Interlens Meeting Köln März 2017

DIE FORM DER SKLERA UND IHRE EINFLÜSSE IN DER ANPASSPRAXIS

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Inhalt

- Sklerallinsen „Fitting Tools“
- Sklerale Torizität
- Update «Neuste Erkenntnisse in der Welt der Sklerallinse»

SKLERAL LENS FITTING TOOLS

ScCL fitting tools

- Pentacam (Scheimpflug)
  - Sagittalhöhe im Limbus
  - Scheinbar ist ein Tool in der Pipeline mit HDR-Technologie um das Überstrahlen der Sklera zu vermeiden → Sklerale Topographie?
- Visante OCT
  - Scanbreite 16mm, Scantiefe 6mm (ganzer Querschnitt der Vorderkammer möglich)
  - Messtools um Sagittalhöhe zu messen
  - Zeitaufwendig
  - Vertrieb von Zeiss 2015 eingestellt

ScCL fitting tools

- Medmont E300
  - Composite Topographie bis zum Limbus
  - Extrapoliert die Sagitalhöhe bis 17mm
- Studie Visante OCT vs. ESP vs. Medmon E300
  - Brooke M. Harkness; Comparison of Sagittal Height Measurement Methods in Scleral Contact Lens Fitting
  - Medmont & Visante gute Übereinstimmung
  - ESP geringere Sagittalhöhe

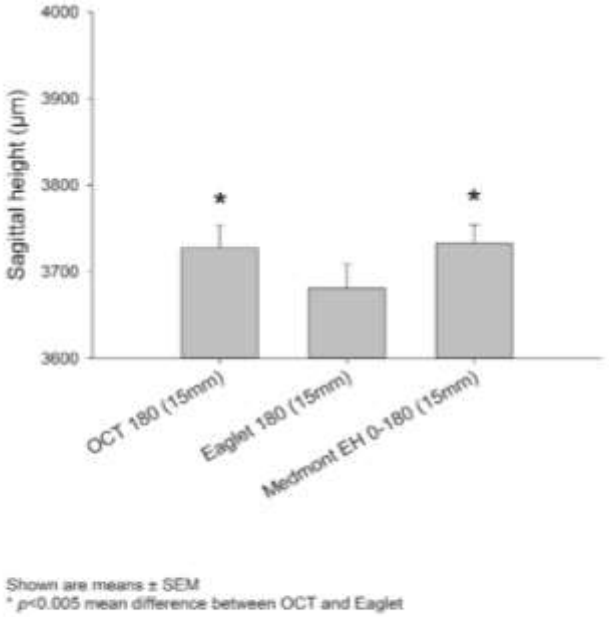


Figure 7: Sagittal height measurements differed by method [$F(2,102)=8.12$, $p<0.001$]. Eaglet ESP values were significantly lower than Zeiss OCT and significantly lower than Medmont ESH ($p<0.005$). Medmont ESH values did not significantly differ from Visante OCT.

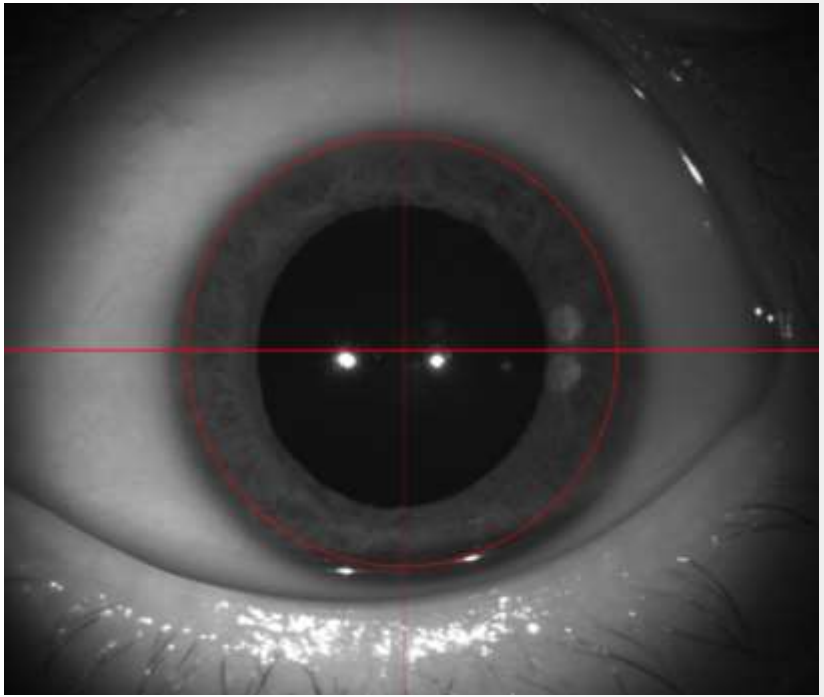
Eaglet Eye ESP

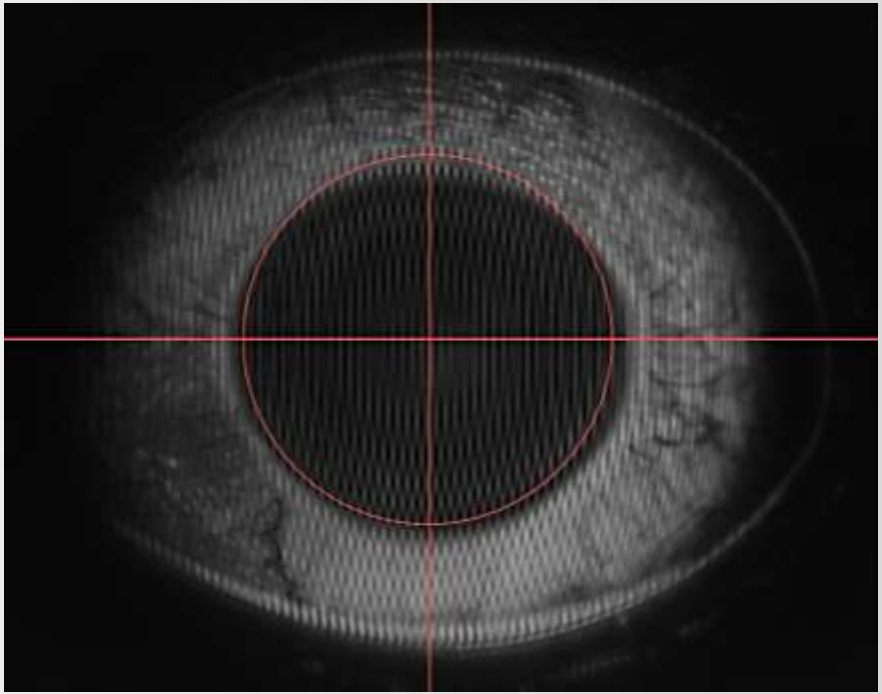
sMap 3D

Vergleich

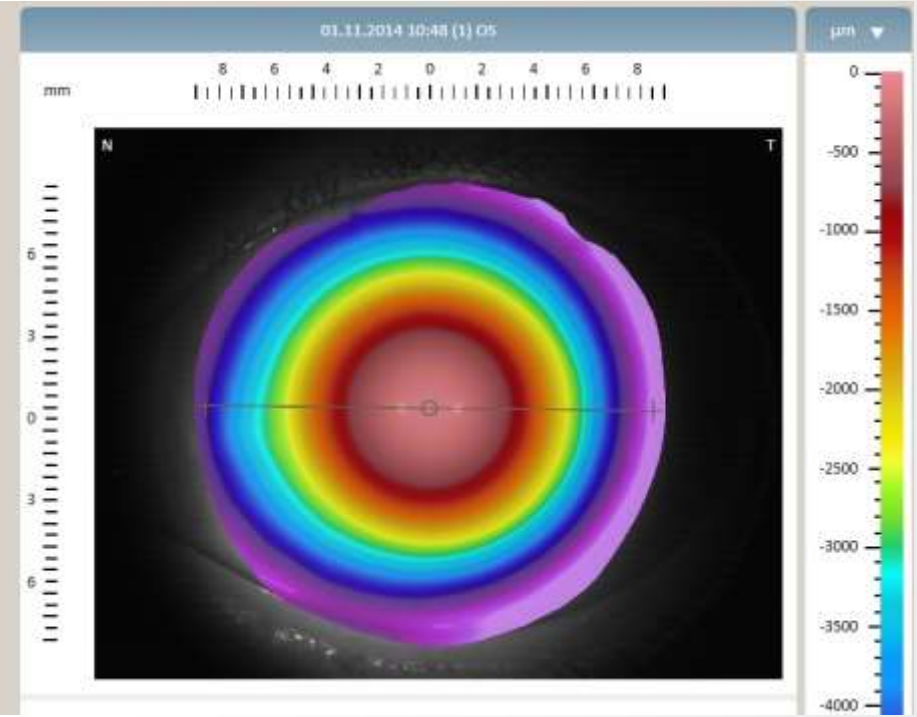
	Eaglet Eye ESP (Eye surface profiler)	sMap 3D
Messmethode	Fourier Profilometrie	Strukturiertes Licht
Messpunkte	350’000	32’400 analysed >1’000’000
Messbereich	bis 20mm	17mm bis 22mm (stiched)
Messgenauigkeit (Sklera)	10µm	10µm
Kamera	1	2
Gitter Projektion	2 Quellen	1 Quelle
Fluo Simulation	Verschiedene Hersteller	Verschiedene Hersteller
Information	www.eaglet-eye.com	www.visionary-optics.com

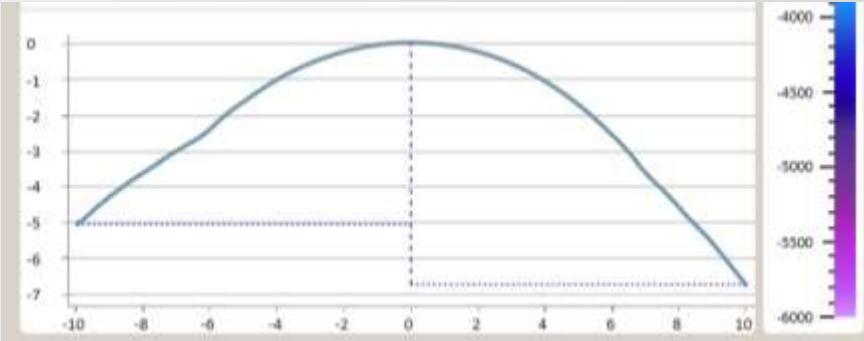
Eaglet Eye ESP



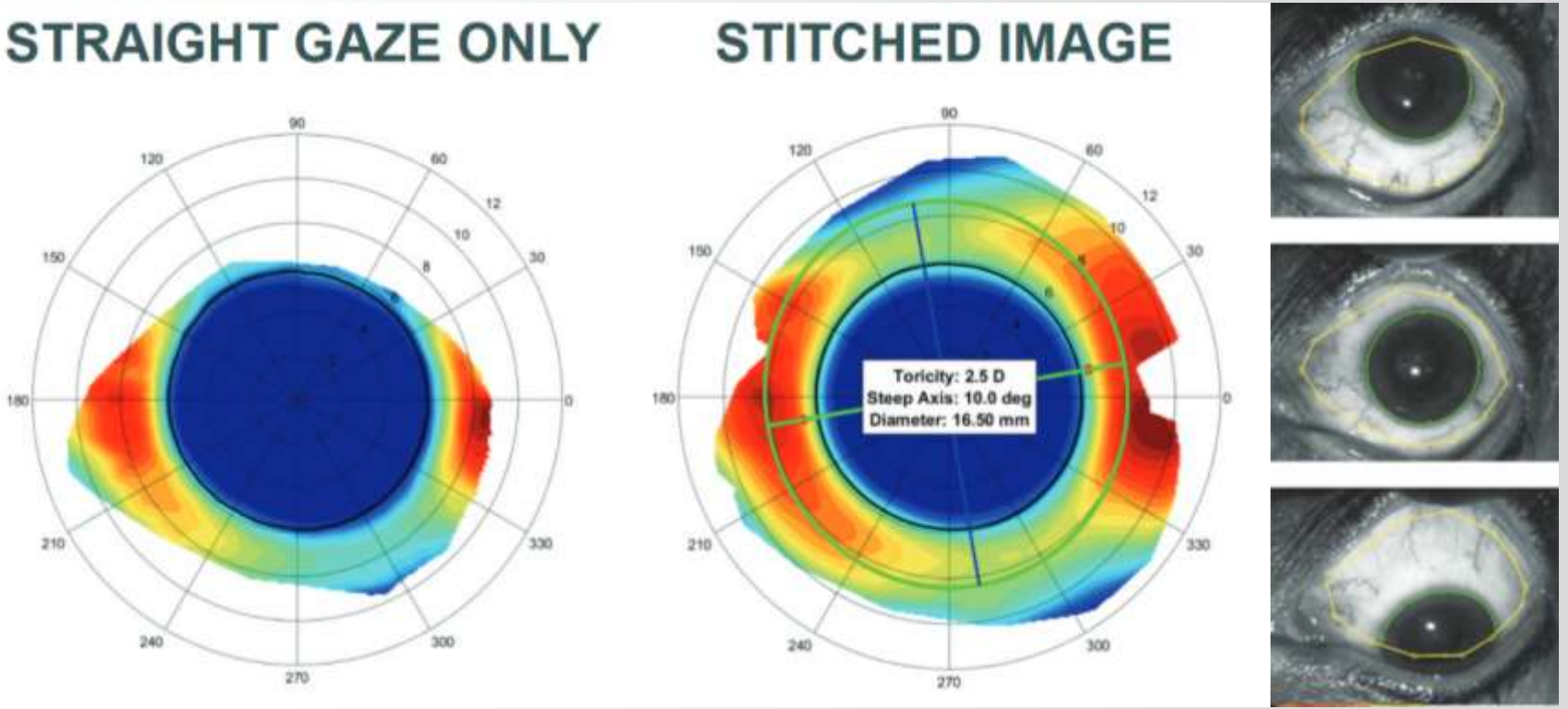


Eaglet Eye ESP





sMap 3D


STRAIGHT GAZE ONLY
STITCHED IMAGE
Toricity: 2.5 D
Steep Axis: 10.0 deg
Diameter: 16.50 mm

OCT vs. ESP vs. sMap 3D

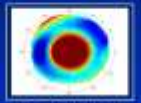
Sagittal Height and Scleral Toricity in 30 Normal Eyes Measured by Three Techniques

Sheila Morrison OD, MS, Markus Ritzmann MS, Patrick Caroline, Beth Kinoshita OD, Matthew Lampa OD and Randy Kojima
Pacific University College of Optometry, Forest Grove, Oregon

Introduction

Previous topographical studies related to scleral shape, have been limited to measurements along the horizontal and vertical meridians. The purpose of this study was to provide a more complete picture of scleral shape through measurements acquired in each of the 8 primary meridians of the sclera. Three anterior segment instruments were used throughout this study: the Zeiss Visante OCT, the Eaglet Eye Surface Profiler and the Precision Ocular Metrology sMap3D (Figures 1,2 and 3).





