

Amplitude of accommodation measurements using the Donders clinical methods and a new vision analyser

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Purpose: To compare the results of subjective methods commonly used in clinics to measure amplitude of accommodation with those implemented in a prototype of a new vision analyzer (EVA) that records eye movements, pupil diameter values and refractive state while the patient watches a true-3D videogame.

Introduction:

- Accommodation is the increase in the dioptric power of the eye that allows to focus the image of near objects on the retina. The maximum increase that an eye can achieve is the amplitude of accommodation (AA). The AA decreases gradually with age, and an accurate measurement is important.
- In clinics the AA is measured using Donders subjective methods. Similar methods have been implemented in a prototype (Figure 1) of a fully autonomous and automated vision analyzer (Eye and Vision Analyzer, EVA, DAVALOR, Spain), that records eye movements, pupil diameter values and refractive state while the patient watches a true-3D short video game.

Methods:

- **Clinical measurements:** 54 young healthy patients were selected. The mean age \pm standard deviation (SD) was 21.9 ± 1.6 years (range: 19 to 24).
- **EVA measurements:** Subsample of 24 patients were selected. The mean age \pm standard deviation (SD) was 22.6 ± 2.0 years (range: 19 to 24).
- **Inclusion criteria:** Far and Near Visual Acuity (VA) ≥ 0.0 logMAR; No previous history of amblyopia or strabismus, ocular pathology or history of eye surgery.



Figure 1: Prototype of Eye and Vision Analyzer, EVA, used in this study.

Clinical methods

- Measurements were made monocularly with a RAF (Royal Air Force) rule to control the distance.
- Stimulus corresponding to a Visual Acuity of 0.2 logMAR.
- E \approx 450 lux

Donders push-up (CAAPU)

- Starting at 40 cm, the optotype was approaching at a speed of 2 cm/sec. The patient had to notify blur vision.

Donders push-down (CAAPD)

- Starting nearest the face, the optotype was moving away at a speed of 2cm/sec. The patient had to notify clear vision.

EVA prototype measurement

- Measurements were made monocularly with a prototype of EVA.
- Stimulus corresponding to a Visual Acuity of 0.2 logMAR.
- In each cycle the optotype was approaching and moving away,

Donders push-up (EAAPU)

- The optotype was approaching at a speed of 2 cm/sec. The patient had to notify blur vision.

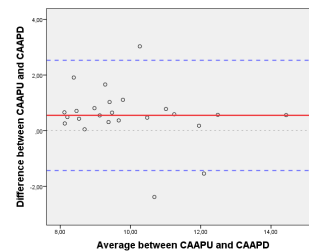
Donders push-down (EAAPD)

- Starting at very near distance, the optotype was moving away at a speed of 2cm/sec. The patient had to notify clear vision.

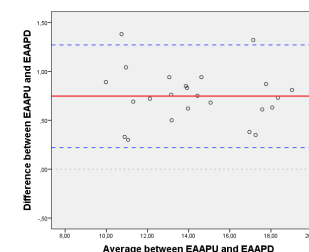
Results:

Method	CAAPU	CAAPD	EAAPU	EAAPD
Mean AA \pm SD (D)	10.58 \pm 1.86	10.55 \pm 1.80	9.83 \pm 1.90	9.03 \pm 1.89

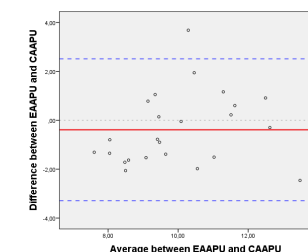
	Mean Differences (D)	Pearson correlation	95% CI (D)
CAAPU vs CAAPD	0.55 \pm 1.01 (p=0.91)	0.5 (p>0.001)	-1.43 to 2.53
EAAPU vs EAAPD	0.80 \pm 0.21 (p<0.001)	0.99 (p<0.001)	0.38 to 1.22
EAAPU vs CAAPU	-0.39 (p=0.448)	0.65 (p=0.001)	-3.29 to 2.51
EAAPD vs CAAPD	0.57 (p=0.267)	0.72 (p<0.001)	-3.30 to 2.14



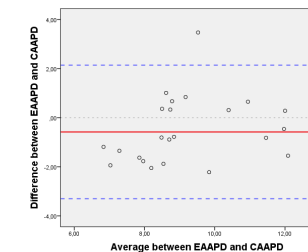
Bland and Altman graph. Comparison between Clinical Push Up and Push Down methods



Bland and Altman graph. Comparison between EVA Push Up and Push Down methods



Bland and Altman graph. Comparison between EVA and Clinical Push Up method.



Bland and Altman graph. Comparison between EVA and Clinical Push Down method.

Conclusions:

- The EVA prototype is a useful device to measure amplitude of accommodation using both push-up and push-down procedures.
- The agreement between push up and push up methods is higher using EVA prototype than using clinical methods.

References:

1. Álvarez, A., et al. (2012). A comparison of the reliability of dynamic retinoscopy and subjective measurements of amplitude of accommodation. *Ophthalmic & Physiological Optics*, 32, 133-144.
2. Chen, A-H., et al. (1998). Validity and repeatability of the modified push-up method for measuring the amplitude of accommodation. *Clinical and Experimental Optometry*, 81 (2), 63-71.