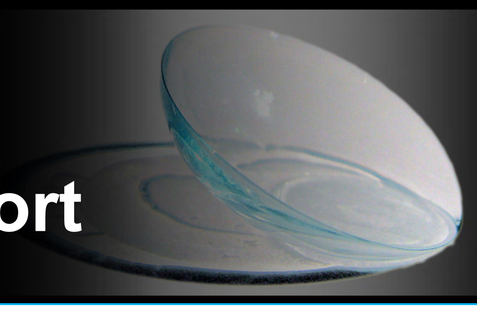
Relationship between Ocular Sagittal Height and Soft Contact Lens Sagittal Depth to Improve Fitting and Comfort



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microlens you will see

INTRODUCTION

- Despite major improvements made to lens manufacturing process, the development of new soft contact lens material and the upgrade of contact lens care regimen, a significant cohort of wearers are reporting discomfort and unsatisfactory visual acuity (Dumbleton, 2002). It was recently suggested that contact lens fit might be an important factor to consider in this equation (Van der Worp, 2014) .
- Thirty years ago, soft lenses were available in several base curves and diameters of the same design. This allowed practitioners to customize and fit the lens to the patient ocular surface profile. The fact that silicone hydrogel lenses and disposable modality became the standard of care set up new rules for manufacturing and inventorying contact lenses. Manufacturers had to restrict dramatically the skews, which was translated as a reduced availability of lens parameters.
- To the contrary, it is now more and more evident that fitting better soft lenses on the ocular surface may lead to improved comfort, and also to a better stable, centered lens, helping to improve vision issues. According to Van der Worp ocular sagital height must be matched with lens sagittal depth, + or – a certain factor, to optimize the lens-to-eye relationship (Van der Worp, 2013).
- It 's hard to determine the exact sagittal depth value of a contact lens because it is labeled with a base curve value, which does not influence with the determination of the sagittal value. Moreover, base curve is not a real value but may represent an average of all the curves included in a particular design. The diameter of the lens represents the most important factor to consider when determining lens sag depth. (Ngo, 2017).

OBJECTIVES

To evaluate how the lens behavior (position and movement) is influenced by the variation of its sagittal depth on a given eye, and to investigate the association between the optimal result with patient's comfort.

METHODS

- Prospective, randomized, non-dispensing study.
- Single session of testing lasting 3h00.

INCLUSION CRITERIA

- aged 18-45 years old
- normal anterior segment ocular health
- No contact lenses for >48hrs if worn

INITIAL TESTING

- Sagittal ocular height evaluated with Medmont topographer (Precision, Vancouver) and Eye Surface Profiler (ESP, Eaglet Eye, The Netherlands) . Values extrapolated (Medmont) or evaluated (meridional) @ 15 mm of chord
- Slit lamp examination

EXPERIMENTATION

- Subject assigned to be fitted with monocurve silicone hydrogel contact lenses (Definitive 74, Microlens Contact Lens Technology, The Netherlands).
- Lenses analyzed through optical coherence tomography (OCT) to validate sagittal value at baseline and after the study (Optimec, UK).
- Lenses with four different sagittal depth values were randomly applied to the eyes of each subject and evaluated after 5 minutes of wear. One eye kept for analysis (random selection)
- The delta-sag (DS) values (the difference between the sagittal height of the ocular surface and the sagittal depths of the measured lenses were respectively: - 200um, 0, +200um and +400 um
- Washout period of 15 minutes between trials.
- Lens movement was recorded through iPhone 6 device, mounted on a slit lamp (Haag-Streit). Images were analyzed with a proprietary software from Aston University, UK. (Belda-Salmeron, 2015).
- One masked observer assessed the video of lens fit for each subject from 1 (optimal fit) to 4 (worst fit).
- Comfort was rated, by the subject, on 100 point Likert-scale before and after each lens trial.

RESULTS

TABLE 1 – CLINICAL POPULATION CHARACTERISTICS

	AVERAGE	STD DEV
AGE	26.20	4.50
Sim K flat (D)	43.62	1.50
Sim K Steep (D)	44.25	1.50
Medmont IS	0.198	0.530
Medmont SAI	0.512	0.201
Medmont SRI	0.436	0.084
Medmont Sag @ 15 mm-meridional (um)	3740.6	94.7
ESP Sag @ 15 mm- meridional (um) **	3630.0	204.5

TABLE 2 – OBJECTIVE AND SUBJECTIVE CONTACT LENS ASSESSMENT

DS	Comfort Initial (0-100)	Comfort End(15min) (0-100)	Push-up (PU) (mm/sec)	Drop after blink(DB) (mm)	Subjective evaluation (median)	
					Centration (#1 to #4)	Movement (#1 to #4)
-200	31.2 ± 27.3	59.4 ± 29.2	0.76 ± 0.34	0.75 ± 0.41	4	4
0	41.0 ± 30.4	78.6 ± 12.1	0.81 ± 0.35	0.81 ± 0.52	2	3
+200	47.9 ± 23.3	74.8 ± 18.8	0.81 ± 0.40	0.84 ± 0.52	1	1
+400	36.5 ± 25.2	68.4 ± 18.2	0.84 ± 0.33	1.19 ± 0.79	3	2

TABLE 3 – LENS ANALYSIS (PRE-POST TRIAL)

Pre-trial Lens Sag (µm)	Diameter (mm)	CT (µm)	BC (µm)	Post-trial ▲Lens Sag (µm)	BC 10MM (µm)
2900	0.21	5	-133	79	-146
3100	0.27	25	37	73	96
3300	0.30	20	67	84	-15
3500	0.81	20	368	241	337
3700	0.35	17	144	123	99
3900	0.62	-3	244	183	193
4100	0.87	26	356	281	337
4300	0.29	-13	112	78	44
Average	0.46	11	150	143	118

DISCUSSION

- Estimated sagittal value (Medmont) is higher than measured one (Eaglett). Values comparable to other studies made with Medmont (3740 ± 200 um (Waterloo); 3735 ± 186 (Pacific) and 3740 ± 160 (Vision Care Research) or ESP (3650 SD ± 200 (Stortelder), 3680 SD ± 203 (Harkness, Pacific)).
- Definitive 74 material was found not stable over 3 months – lens sag increases for most lens used. Results were recalculated considering the average value obtained at the end of the study (+143um), but we cannot exclude errors coming from this manipulation considering that not all lenses, from different trial sets varied the same way.
- Comfort improved over time (15 minutes) for all lenes. The lens fitted with a sag lower than ocular sag is always the least comfortable, but this is not a significant finding due to high inter-subjects variability.
- Recovery after push-up is higher than expected. Published values rated the speed @ 0.49 mm/sec (Belda-Sameron, op.cit) while most lenses here offered 0.8 mm/sec.
- Movement induced by blinking is higher than expected (0.8 vs 0.3 with a lag varying between 0.3 to 0.7) (Belda-Sameron, op.cit). The worst result comes from the lens fitted with +400 um DS
- These differences may be due to:
  - → quality of the video taken
  - → variability among clinical population characteristics (lid aperture, lid tension, ocular profile)
  - → lens design (monocurve vs multiple curves)
  - → lens material
  - → time of the day, length of wear
- Subjective evaluation (from a masked reader) favors lens fitted with +200 um DS. From the patient perspective, lenses fitted with 0 and +200 DS are rated the same.

CONCLUSION

- Lens fitted flatter than ocular sagittal height as well as those fitted with excessive DS seems to be less optimal than the ones aligned or moderately exceeding ocular sagittal value.
- Optimal contact lens should then be fitted with a DS of 0 to 200 um vs ocular sagittal height.

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