Sagitta calculator software validation for soft contact lens fitting

Vicente Berbegal[1], Laura Batres[2], Gonzalo Carracedo[2]

[1]Teixidó Òptiques, Reus, Tarragona, Spain

[2]Faculty of Optics and Optometry, Universidad Complutense de Madrid, Madrid, Spain

Introduction

The measurement of the sagittal height of the eye and the publication of data on sagittal heights of contact lenses can be a way to adapt the lenses in a more personalized way and then reduce the current abandonment rate[1,2]. Despite all these advances, we are still on the starting grid and there is still a long way to go to adapt soft contact lenses in a more personalized way. The Sagitador could be a good tool to improve the soft contact lens fitting.

Purpose

The main objective of this study was to compare the sagitta calculated with the Sagitador, a new software to calculate the sagittal height, with a scleral module of a Scheimpflug topographer (Pentacam) at different chords and find the regression equations to adjust the calculus.

Methods

A descriptive, prospective, and transversal study has been performed. Fifty-five subjects (31 women and 24 men) were recruited from the Optometry Clinic of the Faculty of Optics and Optometry (University Complutense of Madrid, Spain). Mean age was 39.77 ± 15.56 years old (range 16-75 years). Inclusion criteria were age between 15 to 75 years old without any ocular surface pathology. Subjects wearing orthokeratology and scleral contact lenses were excluded. All variables were measured in the same daytime for each subject. Three measurements were taken with each eye with both topographers (Medmont Meridia and Pentacam). Simulated keratometry and eccentricity at principal meridians and corneal diameter were measured with a Placido disc topographer. Sagittal height at 10, 14, 14.50 and 15 mm and scleral symmetry were performed with Scleral module of a Scheimpflug topographer. Data from keratometry and eccentricity mesured with Medmont Meridia was used to calculate the sagittal height at different chord with the Sagitador.

Results

After applying a regression equation, no difference between the Sagitador and the Scheimpflug measurement was found for any chord and meridian analyzed (p>0.05). The difference at 10mm 0.00 ± 39.89 µm for the flat meridian and 0.00 ± 31.38 µm for the steep meridian. The difference for the chord 14 mm was 6.01 ± 101.32 µm and -0.03 ± 88.51 µm for flat and steep meridians, respectively. For chord at 14.50 mm, the sagitta difference was -0.86 ± 93.96 µm and -1.24 ± 102.32µm, for flat and steep meridians, respectively. For 15 mm, the difference was -1.12 ± 101.13 µm and 0.07 ± 113.79 µm, for flat and steep meridians, respectively. Corneal astigmatism has an influence on the error between the real measurement and the calculation (p<0.05) except in the 10 mm chords and 15 mm chord steep meridian.

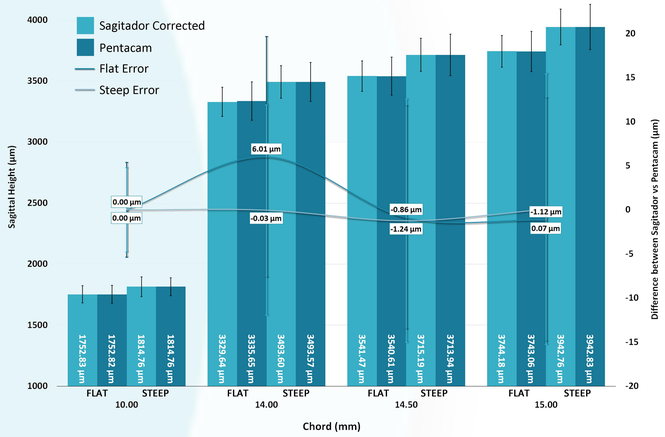

Fig 1. Comparation between the data of the Sagitador after correction and the mesures with Pentacam in the flat and steep meridians of each analysed chord. The bars show the average with the standard deviation and the lines show the difference obtained with the paired student t test and the standard error of the mean.

