Accuracy of ocular parameters measurement with the use of 6 devices

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INTRODUCTION

- The accuracy of ocular parameters assessment is now more important than ever, especially when practitioners consider fitting specialty contact lenses and even for the optimal fitting of soft contact lenses.
- Among the essential ocular parameters to consider, we find the following clinical applications :
  - Ocular sagittal height: soft contact lenses; scleral lenses
  - Corneal diameter: soft contact lenses; orthokeratology
  - Pupil size : soft multifocal lenses; orthokeratology
  - Corneal curves: rigid gas permeable lenses ; hybrids
- There is no consensus on the optimal way to evaluate ocular parameters. Several instruments may be used for this purpose:
  - Electronic refractor
  - Topographer
  - Eye profiler
  - Pupillometer
  - Biometer
  - Scheimpflug technology

OBJECTIVES

- This study aims to compare the assessment of ocular parameters with the use of 6 different devices and to try to estimate which one is the most appropriate for modern contact lens fitting.

METHODS

- This is a prospective, randomized, non-dispensing study. Subjects were enrolled for a single session of testing lasting for 2h00.

INCLUSION CRITERIA :

- ✓ Being aged 18-45 years old
- ✓ Having a normal anterior segment ocular health
- ✓ To do not wear contact lenses or to had been washed out for lens wear in the last 48h00
- ✓ Be able to provide an informed consent

- 24 subjects were recruited and their ocular parameters, in both eyes, under photopic condition (except for Eaglett), were assessed with 6 different devices, on the same day:
  - two topographs (Medmont [M] and Pentacam [P]),
  - two eye profilers (Eaglett [E] and sMap 3D [S]),
  - a biometer (Lenstar [L])
  - a pupilometer (Neuroptics [N]).
- Pupils, flat and steep K readings, corneal diameter and sagital height of the ocular surface at 11 mm of chord were compared.

RESULTS

1 - KERATOMETRY- CENTRAL CORNEAL CURVES [Sim K] (D)

	N	Min	Max	Average	STd DEV
Medmont Flat K	48	40.74	47.23	43.64	1.32
Eaglett Flat K	48	37.60	44.90	41.06	1.67
Pentacam Flat K	48	41.20	47.00	43.42	1.30
Lenstar Flat K	48	41.40	47.20	43.72	1.26

	N	Min	Max	Average	STd DEV
Medmont Steep K	48	42.85	48.61	44.70	1.35
Eaglett Steep K	48	40.50	48.70	44.06	1.81
Pentacam Steep K	48	42.10	48.00	44.31	1.39
Lenstar Steep K	48	42.30	48.40	44.63	1.38

2 - PUPIL DIAMETER (mm)

	N	Min	Max	Average	Std DEV
Medmont	48	2.70	6.60	4.66	.72
Eaglett	48	4.90	7.70	6.37	.61
Pentacam	48	2.30	4.40	3.11	.54
Lenstar	48	3.30	6.30	4.40	.65
Pupillometer Neuroptics	48	3.90	6.90	5.09	.67

3 - CORNEAL DIAMETER (mm)

	N	Min	Max	Average	Std DEV
Eaglett	48	11.30	12.60	12.02	.39
sMap 3D	48	10.50	12.70	11.7	.46
Pentacam	48	11.00	12.50	11.77	.37
Lenstar	48	11.40	13.00	12.30	.39

4 - SAGITTAL HEIGHT (microns)

	N	Min	Max	Average	Std DEV
Eaglett	48	1800	2200	2041	87
sMap 3D	48	1900	3000	2185	154

Statistical analysis

- Statistical analysis was performed using SPSS 26.0 for Windows (SPSS, IBM, Chicago, Illinois, USA). Where data were demonstrated to have a normal distribution, as shown by the 1-sample Kolmogorov-Smirnov test, parametric analyses were used. Statistical P values <.05 were considered significant
- Bland-Altman plots were used to compare measurements between device pairs by plotting the differences between measurements against their mean along with constructs of the limits of agreement (LoA). The 95% LoA (mean difference + 1.96 x standard deviation) define the range within which most differences between measurements from the 2 devices will lie.

DISCUSSION

- The following table illustrates the statistical significance of the differences between paired instruments, as established with a linear regression between the difference and the mean: from this analysis :

	K FLAT	K STEEP	PUPIL SIZE	CORNEAL DIAMETER	SAGITTAL HEIGHT
M vs E	**0.037**	0.074	0.129		
M vs P	0.534	0.197	**0.008**		
M vs L	0.291	0.608	0.437		
M vs N			0.565		
E vs P	0.058	0.058		0.575	
E vs L	**0.038**	0.056		0.937	
E vs S				0.231	**0.002**
L vs N			0.842		
L vs S				0.144	
P vs L	0.422	0.825	**0.087**	0.326	
P vs N			**0.012**		
P vs S				0.065	

- In general, instrumentations can be considered as comparable. However, there are significant differences:

SIM K

- Eaglett estimates a flat K significantly flatter than other devices and a steep K also flatter (near significance)

Pupil Size

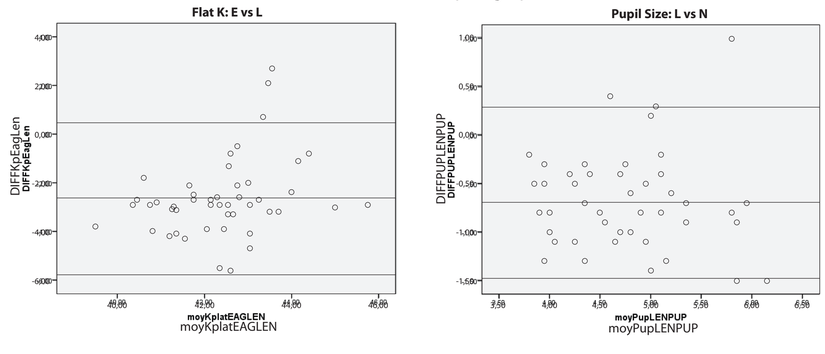
- Pentacam underestimates the pupil size compared to other devices. Eaglet was not considered for analysis because its measurement is taken under mesopic condition.

Sagittal Height

- Eaglett provides a lower Sag value. However, the evaluation is made for 360 deg while sMAp gives a meridional sag value (highest of the 2 principal meridians)

- It is also possible to draw other conclusions from this analysis :
  - Lenstar biometer is highly comparable to Medmont and Pentacam for Sim K readings
  - Lenstar and Neuroptics provides highly comparable findings for pupil size
  - Lenstar and Eaglett provides larger corneal diameter, not significantly different from others. There is still a debate where the corneal limbus is really located.

Bland-Altman plot graphs



CONCLUSION

- This study does not allow us to determine a single best machine for the assessment of ocular components. Devices used here are highly comparable except for a few elements.

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