Thickness of spherical and toric SCLs measured *in vitro* by *Scheimpflug's* principal for determination of the Dk transmissibility values

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Introduction:

Corneal oxygen supply for the maintenance of the aerobiosis is essential for healthy long-term contact lens wear. The physiological response of oxygen insufficiency are well known [1][2][3]. Dk/t values taking care of the oxygen transmissibility right in the center and they are currently mainly limited to -3.00D.

Purpose:

The purpose of this experimental study is to obtain the thickness of spherical and toric SCLs at each point of the lens *in vitro*, using a modified Scheimpflug imaging system. Linking the yielded lens profiles with Dk values of the material allows a visualization of the Dk/t of the entire contact lens in the future.

Material and Methods:

A Scheimpflug imaging system (Pentacam) was modified from a vertical to a horizontal measuring position. Thickness profiles of 19 spherical and 38 toric SCLs were investigated (n=30 SiHy; n=27 non SiHy). The investigated lens powers were -1D; -3D and -6D including toric SCLs with a cylinder of .-0.75D. up to a cylinder value of -1.75D. For better detection of lens surfaces and for algorithmic evaluation of a 14mm diameter the scattered light portion is raised by soaking all lenses into a $2*10^{-4}$% fluorescent solution for 30 seconds up to 15 minutes depending on the lens material. Thickness points yielded are shown in intervals of 1mm. Central contact lens cross sections have been made and analyzed for a comparison with the non-destructive Scheimpflug method.

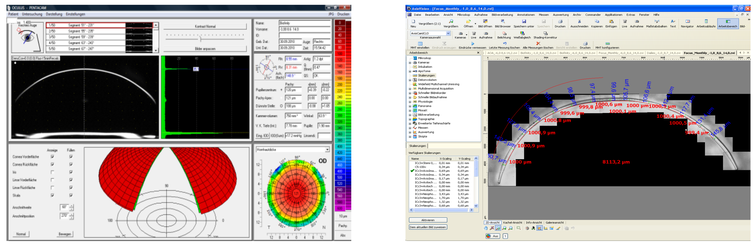

Fig.1 a) Overview of a spherical contact lens measured by Scheimpflug imaging system b) Thickness values of a spherical contact lens segment using a digital microscope analyzing software.

Results:

The thickness profiles of all contact lenses measured in this study were determined and the different stabilization designs of toric contact lenses were detected (Fig.2)

Based on these measurements the Dk transmissibility of the entire contact lenses can be calculated and simulated as shown in Fig.3.

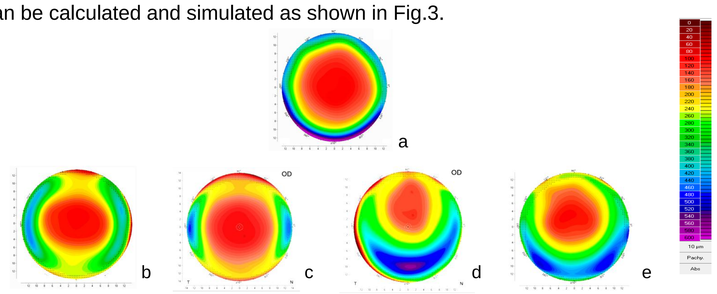

Fig.2 Color coded thickness profiles of contact lenses with different designs measured by Scheimpflug principle a) material Lotrafilcon B POW -3.00D b) material Nelfilcon POW -3.00D -1.50D 180° c) material Senofilcon A POW -3.00D -1.25D 180° d) material Vifilcon A POW -6.00D -1.75D 180° e) Lotrafilcon B POW -3.00D -1.75D 180°

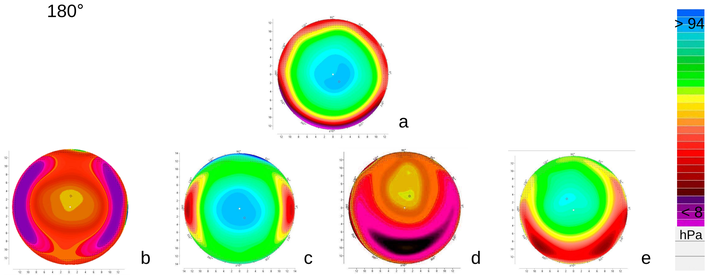

Fig.3 Simulated color coded Dk transmissibility of the spherical and toric contact lenses. a) material Lotrafilcon B POW -3.00D b) material Nelfilcon POW -3.00D -1.50D 180° c) material Senofilcon A POW -3.00D -1.25D 180° d) material Vifilcon A POW -6.00D -1.75D 180° e) Lotrafilcon B POW -3.00D -1.75D 180°

The different material groups are not significantly comparable ($p<0.001$) in scattering light components according to defined insertion times.

A significant correlation ($r_{min}=0.554$, $r_{max}=0.914$, $p<0.001$) was detected between both measurement methods depending on the measurement position (Tab. 1)

	Scheimpflug principal / microscope examination												
Meas.point	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Corr Coeff (r)	.760	.886	.914	.894	.831	.658	.554	.598	.622	.761	.791	.794	.820
Sig_Niv (p)	< 0.001												

Tab.1 Correlation coefficients according to *Spearman* at different measuring positions of the contact lens.

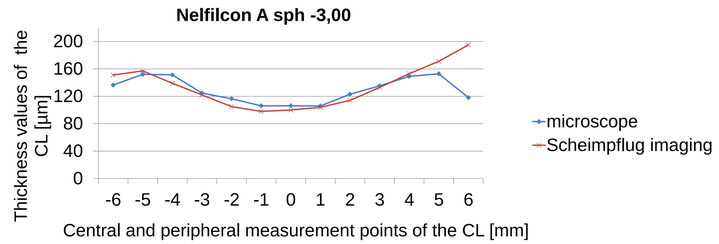

Fig.4 Thickness profile of a rotation-symmetric soft contact lens out of nelfilcon A POW -3,00D

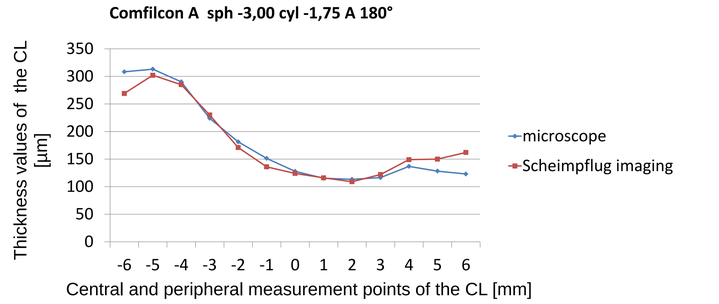

Fig.5 Vertical thickness profile of a lens out of comfilcon A sph -3,00D cyl -1,75D A 180°

Conclusion:

For a practical prospective the Scheimpflug measurement represents a scientific base getting non-disintegratively lens thickness values. By linking these lenses thickness profiles with Dk values a visualization of the oxygen transmissibility can be made. This allows an evaluation concerning the suitability of certain wearing modalities in consideration of the real lens power.

References:

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