



Reliability and reproducibility of the automated measurement of angular deviation of strabismus



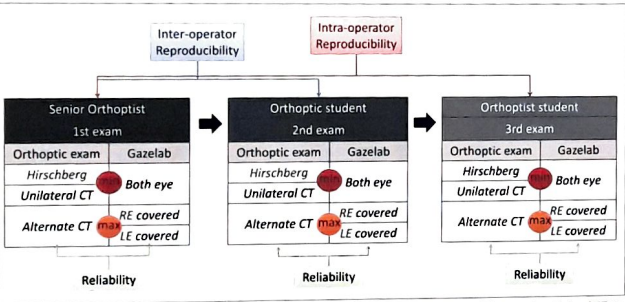
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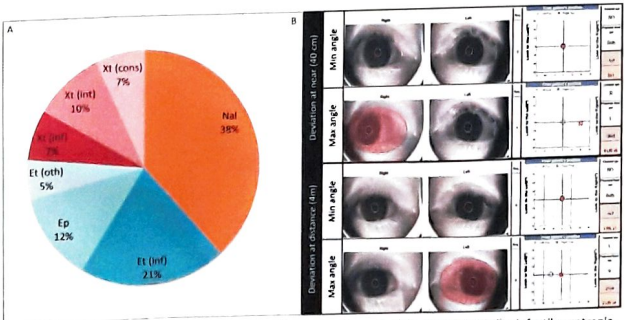
No conflict of interest ; approval of the ethics committee (2018-A00326-49)

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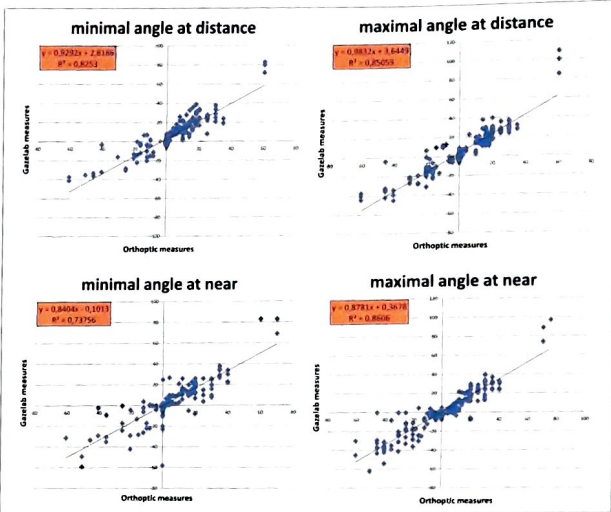
Objective: The angle of deviation of strabismus varies according to the examination method: the Hirschberg corneal reflex test assesses a "minimum" qualitative angle (without dissociation) whereas the alternate cover-test (ACT) measures a "maximum" quantitative angle (dissociative method). The video-oculograph (VOG) allows quantitative measurements of the deviation without and with dissociation. We propose to evaluate the reliability and reproducibility of the video-oculograph measurement compared to techniques of reference.



Methods: Monocentric prospective study (Oct 2018 – May 2019) including 78 adult patients (28 esotropia, 17 exotropia, 28 control). Measures of minimal and maximal angles (both at near and distance) are performed by a senior orthoptist with 2 methods of reference (Hirshberg and cover test), then with VOG (Gazelab®-BCN INNOVA). Reproducibility is tested in the same consultation by a re-examination by an orthoptic student and again by the senior orthoptist.



Results: A significant correlation is observed between orthoptic and gazelab measures, for minimal and maximal angles of deviation, both at near and at distance (figure 3)



Reliability: Coefficients of correlation are good (> 0.85) or very good (> 0.90) between orthoptic and gazelab measures for each angle. The subgroup analysis confirms this correlation when the angle is stable but not for the minimum angle when it is variable.

	Angle at distance		Angle at near	
	Min	Max	Min	Max
All patients (n=78)	r=0.91	r=0.92	r=0.86	r=0.93
« variable angle » group (n=16)	r=0.73	r=0.94	r=0.52	r=0.91
« stable angle » group (n=62)	r=0.93	r=0.92	r=0.92	r=0.93

Figure 4. Reliability of gazelab measures : coefficient of correlation between orthoptic and gazelab measures for each angle of deviation (minimal and maximal, at near and at distance). "variable angle" group = patients with at least 10 PD between minimal and maximal angle (at near or at distance) with the orthoptic exam , "stable angle" group = other patients. r > 0.85 = good ; r > 0.90 = very good.

Reproducibility : intra and inter-operator reproducibility are good or very good, both for orthoptic and Gazelab exams, particularly for the maximal angle of deviation.

		Angle at distance		Angle at near	
		Min	Max	Min	Max
Intra-operator reproducibility	Orthoptic exam	r=0.94	r=0.99	r=0.92	r=0.98
	Gazelab	r=0.98	r=0.97	r=0.91	r=0.93
Inter-operator reproducibility	Orthoptic exam	r=0.94	r=0.99	r=0.91	r=0.97
	Gazelab	r=0.96	r=0.98	r=0.86	r=0.97

Figure 4. Reproducibility of orthoptic and gazelab measures : coefficient of correlation between 1st and 2nd exam by senior orthoptist (intra-operator) and between senior and orthoptist student exams (inter-operator) ; measures for each angle of deviation (minimal and maximal, at near and at distance). r > 0.85 = good ; r > 0.90 = very good.

Discussion: Measurements of angular deviation with Gazelab are reliable and reproducible, especially for maximum angle. Large angle strabismus analysis is more accurate than with prisms. This objective and documented method seems particularly appropriate for multicenter studies to compare results.