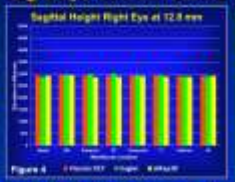
Materials and Methods

Fifteen subjects (30 normal eyes) participated in this study. The inclusion criteria required that each subject be free of any corneal and/or conjunctival pathology. The 30 eyes were imaged with the Visante, Eaglet and sMap3D instruments. Sagittal height measurements were taken in the 8 primary meridians at chords of 12.8, and 15.0 mm. Additional sagittal height measurements were taken with the Eaglet ESP and sMap3D at a chord of 17.0 mm.

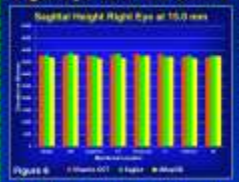
Results

Figures 4-7 are the mean sagittal height results of the OCT, Eaglet and sMap3D in the 8 primary meridians: nasal, superior-nasal, superior, superior-temporal, temporal, inferior-temporal, inferior and inferior-nasal of both right and left eyes at chords of 12.8 and 15.0 mm. Figures 8-9 are the Eaglet and sMap3D at 17.0 mm.

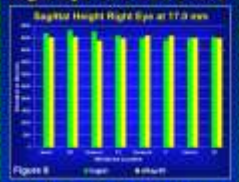
Right Eye 12.8 mm Chord



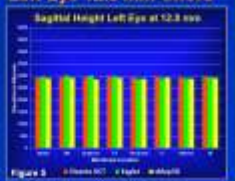
Right Eye 15.0 mm Chord



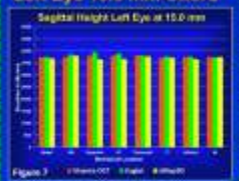
Right Eye 17.0 mm Chord



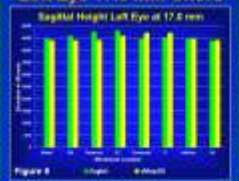
Left Eye 12.8 mm Chord



Left Eye 15.0 mm Chord

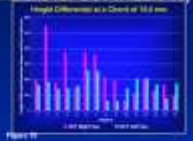
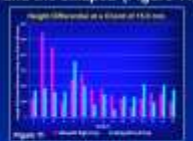


Left Eye 17.0 mm Chord



Scleral Asymmetry

The figures below describe the scleral height differential at 15.0 mm between the flattest and steepest scleral meridians for OCT (Figure 10) and the sMap3D (Figure 11).

The average height differential at the 15.0 mm chord was:

- Right Eye Visante OCT = 225 um, Range 65 to 544 um
- Left Eye Visante OCT = 161 um, Range 60 to 255 um
- Right Eye sMap3D = 195 um, Range 94 to 544 um
- Left Eye sMap3D = 165 um, Range 50 to 213 um

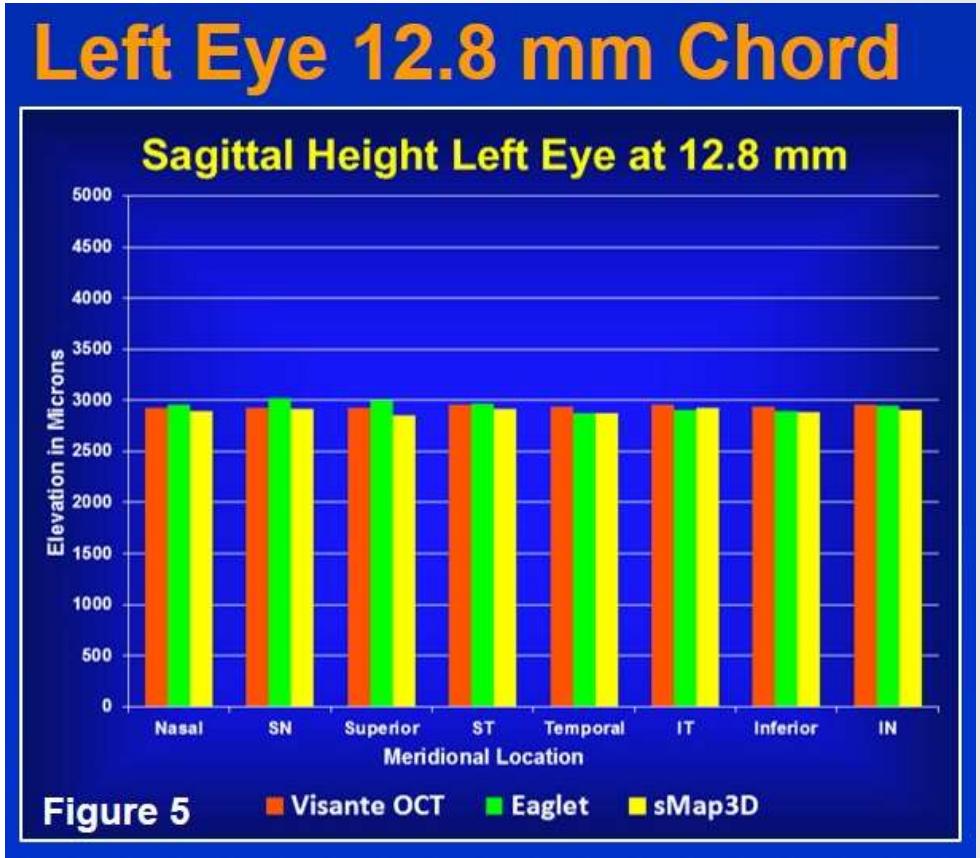
Conclusions

The results of this 30 normal eye study show:

1. A consistency between the data from all three measurement techniques at all three chords.
2. Differences were noted between right and left eyes.
3. The average scleral asymmetry measured by the OCT and sMap3D was slightly greater in right eyes 210 um (~8.50 D.) than left eyes 163 um (~6.50 D).

Vergleich von Visante OCT, ESP und sMap 3D

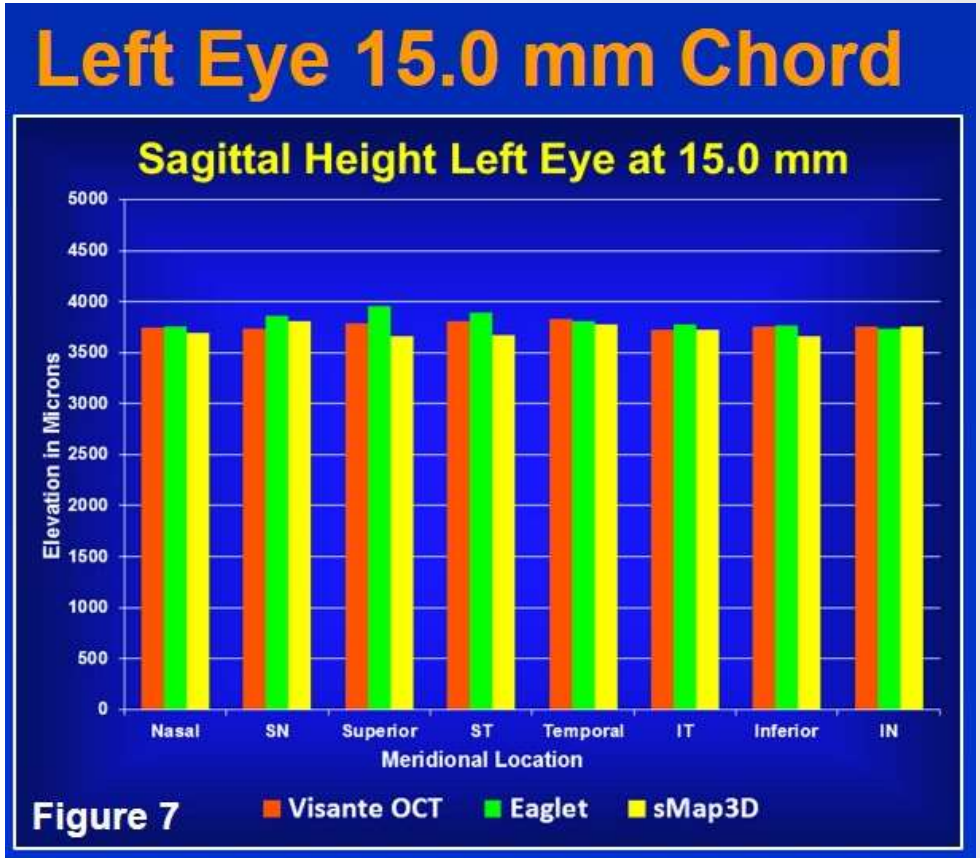
OCT vs. ESP vs. sMap 3D



Resultat

- Relativ gute Übereinstimmung in allen 3 Sehnenlängen
- Unterschiede zwischen rechten und linken Augen wurden festgestellt

OCT vs. ESP vs. sMap 3D



Resultat

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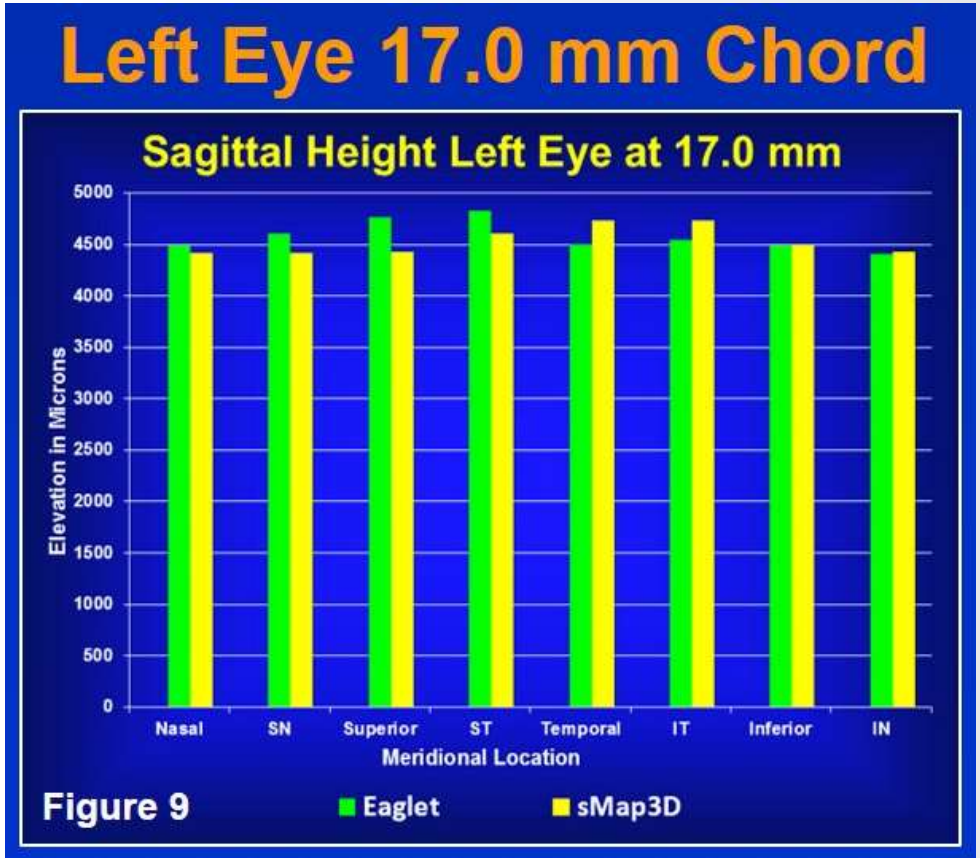
OCT vs. ESP vs. sMap 3D



Resultat

- Relativ gute Übereinstimmung in allen 3 Sehnenlängen
- Unterschiede zwischen rechten und linken Augen wurden festgestellt

sMap 3D & ESP in der Praxis

- Sagittal Höhe kann entnommen werden in verschieden Sehenlängen
- Skleral-Torizität wird sichtbar und kann quantifiziert werden
  - 1. sphärische Mess-CL bleibt ggf. erspart
- Fluobild mit Sklerallinse kann simuliert werden
  - Bestell-Interface mit Lieferanten

