TÜBİTAK

Original Article

Turk J Med Sci
2010; 40 (4): 511-514
© TÜBİTAK
E-mail: medsci@tubitak.gov.tr
doi:10.3906/sag-0804-21

A novel hand-held device for the measurement of ocular alignment

Uğur E. ALTIPARMAK[1], Esra KARABULUT[1], Eric R. EGGENBERGER[2]

Aim: The measurement of ocular alignment can be challenging and difficult to reproduce. A method for the measurement of ocular alignment with accuracy, speed, and reproducibility would be a useful clinical addition.

Materials and methods: A hand-held device consisting of a rotary prism and a red Maddox rod was constructed. This was used to evaluate 18 patients with ocular misalignment and the results were compared with the ones obtained using the prism cover testing.

Results: The results from the hand-held device showed a close correlation with those of the prism cover test.

Conclusion: The hand-held instrument is a useful method to quantify ocular misalignment and correlates with the prism cover test results.

Key words: Prism cover test, rotary prism, red Maddox rod, ocular misalignment

Göz hareketlerinin ölçülmesinde kullanılabilecek yeni el cihazı

Amaç: Göz kaymasının muayenesi zorlayıcı olabilir ve tekrarlanması güçlükler içerebilir. Göz kayma muayenesini doğru kesinlikte, hızla ve tekrarlanabilir şekilde ölçen bir teknik, klinik uygulamada yararlı katkılar sağlayabilir.

Yöntem ve gereç: Dönebilen ölçüm prizmasını Maddox çubuğu ile birleştiren bir el cihazı tasarlandı. Bu cihaz ile göz kayması olan 18 hasta değerlendirildi ve ölçümler prizma örtme teknikleri ile elde edilen ölçümlerle karşılaştırıldı.

Bulgular: El cihazı ile elde edilen ölçümler prizma örtme tekniği ile elde edilen ölçümlerle yakın uyum göstermiştir.

Sonuç: Yeni el cihazı, göz kaymalarının ölçümünde prizma örtme yöntemleri ile yakın uyum gösteren ve yararlı olabilecek bir metoddur.

Anahtar sözcükler: Prizma örtme testi, dönen prizma, kırmızı Maddox çubuğu, göz kayması

Introduction

Accurate measurement of ocular misalignment in patients with ocular motility problems is of utmost importance for diagnostic and follow-up purposes. Of the commonly used techniques, prism cover (PC) test, Lancaster screen (LS), and the red Maddox rod tests all require adequate examiner skill and patient cooperation. These techniques may be time consuming and can yield inaccurate results under suboptimal conditions.

We used a simple, hand-held device, combining a rotary prism and a red Maddox rod as a new method for measuring ocular alignment (Figure 1). The ease and speed of this instrument are superior. We compared alignment results obtained using this tool with the ones obtained using the PC test.

Received: 08.04.2008 – Accepted: 04.02.2010

[1] Department of Ophthalmology Ankara Research and Training Hospital Ankara - TURKEY
[2] Michigan State University, Department of Neuro-ophthalmology, USA
Correspondence: *Uğur E. ALTIPARMAK, Naci Cakır Mah. 13. Sokak 3/29 Dikmen, Ankara - TURKEY*
E-mail: ealtiparmak@hotmail.com

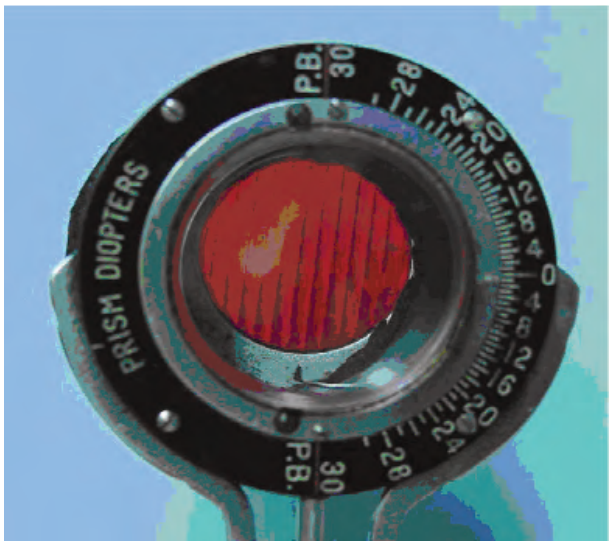

Figure 1. The novel hand-held device.

