases where this prescription varied significantly from the subject's habitual correction, was prescribed for the subject at least one month before the assessment of the accommodative lag. This was to allow the subject habituate to the new prescription.

Nott retinoscopy was always performed first to prevent any bias that would result from the influence of lenses on the subsequent measurement of the accommodative lag. Nott retinoscopy was performed using the phoroptor and a commercially available nearpoint card (Bernell Corporation BC 11981, Indiana, USA) placed 40 cm away from the subject on the nearpoint rod, and with the subject reading the 20/40 text immediately adjacent to the aperture in the nearpoint card. The first observed neutral (low neutral) was used as the end point for the assessment of the accommodative lag. To prevent examiner bias for the subsequent MEM assessment, the results of Nott retinoscopy were recorded in millimetres [8].

To minimize the effect of astigmatism and anisometropia on the accurate determination of the accommodative response, subjects who had a total astigmatism in either eye greater than 1.00 D, or those who had anisometropia greater than 1.00 D, were excluded from this investigation [10]. The accommodative lag was determined for both principal refractive meridians and the average was recorded as the accommodative lag for that distance.

MEM retinoscopy was performed with the same near point card attached to the retinoscope and with the patient viewing the card through trial frames or his/her habitual spectacles, under ambient illumination. The only procedural difference with MEM retinoscopy is that Trial lenses were used to measure accommodative lag and these lenses were

introduced for 0.5 seconds or less to prevent a bias in the measured accommodative response [11].

To assess the reliability of each technique, the accommodative lag was reassessed with Nott retinoscopy and MEM retinoscopy within two weeks.

Statistical analysis

Results are presented as mean ±SD. Multiple comparisons between the four measurement sessions were made using repeated measures ANOVA. Pearson's correlation coefficient was used to screen for a bias of the mean difference with the average lag between sessions (for each technique) and between techniques. A 5% level of statistical significance was selected for this study.

All statistical analyses were conducted using the Graphpad Instat program, version 3.00 (Graphpad Software Inc., San Diego California USA, www.graphpad.com).

Results

The age and refractive error characteristics of the subjects in this study are shown in Table I.

The mean of three measurements was recorded as the accommodative response for each subject for both Nott and MEM retinoscopy. Each subject had four average readings (two sessions each for Nott and MEM). A repeated-measures analysis of variance (ANOVA) was performed for the four groups (Nott first session, MEM first session, Nott second session, MEM second session) and the differences between the groups were found not to be statistically significant (P>0.05). The average accommodative lags and standard deviations measured in each of the four sessions are illustrated in Table II.

For Nott retinoscopy, the mean difference (second session minus first session) (Figure 1) in the accommodative lag between the first and second sessions was 0.01±0.1 D (mean ±SD) and the 95% limits of repeatability for this method were +0.21 to -0.19 D.

The mean difference between sessions for MEM retinoscopy (Figure 2) was – 0.002±0.11 D (mean ±SD) with 95% limits of repeatability ranging from +0.22 to -0.23 D.

Table I. Age and refractive errors distribution of subjects

	Age (years)	Spherical equivalent refractive error (D)
Mean	22.0	-0.48
Standard Dev.	3.0	1.33
Range	18-30	-5.88-+2.69
N	130	130

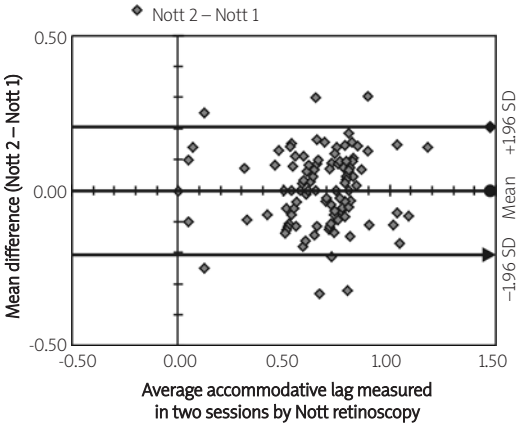

Figure 1. Intersession reproducibility of the accommodative lag measured by Nott dynamic retinoscopy is presented. The mean difference between sessions for MEM retinoscopy and the 95% limits of repeatability are also shown

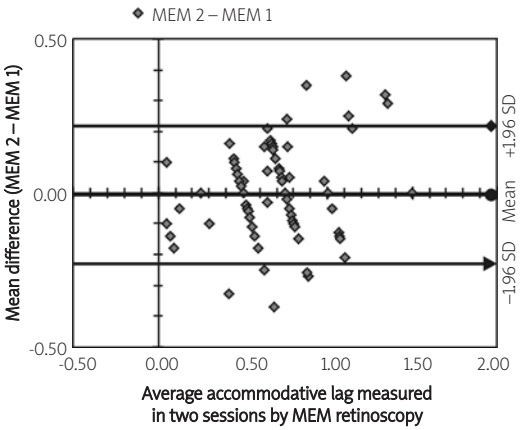

Figure 2. Intersession reproducibility of the accommodative lag measured by MEM Dynamic Retinoscopy is presented. The mean difference between sessions for MEM retinoscopy and the 95% limits of repeatability are also shown