Anwendung in der Praxis

- Fluo Applikation notwendig
- Raumbeleuchtung speziell ESP muss dunkel sein
- Es wird wie in der Placido-Topographie Tränenfilm gemessen
  - inferior können sich Verfälschungen durch Tränenmeniskus ergeben
- Bei ESP müssen Lider stark geöffnet werden um grossen Messbereich zu erhalten (vertikal)
- Für Topographie eher ungeeignet (Messgenauigkeit)
- Relativ «enger» Anwendungsbereich

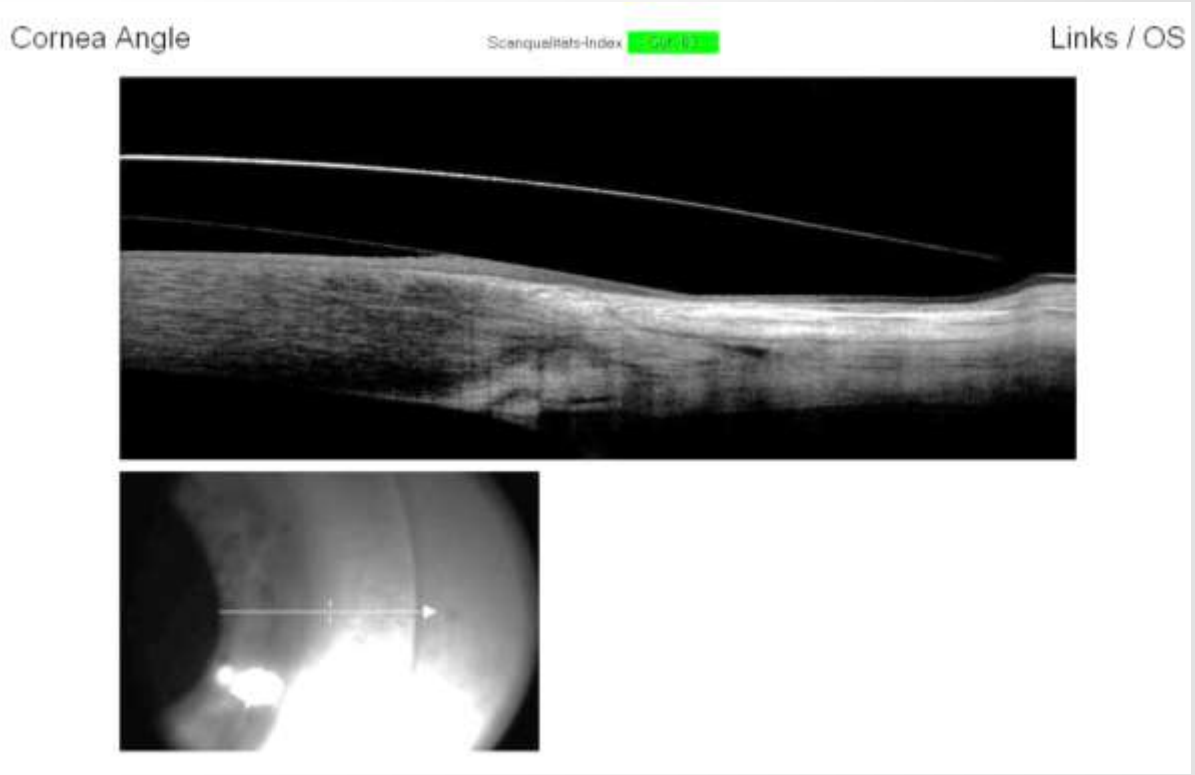
Anwendung in der Praxis

- Eaglet Eye ESP
  - Gespräch mit M. Langis an NCC 2016
    - Benutzt ESP um die ungefähre Scheiteltiefe der ersten Messlinse zu ermitteln
    - Wo konjunktivale Falten vom limbalen Niveau zu erwarten sind.
- Eigene Erfahrung im 2014 im Rahmen der Masterthesis
  - Mit Übung erhält man gut 18-20mm vertikal

Anterior Segment OCT

- Verschiedene OCT-Geräte verfügen über AS Module um Kammerwinkel darzustellen
  - Skerallinsen Sitz kann überprüft werden
  - Überbrückung kann gemessen werden
- (Noch?) keine Software um Skleral-Form zu messen

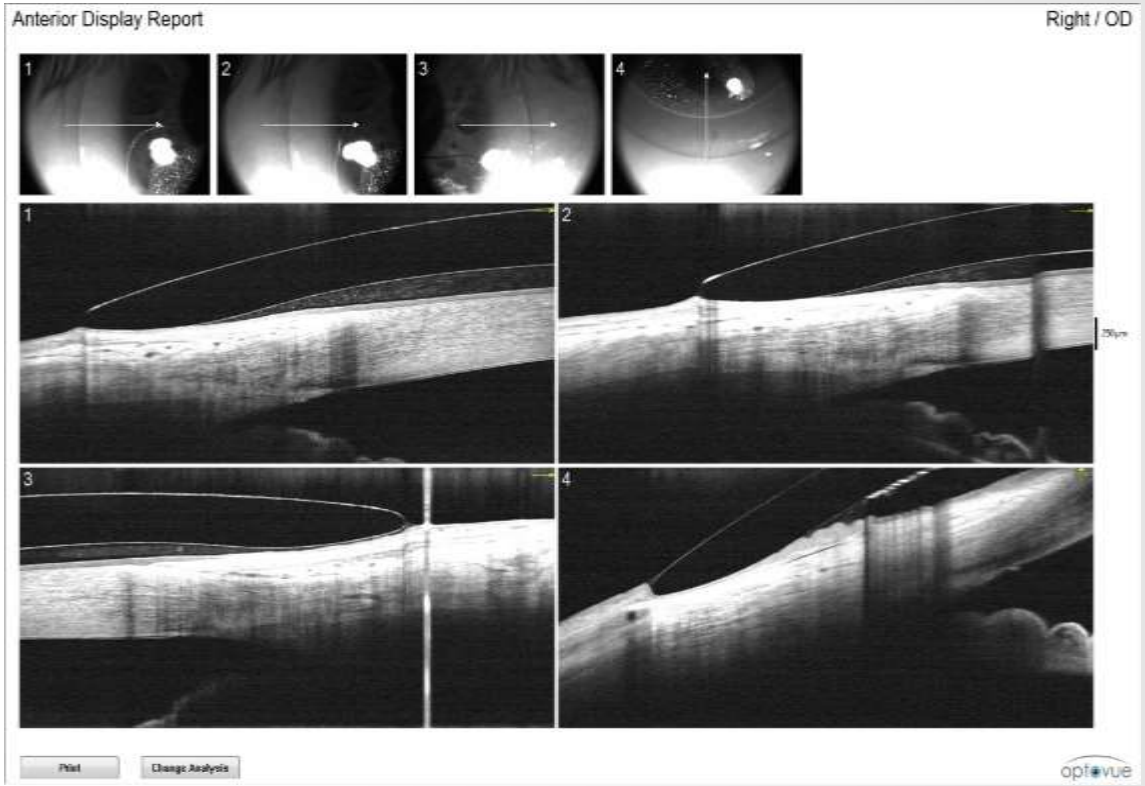
Optovue iVue OCT



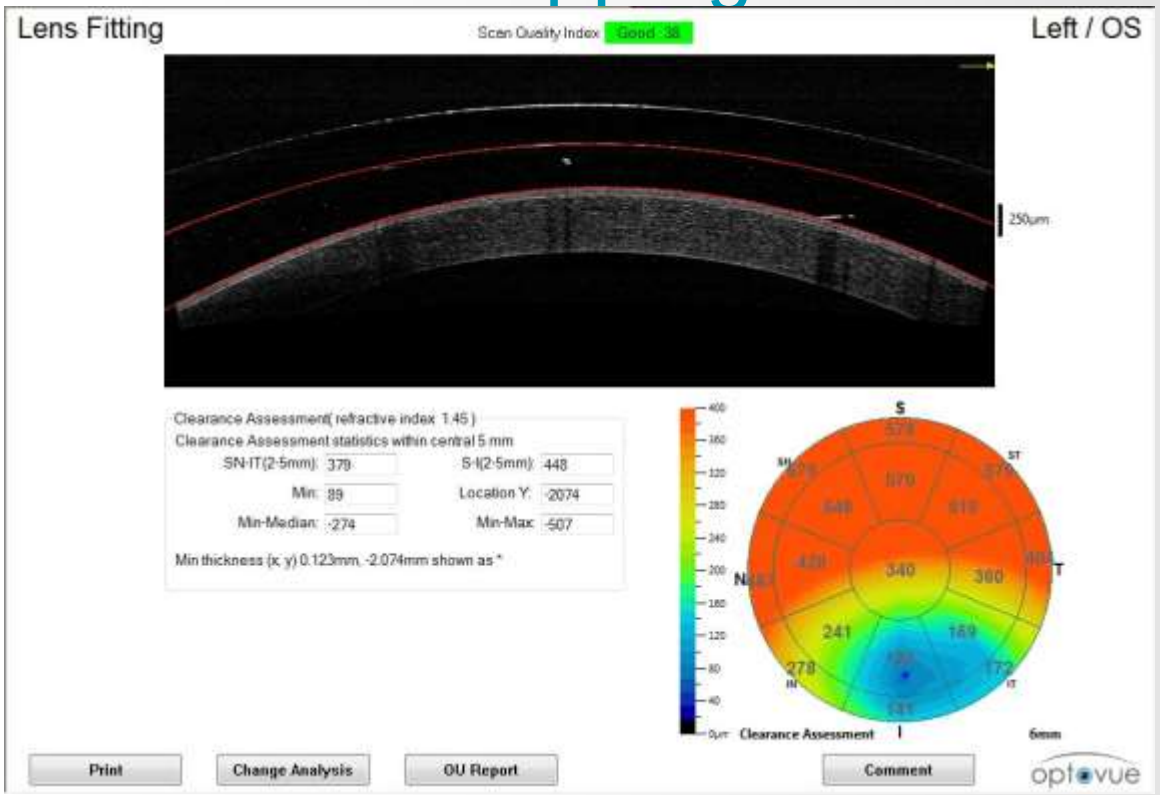
Optovue iVue OCT

- AS-Aufsteckmodul
- Pachymetrie-Mapping im Bereich 6mm
- Zentrale «Vault-Mapping»

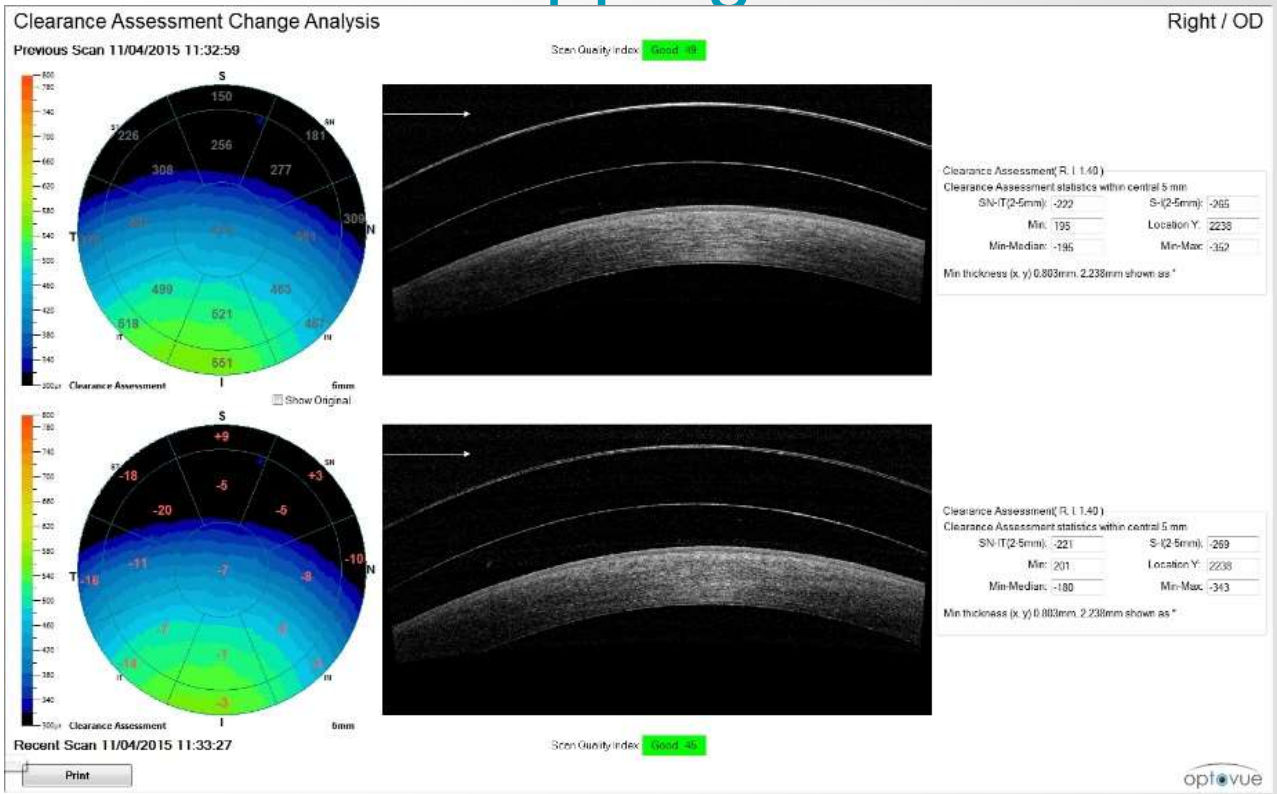
Optovue iVue OCT



iVue Vault Mapping



iVue Vault Mapping



Zeiss Cirrus HD-OCT 500/5000

- 2 Verschiedene Vorderkammer Aufsetzmodule
  - 9mm Cornea HD
    - 9mm Pachymetrie
    - Pro 7.5° ein Scan
  - 15.5mm Anterior Segment
    - Nur eine Scan-Achse (Richtung) möglich pro Scan
      - Visante war 4 Achsen simultan möglich
    - Dh. Horizontal und Vertikal entsprechen 2 einzelnen Aufnahmen
    - Sagittale höhe kann gemessen werden bis max 15.5mm