Materials and methods

Michigan State University Institutional Review Board approved this protocol, and patients gave informed consent prior to participation. Eligibility criteria included Snellen visual acuity of at least 20/25 and color vision of at least 9/10 Hardy-Rand-Rittler pseudoisochromatic plates OU. Patients with a neuromuscular disease were excluded from this study, as the disease may interfere with the exam results. Ocular misalignment of the patients was measured by one examiner using both the PC test and the hand-held during their routine visit. Measurements were taken in the primary position, as well as up, down, right, and left gaze positions (1). For the hand-held device, a bright white light at distance was used. For horizontal measurements, patients were asked to fixate on the bright light at distance and to locate the red line (created by red Maddox rod in horizontal orientation) as opposed to the bright light. In the next stage, the patient was asked to tell the examiner when the bright light and the red line overlapped, while the examiner slowly rotated the rotary prism of the hand-held device. The point where the 2 images overlapped was recorded from the frame of the rotary prism and the corresponding measurement was taken as the prism diopter measure for the ocular misalignment. For vertical measurements, the same principle was used, with the Maddox rod oriented horizontally as the only difference. For PC test, the patients were asked to fixate the letter "A" of the 20/70 Snellen line at distance and the test was performed in the usual fashion and the vertical and horizontal components of measures were recorded individually.[1] The correlation between the hand-held device and the PC test measurements were analyzed for both horizontal and vertical measures in 5 gaze positions. The test duration for each technique was measured and compared. The patients were asked to comment on the comfort experienced during the exam, subjectively. They classified the techniques as: Easiest, medium, and hardest. Spearman's correlation analysis was used for the correlation analysis of the data obtained by 2 methods. SPSS 13.0 was used for statistical analyses. Independent samples t-test was used to compare the test duration between the 2 groups.

Results

Eighteen patients were included in this prospective study. The diagnoses were; trochlear nerve palsy in 4 patients, abducens nerve palsy in 5 patients, oculomotor nerve palsy in 1 patient, combined abducens and oculomotor nerve palsy in 1 patient, skew deviation in 1 patient, combined skew deviation and internuclear ophthalmoplegia in 1 patient, internuclear ophthalmoplegia in 2 patients, and decompensated phoria in 3 patients (Figure 2). There was a significant correlation between the results of the

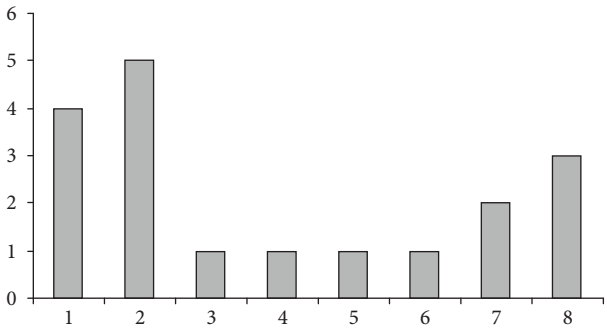

Figure 2. Number of patients for each diagnosis.
(1: *Trochlear nevre palsy*; 2: *Abducence nevre palsy*; 3: *Oculomotor nevre palsy*; 4: *Combined oculomotor and abducence nevre palsy*; 5: *Skwe deviation*; 6: *Combined skew deviation and internuclear ophthalmoplegia*; 7: *Internuclear ophthalmoplegia*; 8: *Decompensated phoria*)

2 tests, attesting to the hand-held method's reliability and reproducibility compared to more established measure of alignment (Table 1). The hand-held device was easy to perform and well tolerated by the patients. Eleven patients (61.1%) found the hand-held device easier to perform, compared to 7 patients (38.9%) who found the PC test easier to understand and follow. The mean test duration was 4.94 ± 1.0 min for PC test and 3.83 ± 1.20 min for the hand-held device (P = 0.005).