Table II. Average values for the accommodative lag measured with Nott and MEM dynamic retinoscopy methods. The 95% confidence intervals (CI) and standard deviation of the accommodative lag are also shown

	Nott (1st sess.)	MEM (1st sess.)	Nott (2nd sess.)	MEM (2nd sess.)
Mean Lag	0.666	0.672	0.673	0.667
Std. Dev.	0.200	0.245	0.203	0.266
95% CI	0.274-1.058	0.192-1.152	0.275-1.071	0.401-1.188
n	130	130	130	130

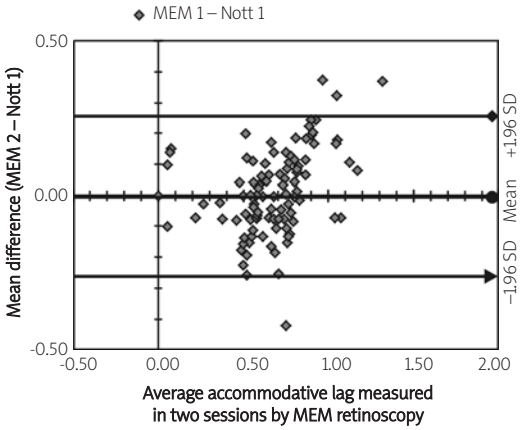

Figure 3. Limits of agreement between MEM and Nott dynamic retinoscopy techniques are presented. The mean difference between both techniques and the 95% limits of agreement are also shown

For the limits of agreement between the techniques (Figure 3), the average value for the first session measured with Nott retinoscopy was subtracted from that measured with MEM retinoscopy (MEM1 – Nott1). The mean difference between both techniques was 0.01±0.13 D (mean ±SD) with 95% limits of agreement ranging between +0.26 and -0.25 D.

Discussion

The current opinion is divided as to which dynamic retinoscopy technique is a more reliable measure of the accommodative lag – Nott retinoscopy or MEM (monocular estimate method) retinoscopy. Some authors suggest that Nott dynamic retinoscopy is the dynamic retinoscopy method of choice to assess the lag of accommodation because the accommodative system of the subject is observed in an unaltered state [6, 8, 12]. Others regard the MEM as the preferred technique for assessing the accommodative lag, citing its accurate assessment of the accommodative response [13], its good interexaminer reproducibility [14] and its agreement with the phoroaccommodometer [16]. One other paper in the literature [7] asserts that MEM and Nott retinoscopy may be used interchangeably to assess the accommodative lag, because the results of both techniques are virtually identical.

This study set out to evaluate the position by Cacho et al. (1999) [8] and Garcia and Cacho, (2002) [9] that in both normal subjects and those with disorders of accommodation and vergence, the MEM estimate of the accommodative lag is approximately twice that made with Nott retinoscopy. In this study, using MEM and Nott dynamic retinoscopy, we evaluated the accommodative lag for the right eyes of 130 normal subjects. No significant difference was found between sessions for either technique and between the techniques indicating that both dynamic retinoscopy methods yield reliable estimates of the accommodative lag and that both techniques can be used interchangeably to monitor the lag of accommodation in subjects free from disorders of accommodation and from binocular dysfunction. This is the first study in which MEM and Nott retinoscopy have been compared using Bland-Altman analysis and using the repeatability of each technique as an index of reliability, which was then taken into consideration in the assessment of the agreement between both methods. We suggest that two methods can be used interchangeably to assess the same variable when each method is reliable (as assessed by its repeatability) and there is no significant difference between the assessments made by both methods.

The results from this study differed significantly from those of Cacho et al. (1999) [8]. Though the age range of the subjects in both studies was similar and in both studies the accommodative lag was measured through the corrected-ametropia-most-plus (CAMP) lenses, the average values for the accommodative lag in their study was 0.735 D and 0.415 D for the MEM and Nott techniques respectively, as opposed to 0.672 D and 0.666 D found in this study. The statistical analysis shows that the average lag, using MEM dynamic retinoscopy, did not differ between both studies ($P>0.05$, Welch-corrected unpaired t-test). It was the average accommodative lag measured with the Nott dynamic retinoscopy technique that showed a significant difference between our study and that of Cacho et al. (1999) [8]. It is difficult to postulate possible sources of error that could have led to a smaller than normal accommodative lag, measured with Nott retinoscopy, in their study because no repeatability study was performed for either technique in the study by Cacho et al. (1999) [8] and therefore the reliability of both methods used in their study can not be appropriately assessed.

Conclusions

We find that in normal healthy subjects with normal accommodative and binocular function, MEM and Nott dynamic retinoscopy techniques may be used, interchangeably, to assess the lag of accommodation at 40 cm. More investigation of this sort is required to determine the reliability of each method, and the agreement of both methods at other near target distances.

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