Zeiss Cirrus HD-OCT 500/5000

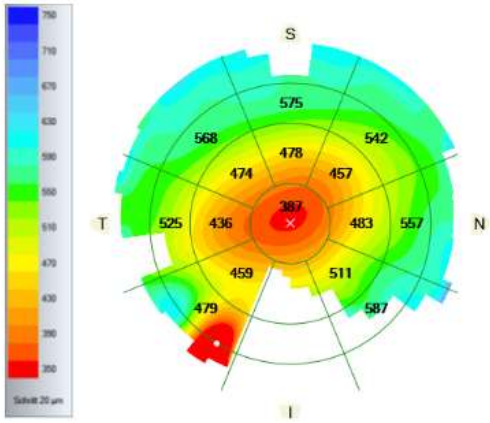
- 15.5mm
  - AS-Scan
    - Ca. 6mm Scantiefe
  - HD-Angle to angle
    - Ca. 2mm Scantiefe
- 9mm
    - Pachymetrie
    - Cornea HD

Zeiss Cirrus HD-OCT 500/5000

			OD	OS	
Name:	Lei, Pe				
Patienten-ID	326	Untersuchungsdatum:	03.03.2017	03.03.2017	CZMI
Geb.-Datum:	06.06.1959	Untersuchungszeit:	14:17	14:19	
Geschlecht:	Unknown	Seriennummer:	5000-6989	5000-6989	
Techniker:	Operator, Cirrus	Signalstärke:	n.v.	n.v.	

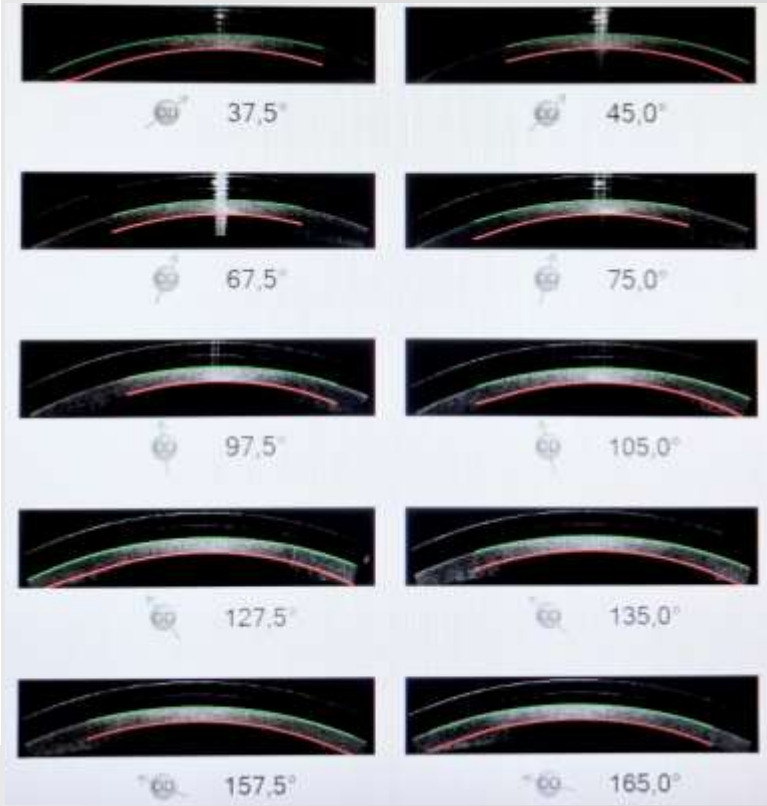
Pachymetrie-Analyse : Pachymetrie OD ● ● OS

OD

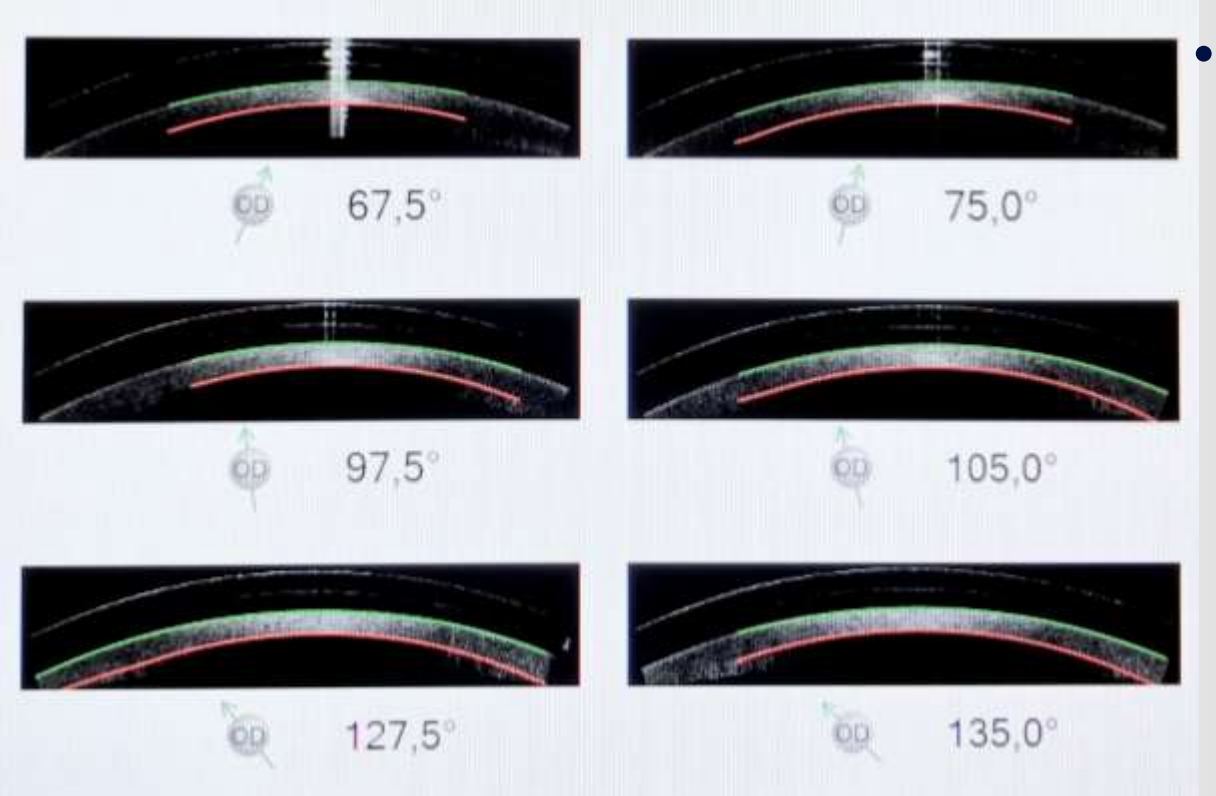


Bereich (mm)	Min. (µm)	Durchschn. (µm)	Max. (µm)
0,0-2,0	364	387	436
2,0-5,0	384	471	582
5,0-7,0	257	548	623