Discussion

One major goal of strabismus examination is accurate measurement and characterization of ocular misalignment. Accurate measurement not only enables accurate diagnosis but also helps develop a reliable baseline examination for the follow-up of the patients.

Methods for measuring the angle of strabismus were divided into the following categories: light reflex tests, cover tests, and subjective tests (2). Though light reflex tests are easiest to perform on infants and children, they are less accurate than other measures and are seldom used in adult patients with ocular deviations. Prism cover test determines the amount of prism necessary to neutralize the full deviation tropia and any latent phoria. A prism of appropriate strength held in the appropriate direction is introduced before one eye as its fellow is covered. Prism strength is increased until the eye movement ceases; this prism strength corresponds to the size of the strabismus. Prism cover test necessitates patient cooperation and fixation to a predetermined target throughout the examination. Prisms must be appropriately handled to yield accurate measurement of strabismus (3). Although many consider the PC test as the most precise and objective measure of ocular alignment, it may be time-consuming and inaccurate with an inexperienced examiner and requires sufficient patient cooperation.

The Maddox rod consists of closely aligned, powerful glass or plastic cylinders (4). When illuminated, these cylinders project a line upon the patient's retina perpendicular to the groove orientation. By the use of a prism presented to the patient, the line is aligned horizontally/vertically to detect and measure horizontal/vertical phorias.

Von Noorden mentioned the combined red Maddox rod-rotary prism instrument in early 1980s.[5] The main principle is the use of a rotary-prism behind a red Maddox rod, which will project a red line upon the patient's retina. The patient is then asked to comment on the position of the red line as opposed to the fixation light as the prism rotates and the patient subjectively guides the examiner during the measurement of ocular misalignment. In principle, a prism is used to neutralize the deviation, as in the PC test, however, subjective, rather than objective data is obtained and patient cooperation is of utmost importance during this examination.

Table 1. Correlation between 2 methods of ocular alignment at different gaze positions per horizontal and vertical components of measure (Correlation is significant at the 0.01 level (2-tailed), Spearman's correlation coefficient).

	Primary position horizontal component	Up gaze horizontal component	Down gaze horizontal component	Right gaze horizontal component	Left gaze horizontal component
• Correlation coefficient	0.794	0.832	0.893	0.684	0.863
• Significance	<0.001	<0.001	<0.001	0.002	<0.001
	Primary position horizontal component	Up gaze horizontal component	Down gaze horizontal component	Right gaze horizontal component	Left gaze horizontal component
• Correlation coefficient	0.763	0.995	0.651	0.780	0.948
• Significance	<0.001	<0.001	0.003	<0.001	<0.001

The authors of this study designed such a hand-held device by combining the red Maddox rod and a rotary prism and then compared the ocular misalignment results obtained using both this simple handheld and the PC test. Use of this simple device would help examiners measure ocular misalignments within a shorter period of time with similar results. In summary, the measurement with the hand-held device showed a close correlation with the commonly used PC test, within a relatively shorter time period.

The ease of use of this instrument even with an inexperienced examiner, and the close correlation with other techniques are encouraging for further use this device. This hand-held device may be a useful clinical tool for quantifying ocular misalignment accurately and quickly.

References

1. Wilson ME, Buckley EG, Kivlin JD, et al. Basic and Clinical Science Course. Section 6. Pediatric Ophthalmology and Strabismus.1999-2000.
2. Wright KW. Chapter 5. Ocular Motor Examinaton, p.138-173, in: Wright KW, Spiegel PH, Thompson LS. Handbook of Pediatric Strabismus and Amblyopia, 3rd ed (Springer Science+Business Media, New York, NY,2006).
3. Thompson J.T., Guyton D.L.: Ophthalmic prisms: measurement errors and how to minimize them. Ophthalmology 1983; 90: 204-210.
4. Diamond GR, Section 2. Evaluation and Diagnosis, Part 11. Pediatric and Adult Strabismus, in: Yanoff M, Duker J: Ophthalmology, 3rd ed (The C.V. Mosby Company 2008).
5. Gunter K. Von Noorden. Atlas of Strabismus. 4th ed. The C.V. Mosby Company 1983.