CHORD	FLAT	SAGITADOR CORRECTED	PENTACAM		SAGITADOR CORRECTED	PENTACAM	STEEP	CHORD
		1752.83 ± 69.90 µm	***1752.82 ± 72.29 µm***	*Average*	***1814.76 ± 81.08 µm***	***1814.76 ± 72.29 µm***		
		1913.93 µm	1939.50 µm	*Max*	2076.07 µm	2036.50 µm		
		1594.56 µm	1596.33 µm	*Min*	1679.30 µm	1640.33 µm		
	10.00 mm	**0 ± 39.89 µm**		*t-student*	**0 ± 35.37 µm**		10.00 mm	
		0.99		*p-value*	**0.99**			
		0.85		*ICC*	**0.95**			
		3329.64 ± 119.71 µm	***3335.65 ± 156.92 µm***	*Average*	***3493.6 ± 133.01 µm***	***3493.57 ± 159.77 µm***		
		3580.95 µm	3708.00 µm	*Max*	3898.52 µm	3842.00 µm		
		3092.39 µm	2953.33 µm	*Min*	3248.08 µm	3164.00 µm		
	14.00 mm	**6.01 ± 101.32 µm**		*t-student*	**-0.03 ± 88.51 µm**		14.00 mm	
		0.66		*p-value*	**0.94**			
		0.73		*ICC*	**0.82**			
		3541.47 ± 125.06 µm	***3540.61 ± 156.41 µm***	*Average*	***3715.19 ± 135.41 µm***	***3713.94 ± 169.70 µm***		
		3808.29 µm	3920.00 µm	*Max*	4151.59 µm	4079.00 µm		
		3292.06 µm	3239.00 µm	*Min*	3488.98 µm	3359.50 µm		
	14.50 mm	**-0.86 ± 93.96 µm**		*t-student*	**-1.24 ± 102.32 µm**		14.50 mm	
		0.95		*p-value*	**0.93**			
		0.78		*ICC*	**0.78**			
		3744.18 ± 130.40 µm	***3743.06 ± 165.01 µm***	*Average*	***3942.76 ± 146.27 µm***	***3942.83 ± 185.32 µm***		
		4025.54 µm	4135.00 µm	*Max*	4414.15 µm	4372.00 µm		
		3484.69 µm	3424.50 µm	*Min*	3698.42 µm	3567.50 µm		
	15.00 mm	**-1.12 ± 102.32 µm**		*t-student*	**0.07 ± 113.79 µm**		15.00 mm	
		0.93		*p-value*	**0.99**			
		0.77		*ICC*	**0.86**			

Fig 2. Statistical analysis of the data with the paired t student test. The values calculated by the Sagitador after the correction and Pentacam have high correlation for all the chords.

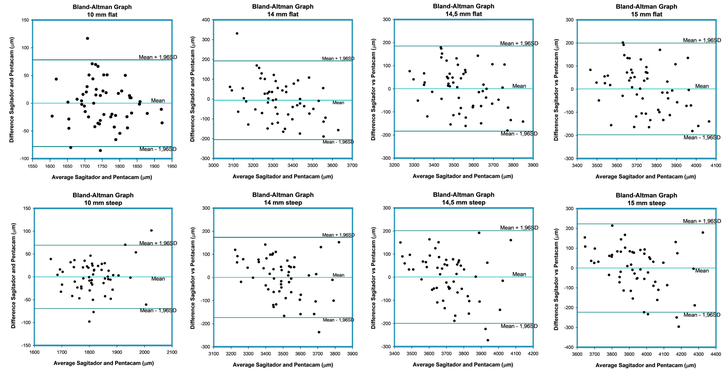

Fig 3. Bland-Altman analysis after correction. The limits of agreement are ±78.19 µm at 10.00 mm for flat meridian and ± 69.33 µm for steep meridian. For the 14.00 mm chord they are +192.57 µm and -204.57 µm (Bias = -6.01 µm) for the flat meridian and ±173.50 µm for the steep meridian. For the 14.50 mm chord they are +185.03 µm and -183.32 µm for the flat meridian (Bias = 0.86µm) and +201.80 µm and -199.31 µm (Bias = 1.24 µm) for the steep meridian. Finally for the 15 mm chord the limits of agreement are +199.34 µm and -197.10 µm for the flat meridian (Bias = 1.12 µm) and +222.96 µm and -223.07 µm for the steep meridian (Bias = -0.07 µm).

CHORD	MERIDIAN	REGRESSION FORMULA	
10.00 mm	FLAT	*SagCorrec = Sag + 66.67*	
	STEEP	*SagCorrec = Sag + 60.67*	
14.00 mm	FLAT	*SagCorrec = SagB - 2651.6 - 0.77SagB + 462.1Astig*	*p < 0.05*
	STEEP	*SagCorrec = SagB - 2471.88 - 0.7165SagB + 187.15Astig*	*p < 0.05*
14.50 mm	FLAT	*SagCorrec = SagB - 3103.3 - 0.856SagB + 439.7Astig*	*p < 0.05*
	STEEP	*SagCorrec = SagB - 2806.04 - 0.76SagB - 193.91Astig*	*p < 0.05*
15.00 mm	FLAT	*SagCorrec = SagB - 3575.73 - 0.94SagB + 417.10Astig*	*p < 0.05*
	STEEP	*SagCorrec = SagB - 3169.7 - 0.804SagB*	

Fig 4. Regression formula calculated for each chord at the flat and steep meridian. Sag is the raw calculus of the Sagitador. SagB is the value of the calculus of Sagitador (µm) corrected by the deviation (Bias). Astig is the value of the corneal astigmatism (D). The corneal astigmatism affects the final result in the chords 14.00 mm, 14.50 mm and in the 15.00 mm flat meridian.

Conclusions

The Sagitador is able to estimate the sagittal height in regular corneas at different chords using the eccentricity and keratometry from a Placido disc corneal topographer, being a great tool to select the best soft contact lens fitting.

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Vicente Berbegal - vberbe@gmail.com