Minimum Dicke (µm)	257
Vertex Dicke (µm)	365

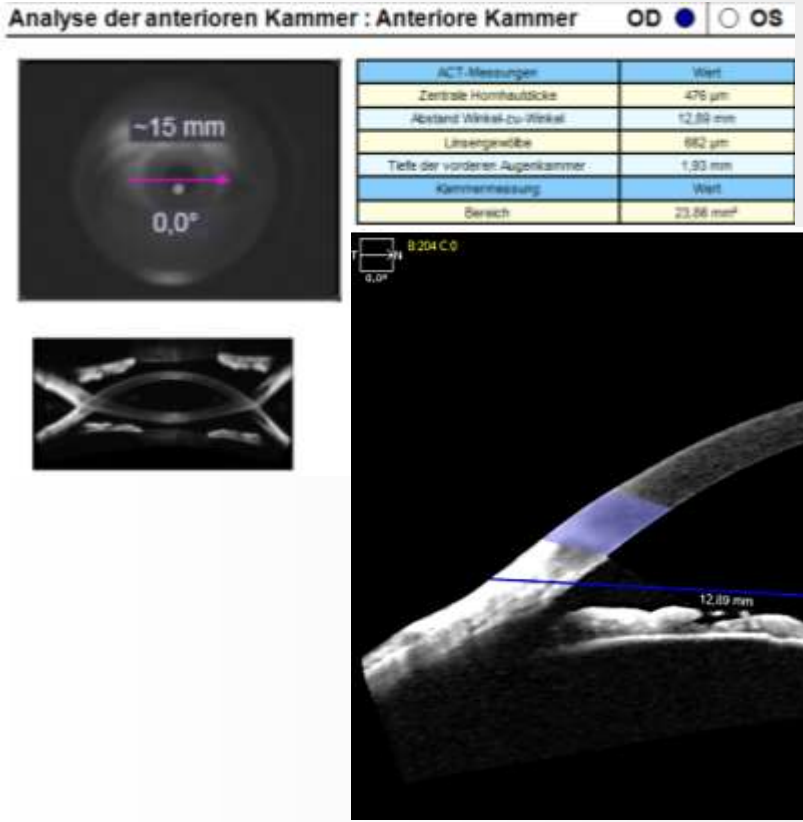


Zeiss Cirrus HD-OCT 500/5000

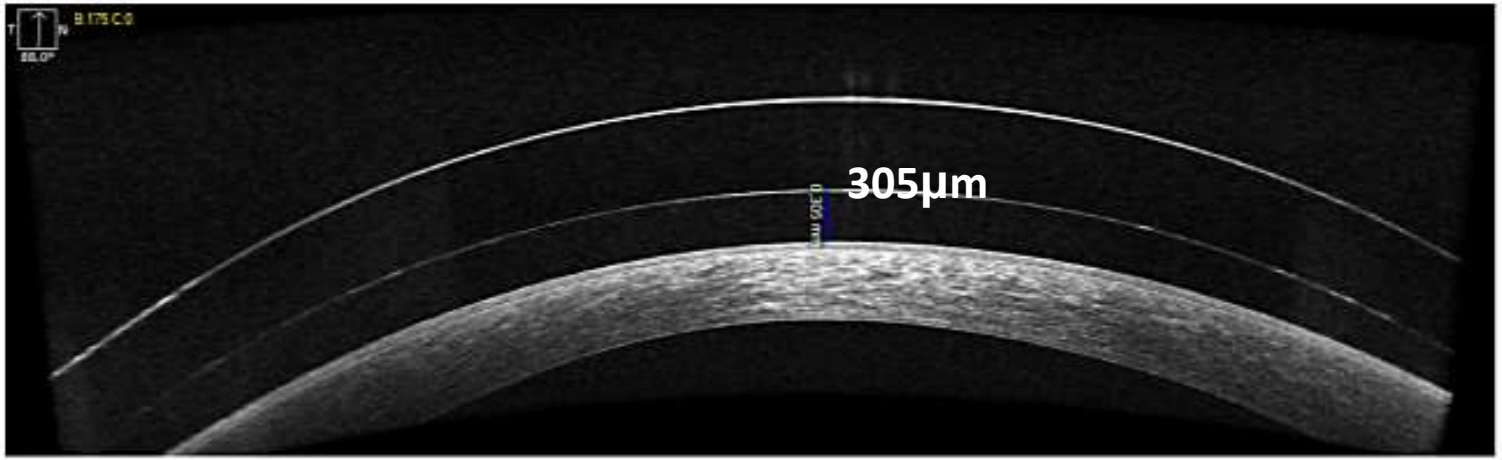


- CL wir als Artefakt „weggerechnet“

Beispiel Sag-Messung



Beispiel Sag-Messung

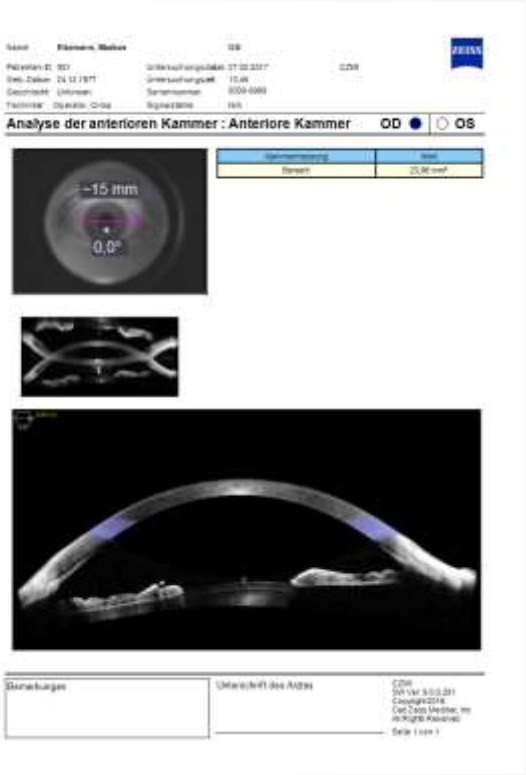


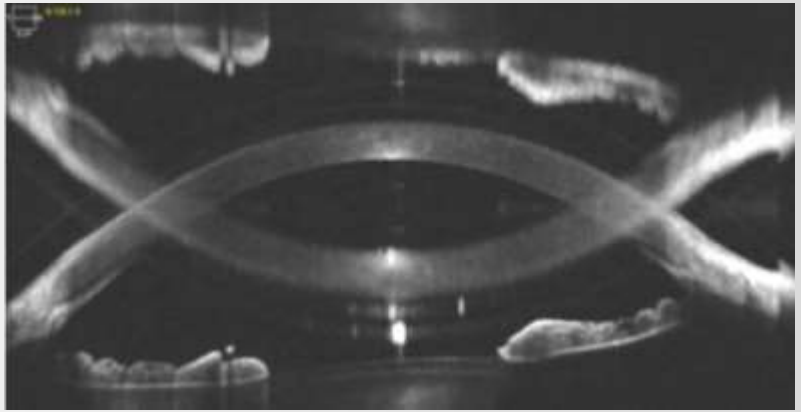
X Linse bei 12.8mm = 3300µm

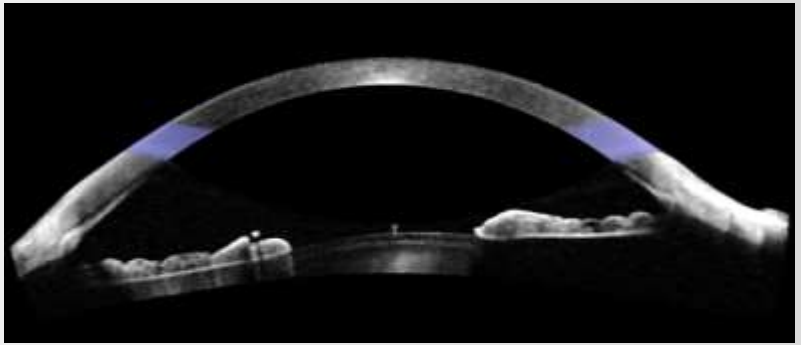
Sag Cornea + Clearance = Sag ScCL

3056 µm + 305 µm ≈ 3300 µm

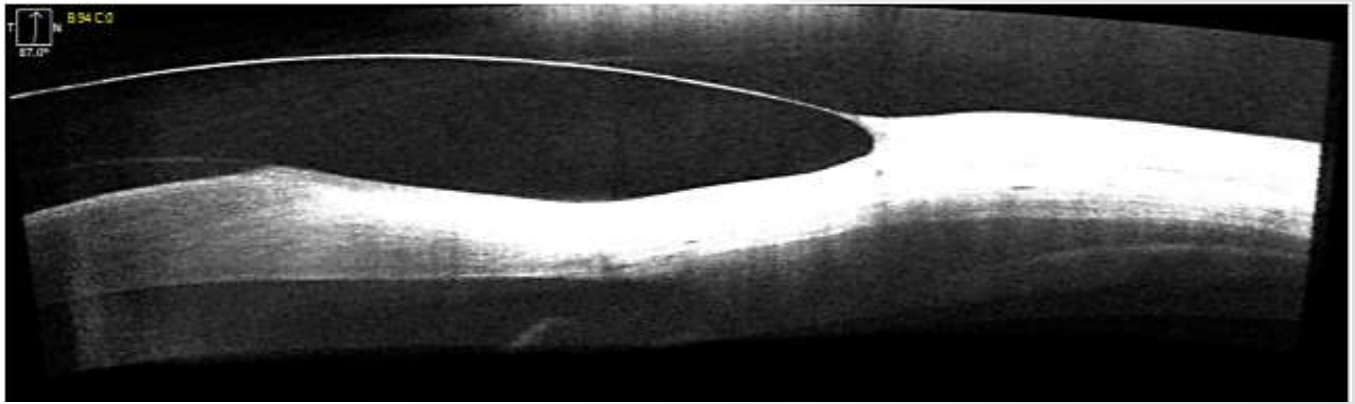
Zeiss Cirrus HD-OCT 500/5000







Zeiss Cirrus HD-OCT 500/5000



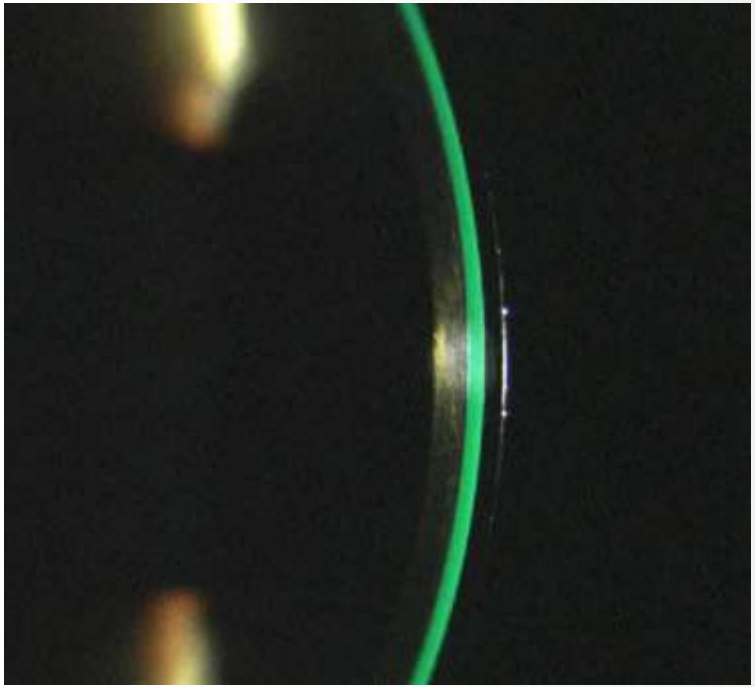
Zeiss Cirrus HD-OCT 500/5000

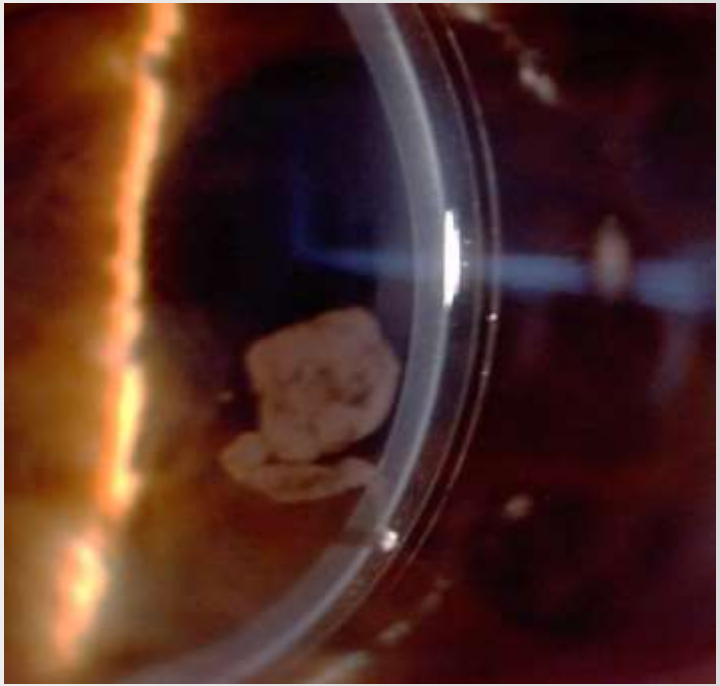
- 15.5mm Scan wird Sklerallinse als Artefakt aus RAW ausgeblendet → (noch?) kein Clearance Mapping
- Es kann nicht die ganze Linse aufgenommen werden mit 15.5mm
- Sagitalhöhenmessung mit AS-Scan zeitaufwendig
- Handhabung der Zentrierung via Maus und Kinnstütze
  - Gewöhnungsbedürftig

Spaltlampe

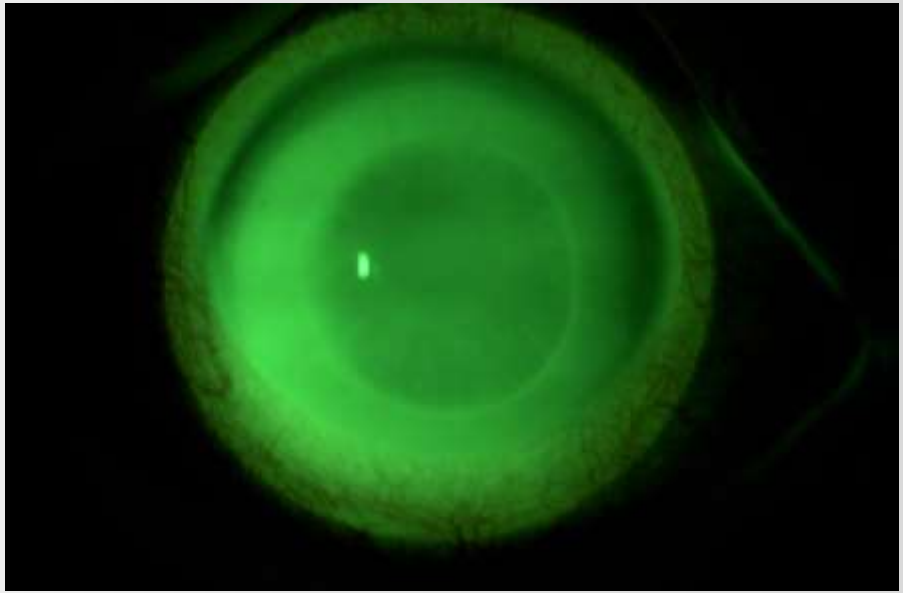
- Do not forget the obvious!
- Wichtigstes Tool in der Sklerlalinsen Anpassung überhaupt!!!!

Clearance



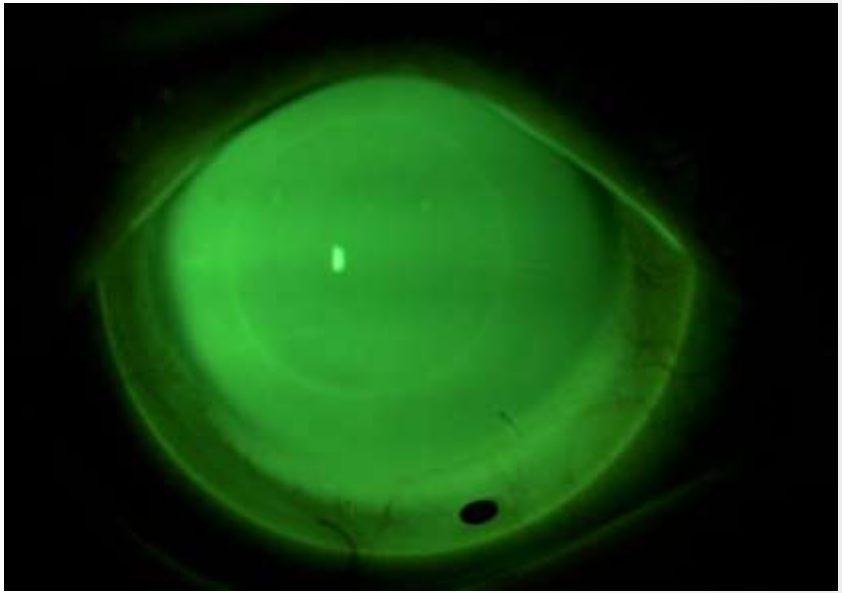


Clearance & Sitz

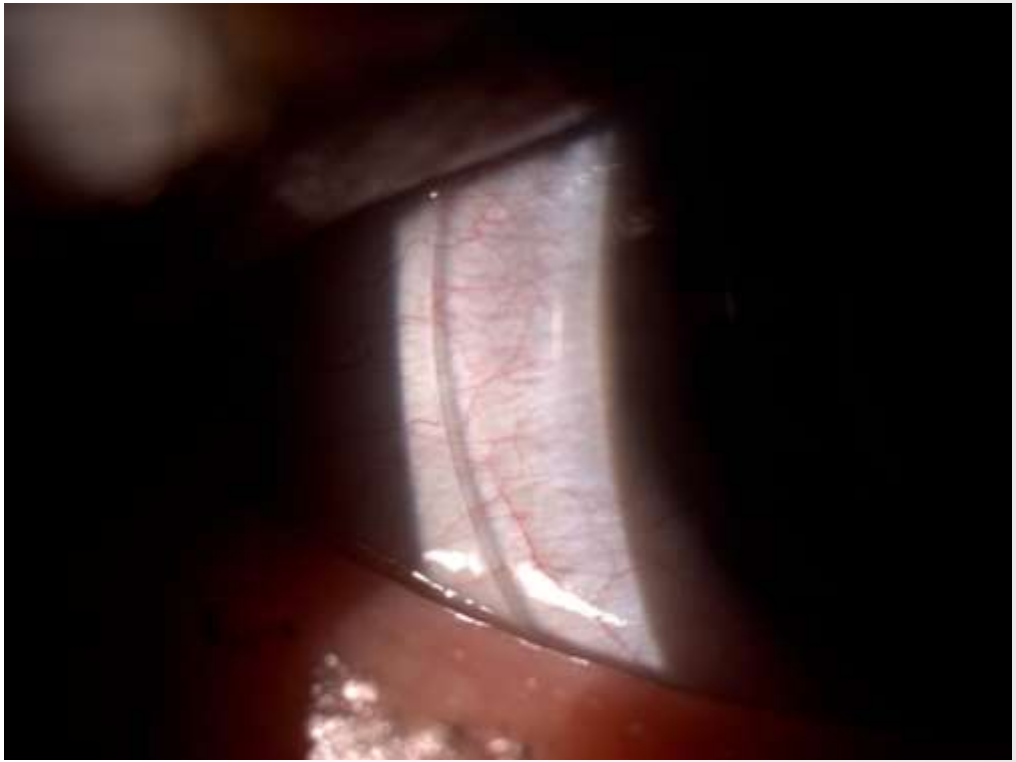


Clearance & Sitz

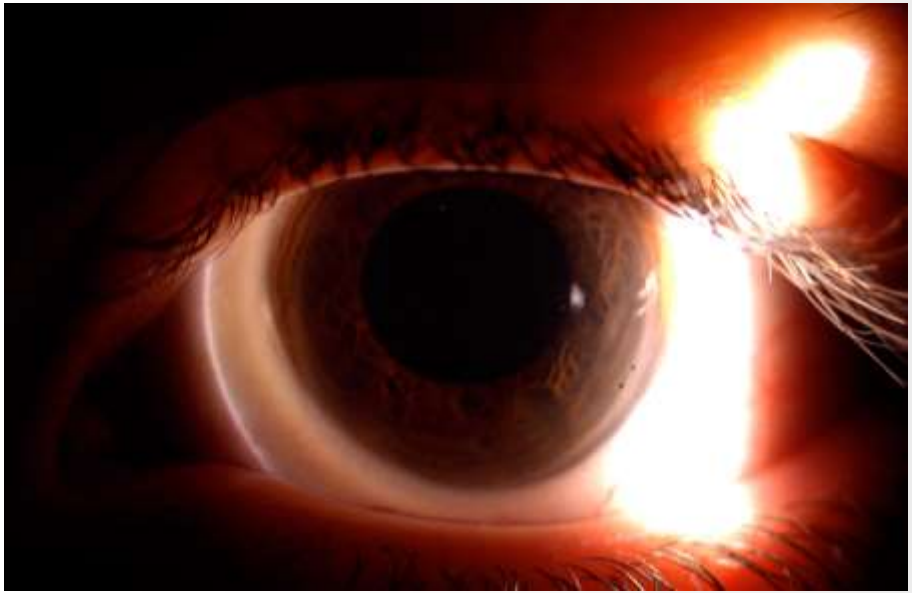
Limbal Clearence & Sitz



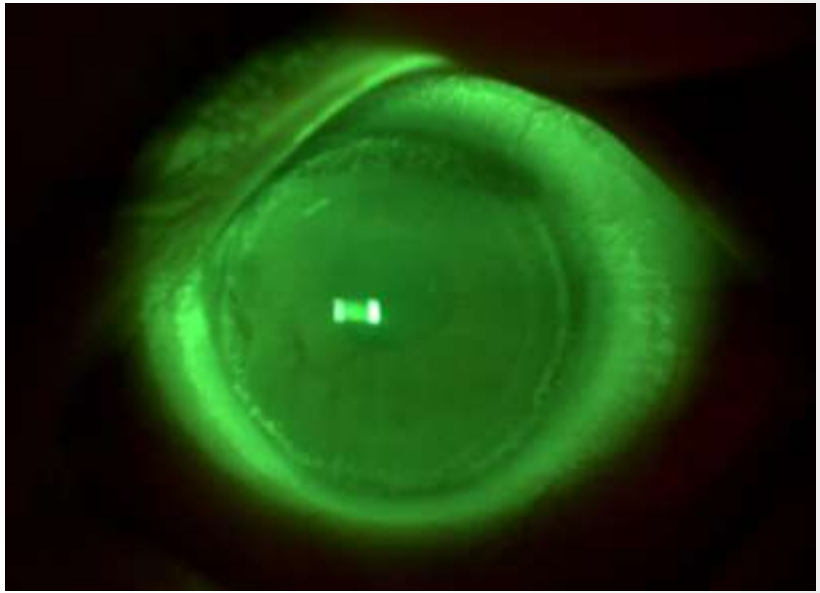
Edge lift

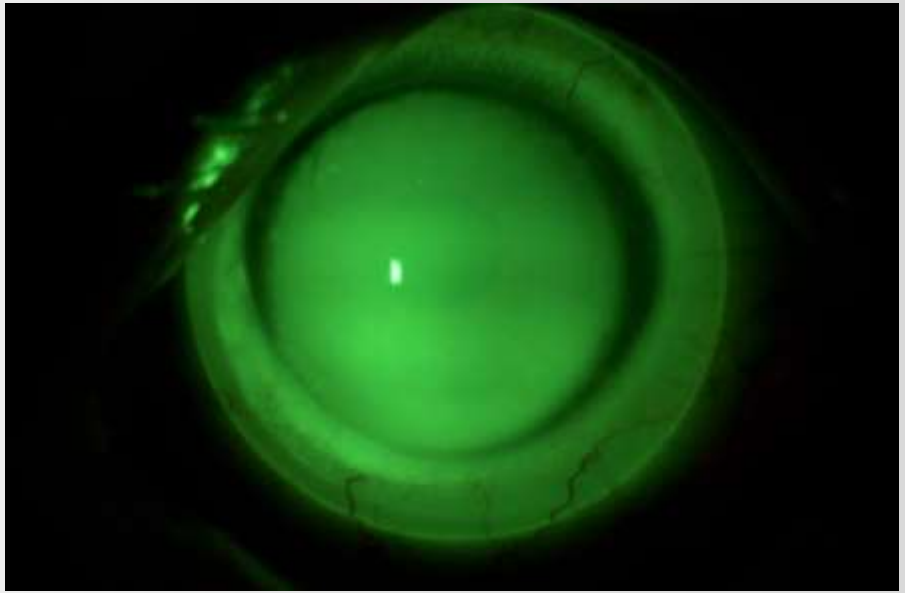


Microcystic Edema Limbal-Touch



Microcystic Edema Limbal-Touch





Schlussfolgerung Fitting Tools

- Messlinsen sind schnell und unkompliziert
  - ergänzt mit Pentacam und OCT
- Messtechniken Sklera sind relativ einseitig vom Einsatzgebiet
  - Corneale Topographie bedingt übereinstimmend mit herkömmlichen Topographen
- Zukunftswunsch
  - OCT mit AS-Zusatzmodul mit Messbereich von 17mm +
  - integrierter Corneal-Topographie-Software
  - Sklerale-Topographie mit Höhenkarte
  - Fluosimulation & Schnittbild Simulation
  - Ergänzt mit 3D-Sklerallinsen-Drucker ☺

SKLERALE TORIZITÄT

Skleraler Astigmatismus

Scleral astigmatism	eye	n	Mean difference Primary astigmatism	*Mean difference secondary astigmatism*
Rectus	OD	10	170µm	*60µm*
Invers	OD	12	130µm	*60µm*
Oblique 45°	OD	2	80µm	*60µm*
Oblique 135°	OD	14	170µm	*60µm*
Rectus	OS	10	190µm	*80µm*
Invers	OS	14	140µm	*50µm*
Oblique 45°	OS	5	130µm	*100µm*
Oblique 135°	OS	8	140µm	*60µm*
No astigmatism	OS	2	0 µm	*0µm*

Cornealer Asti vs. Skleraler Asti

Corneal Toricity and Scleral Asymmetry…. Are They Related?

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Introduction

Historically we have most often described astigmatism in terms of the dioptric power from the keratometer or axial display topography map. The axial display map does an excellent job of describing the dioptric power of the cornea and illustrating the shape and location of the corneal astigmatism (Figure 1). But, this map provides only limited information that can be used in the fitting of corneal contact lenses. Today, there has been a paradigm shift within our industry to describe corneal astigmatism not as a dioptric power but instead as a difference in height (i.e. sagittal depth) between the two principle meridians (flat and steep) of the cornea.

Using sagittal height data, the corneal topographer creates an elevation map by selecting a "theoretical" spherical surface that runs through the cornea (Figure 2). It is the elevation display map that best describes the ultimate fluorescein pattern seen clinically (Figure 3).

Previous studies at Pacific University have shown that a:

25 µm differential in corneal height (between the flat and steep meridians) is equal to approximately 1.00 D of toricity.

Purpose

The purpose of this study is to determine if there a relationship between the corneal toricity and the scleral shape (toricity) using sagittal height measurements.

Materials and Methods

- Twenty subjects, 10 left eyes with <0.75 D of with-the-rule corneal toricity and 10 left eyes with >1.75 D with-the-rule corneal toricity, participated in this pilot study.
- The Placido ring based Medmont E300 Corneal Topographer was used to determine the corneal toricity and elevation along the flat and steep meridians.
- The sMap3D by Precision Ocular Metrology was used to determine the scleral shape along four meridians (0-180°, 45°-225°, 90°-270°, 135°-315°) of the sclera at chords of 15.0 mm and 17.0 mm. The system uses Nafi and projected pattern sequences to map the corneal and scleral surface out to a chord of 22 mm (three fields of gaze are stitched together to form a single composite map).

Results

Low Corneal Astigmatism < 0.75 D

High Corneal Astigmatism > 1.75 D

Results Continued

- Of the 10 low WTR corneal astigmatism subjects, only 1 maintained a WTR orientation of the sclera at a 15.0mm chord and none of the subjects at a 17.0 mm chord.
- Of the 10 high WTR corneal astigmatism subjects, 3 maintained a WTR orientation of the sclera at chords of 15.0mm and 17.0 mm.
- The average amount of height differential between the principle meridians increased from the cornea to the sclera
- The orientation of the steep and flat meridians was variable at 15.0 & 17.0mm for both low and high astigmatism corneas.
- These results confirm that a 25 µm height differential of the principle corneal meridians is equal to ~1.00 D of corneal toricity.

Average Height Differential

Chord	Low Astigmatism	High Astigmatism
8 mm	8.5 µm	88.2 µm
15 mm	153.3 µm	235.6 µm
17 mm	280 µm	335 µm

Conclusions

- This pilot study appears to indicate that the scleral shape is highly asymmetric and confirms the presence of toricity that is often not in the same orientation and magnitude as the corneal toricity.
- The implications of these data may influence future contact lens designs to improve lens position and optics (i.e. Toric, MF, KCN)
- As future lens designs increase in diameter, it may be necessary for eye care professionals to image both the cornea and sclera and utilize lens designs that take into account the highly asymmetric shape of the human sclera.

Die geringe Abhängigkeit von cornealer Torizität zu Skleralen Torizität bestätigt

Cornealer Asti vs. Skleraler Asti

Results

Low Corneal Astigmatism < 0.75 D

ID	Δ Km 8.0mm chord	Corneal Height Difference 8.0mm chord	Scleral Height Difference 15.0mm chord	Location of Astigmatism 15.0mm chord	Scleral Height Difference 17.0mm chord	Location of Astigmatism 17.0mm chord
1	0.25 D	3.7 µm (WTR)	115 µm	Asymmetric	75 µm	Asymmetric
2	0.43 D	3.7 µm (WTR)	186.5 µm	ATR	104.5 µm	Asymmetric
3	0.53 D	3.7 µm (WTR)	226 µm	Oblique	649 µm	Asymmetric
4	0.51 D	20.6 µm (WTR)	247 µm	Oblique	316.5 µm	Oblique
5	0.37 D	2.1 µm (WTR)	116.5 µm	Asymmetric	111 µm	Asymmetric
6	0.27 D	11.8 µm (WTR)	111.5 µm	ATR	35.5 µm	ATR
7	0.53 D	10.2 µm (WTR)	80.5 µm	Asymmetric	201.5 µm	Oblique
8	0.32 D	5.9 µm (WTR)	147.5 µm	ATR	86 µm	Asymmetric
9	0.42 D	20.5 µm (WTR)	166 µm	Asymmetric	196 µm	Asymmetric
10	0.52 D	12.9 µm (WTR)	137.5 µm	WTR	225 µm	Oblique

High Corneal Astigmatism > 1.75 D

ID	Δ Km 8.0mm chord	Corneal Height Difference 8.0mm chord	Scleral Height Difference 15.0mm chord	Location of Astigmatism 15.0mm chord	Scleral Height Difference 17.0mm chord	Location of Astigmatism 17.0mm chord
1	1.92 D	52.2 µm (WTR)	47.5 µm	Oblique	74 µm	Asymmetric
2	1.89 D	27.5 µm (WTR)	199 µm	ATR	123.5 µm	ATR
3	4.17 D	113.3µm (WTR)	278 µm	Oblique	276.5 µm	Oblique
4	2.40 D	52.3 µm (WTR)	138.5 µm	Asymmetric	174 µm	ATR
5	2.16 D	58.9 µm (WTR)	323 µm	Asymmetric	436 µm	Asymmetric
6	3.73 D	96.4 µm (WTR)	684 µm	WTR	1099 µm	WTR
7	1.99 D	52.5 µm (WTR)	201 µm	WTR	342.5 µm	WTR
8	3.34 D	79.8 µm (WTR)	162 µm	WTR	262.5 µm	WTR
9	3.94 D	99 µm (WTR)	129 µm	Asymmetric	204 µm	Asymmetric
10	2.42 D	61.4 µm (WTR)	193.5 µm	Oblique	358 µm	Oblique

subjects at a 17.0 mm chord.

- Of the 10 high WTR corneal astigmatism subjects, 3 maintained a WTR orientation of the sclera at chords of 15.0mm and 17.0 mm.
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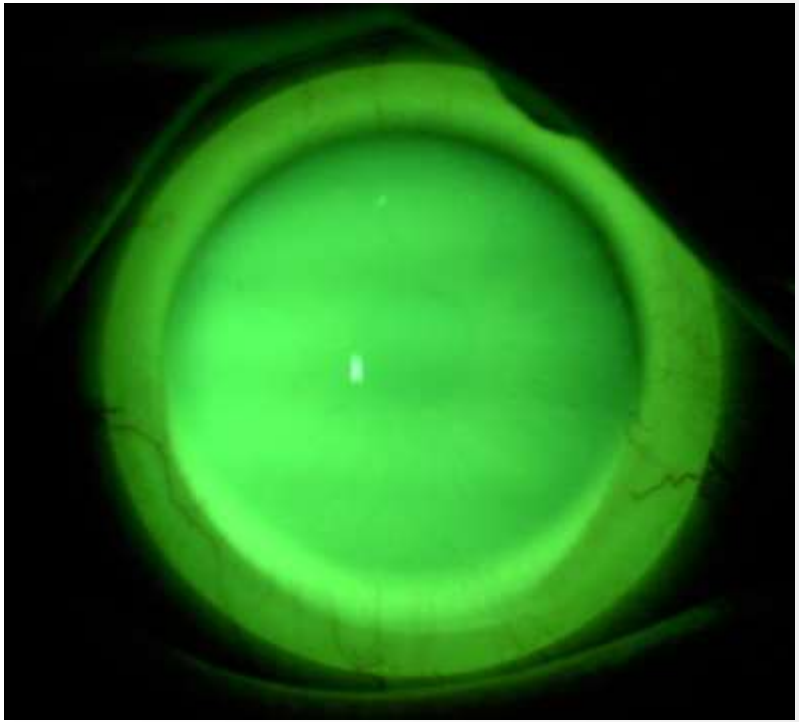
Torische Sklerallinsen

- Torische Sklerallinsen
  - Advantages of Toric Scleral Lenses
    - Visser et. al OVS 2006
- Linsencentrum
  - 60-80% aller Neu-Anpassungen mit SMT (Limbal- & Skleraltorisch)
  - Bessere Zentrier-Eigenschaften
  - Regelmässigere Skleralauflage
  - Weniger Limbalödeme

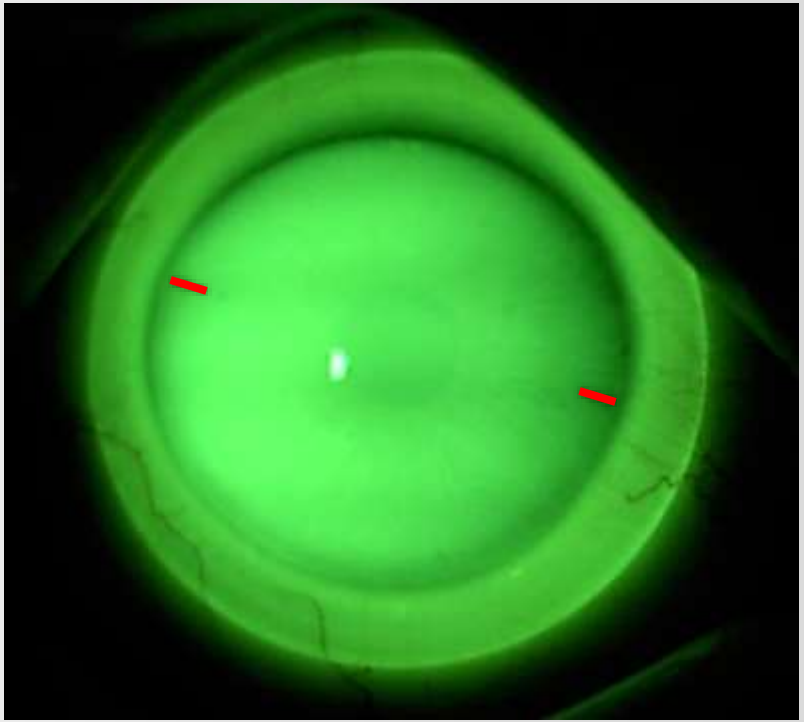
Rotationssymmetrisch. vs. torisch

- Nur mit hohem cornealen Astigmatismus Zusammenhang mit Skleraltorus Achse
- Bessere Verträglichkeit und höherer Komfort
- Einfacher um den Rest-Astigmatismus zu korrigieren
  - Sehr konstante Stabilisation
  - Dünnere Linse gegenüber prismatisch oder dynamisch → Komfort & Sauerstoff
  - Eignet sich hervorragend für Versorgungen hohen Asti an Stelle von Weichlinsen

Rotationssymmetrisch. vs. torisch

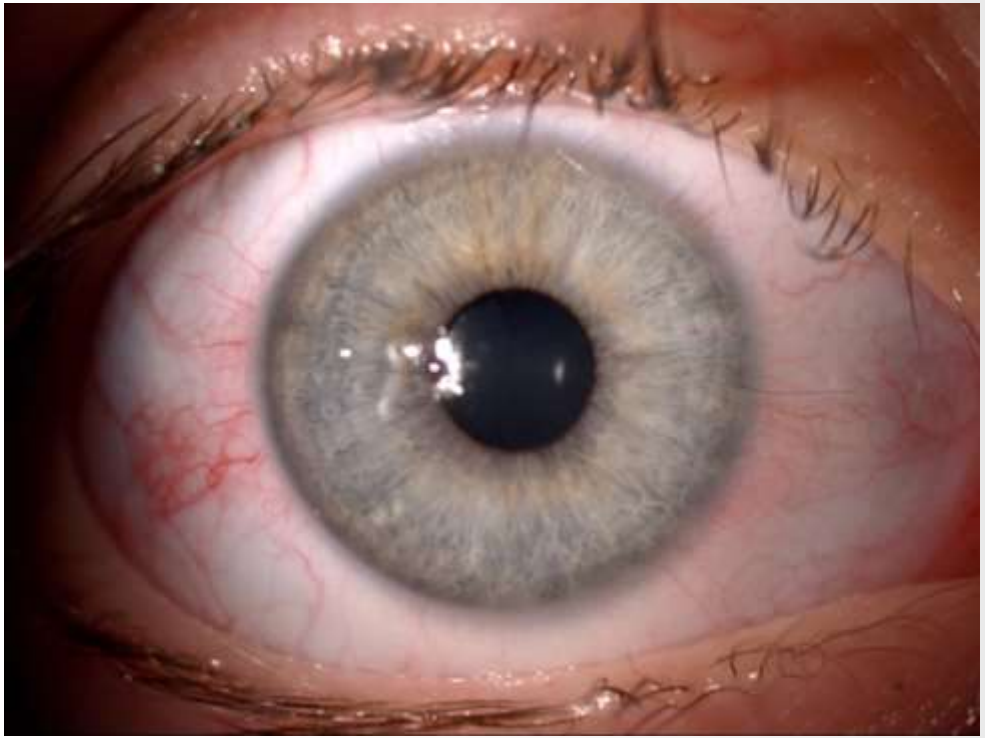


Rotationssymmetrische Sklerallinse



Skleral- und Limbaltorische Sklerallinse

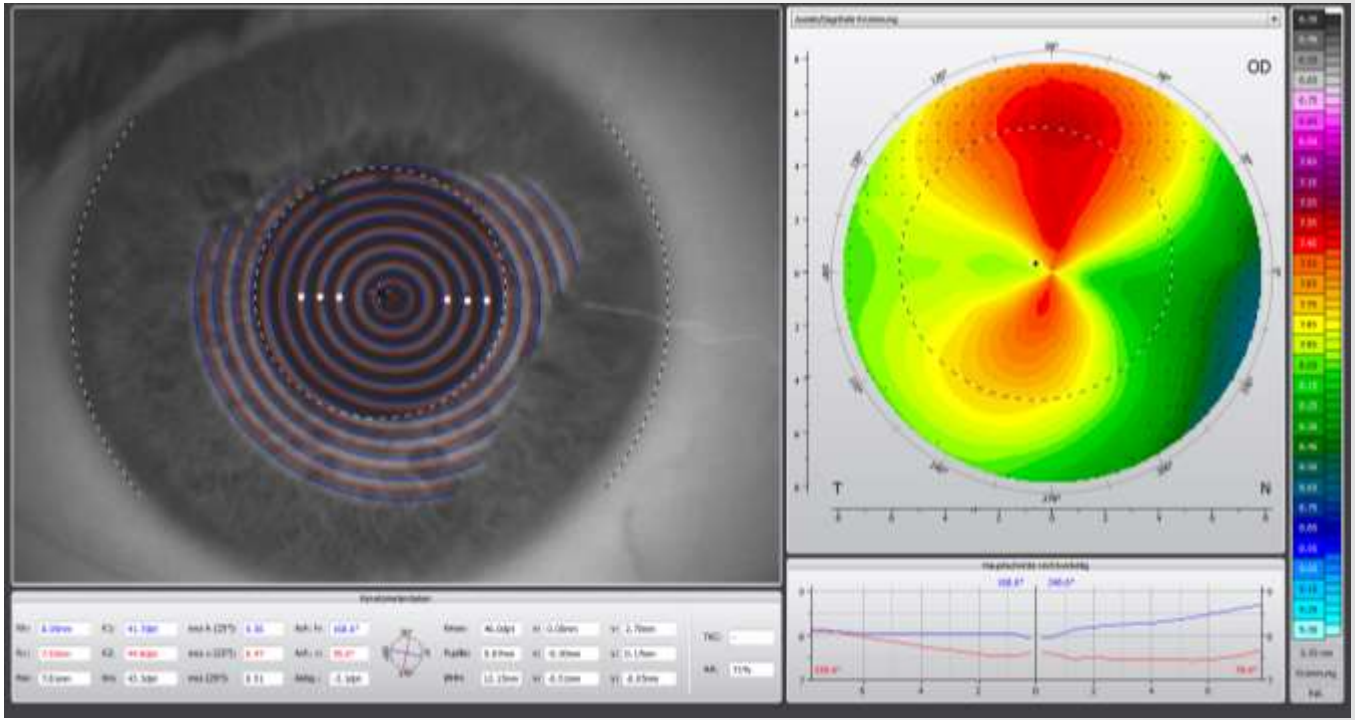
Rotationssymmetrisch. vs. torisch



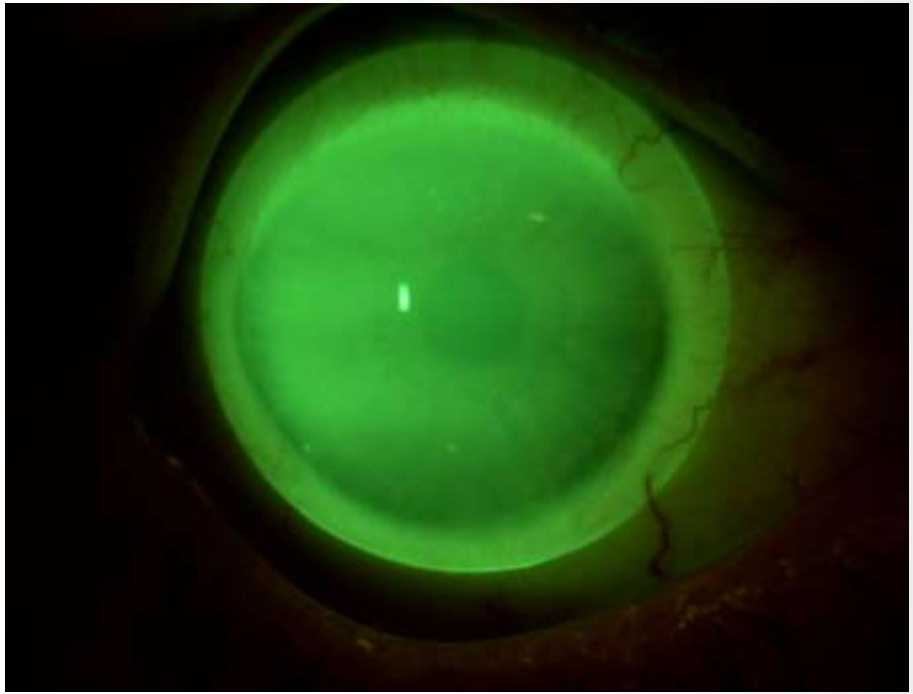
Rotationssymmetrische Sklerallinse

Horizontal grössere Druck/Auflage als vertikal in der Skleralzone

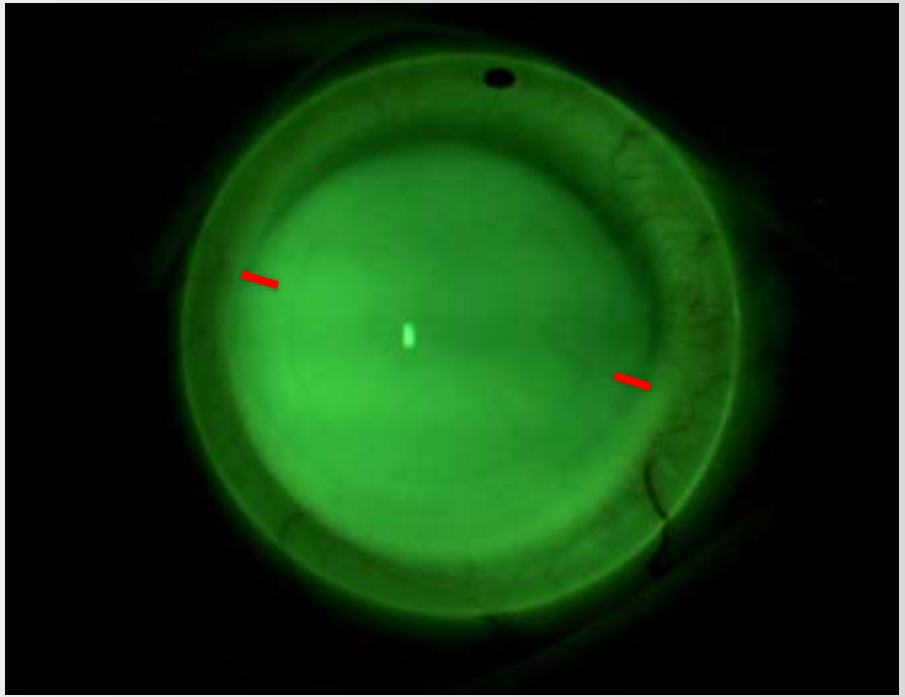
Rotationssymmetrisch. vs. torisch



Rotationssymmetrisch. vs. torisch



Rotationssymmetrische Sklerallinse



Skleral- und Limbaltorische Sklerallinse

Limbaltorus

- Neue Generation der torischen Sklerallinse
- Skleraltorisch
  - Unterschiedliche Skleralradien (steil vs. flacher HS)
- Limbaltorisch (und Skleraltorisch möglich)
  - Unterschiedliche limbale Abflachung (steil vs. flacher HS)
- Verbesserung Anpassung
  - Weniger caudale Ödeme und Bindehaut Falten
  - Weniger vertikale Dezentrationen
  - Kaum „midday Fogging“ bekannt

SKLERLALINSEN UP-DATE

ScCL Update

- Predicting estimates of oxygen transmissibility for scleral lenses (Michaud L. et al. 2012)
  - Theoretisch kalkulierte O_2 Transmissibiltät
  - Tränenfilm DK 80
  - Fazit:
    - Mittendicke <250µm
    - Material DK so hoch wie möglich >150
    - Überbrückung ≤ 200µm

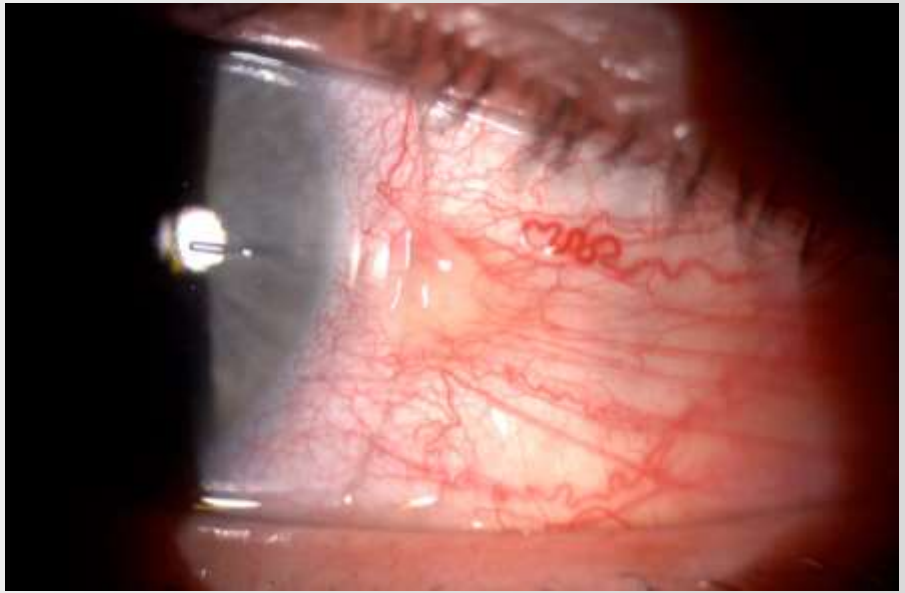
ScCL Update

- Evaluation of oxygen under scleral lenses fitted with different reservoir thickness (Michaud L. et al.) Poster AAOPT 2015
  - Evaluation von Sauerstoffdruck EOP (equivalent oxygen percentage) an der Cornea bei 8 Probanden nach 5 Min
  - Fazit:
    - 200µm vs. 400µm Überbrückung
    - Je höher die Überbrückung desto geringer der Sauerstoff-druck an der Cornea
      - 200 = 9.0
      - 400 = 6.7
      - Schwellwert EOP = 9.9 für Tagestragen

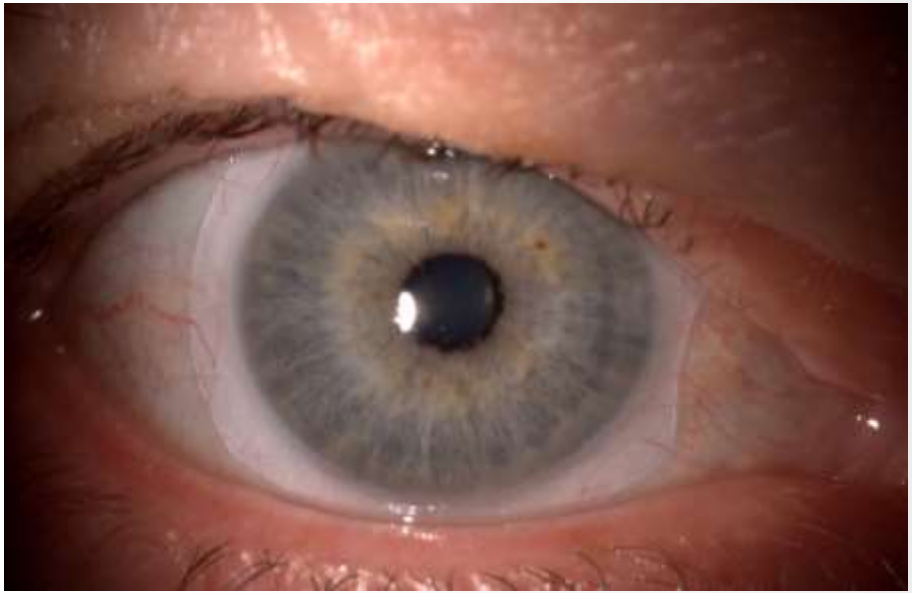
ScCL Update

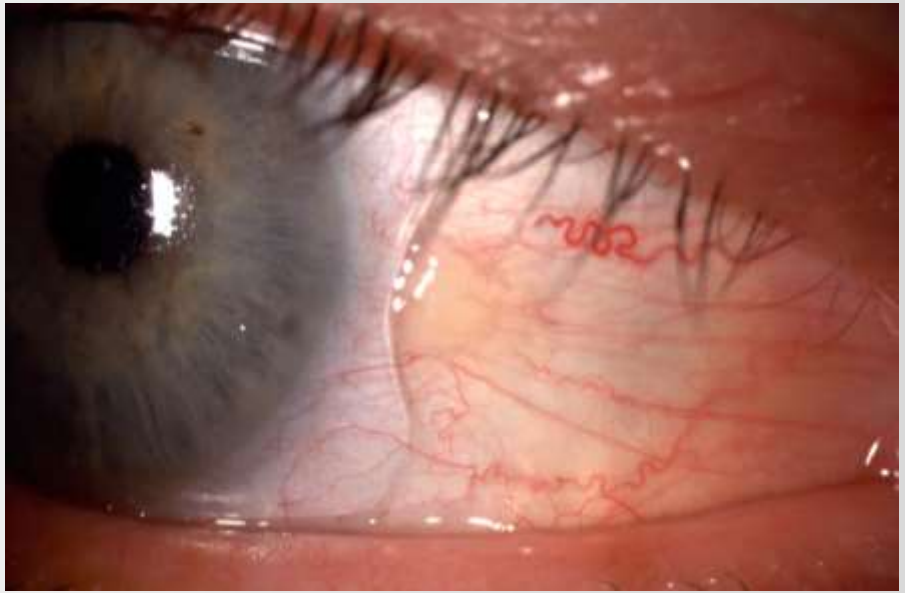
- Trend auf kleinere Sklerallinsen Ø <15mm
  - Geringere Limbale Überbrückung <100µm
    - Verminderung «midday fogging»
- Analysis of complications related to the fitting of small diameter scleral lenses (Michaud L.) Poster NCC
  - 113 Augen → 83% blieben bei ScCL
    - 39 KC → 39% Komplikationen
    - 74 Non-KC → 52% Komplikationen
      - Komplikationen = Oberflächliche Stippung wegen konservierter Einsetzlösung
      - Handlingsverursachte Stippung und konjunktivale Rötung (Grade1)

Pingueculitis

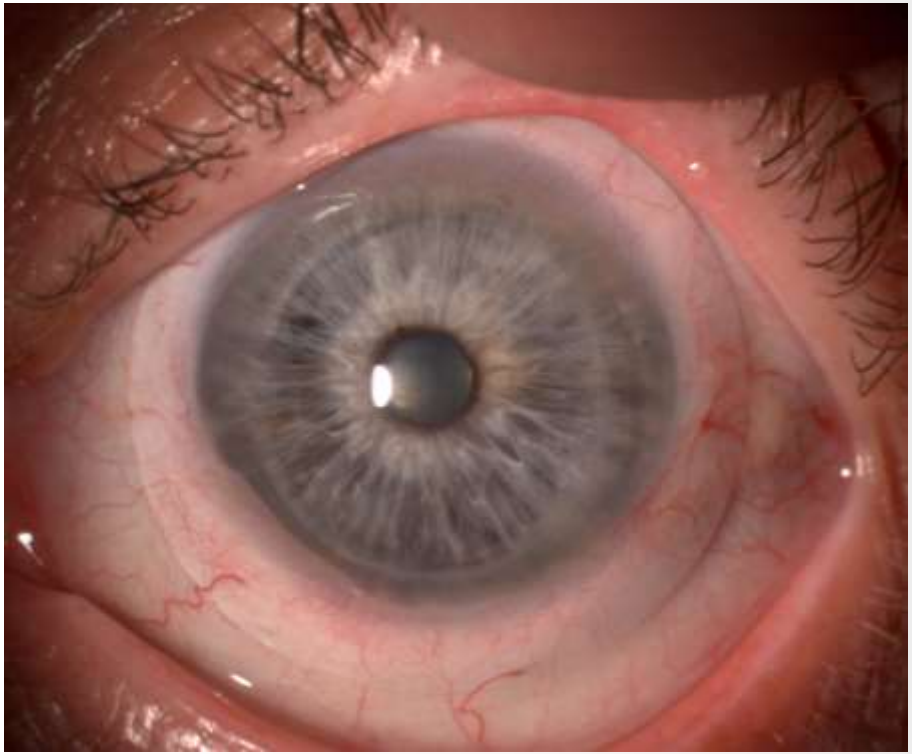


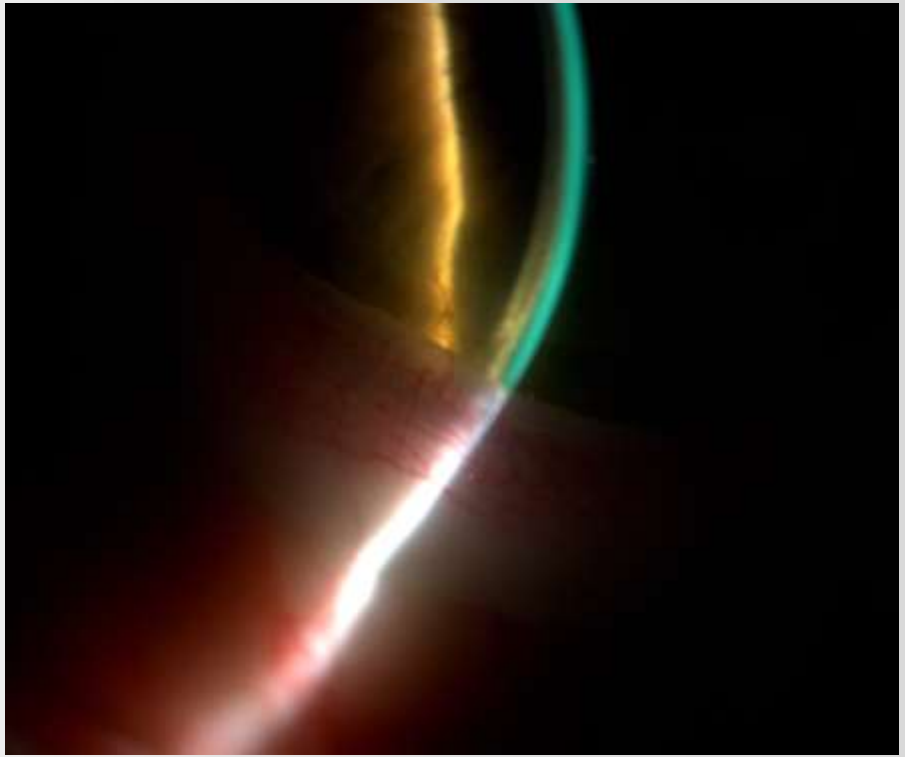
Pingueculitis





Konjunktival-Falten





Schlussfolgerung Sklerallinsen

- Linsenanpassung bleibt uns erhalten
- Hilfsmittel Ergänzen unsere Anpasstools und Erfahrung
- Just do it… and make People happy ☺

DANKE FÜR IHRE AUFMERKSAMKEIT


ALLES
WIRD
GUT.
falco

FRAGEN