Post LVC Ectasia

Tarek El-Naggar, MD, FRCS (Glasg)
A. Professor of Ophthalmology-Research Institute of Ophthalmology
Cornea and Refractive surgery Consultant-International Eye Hospital
The Speaker Has No Financial Interest

Post LVC Ectasia

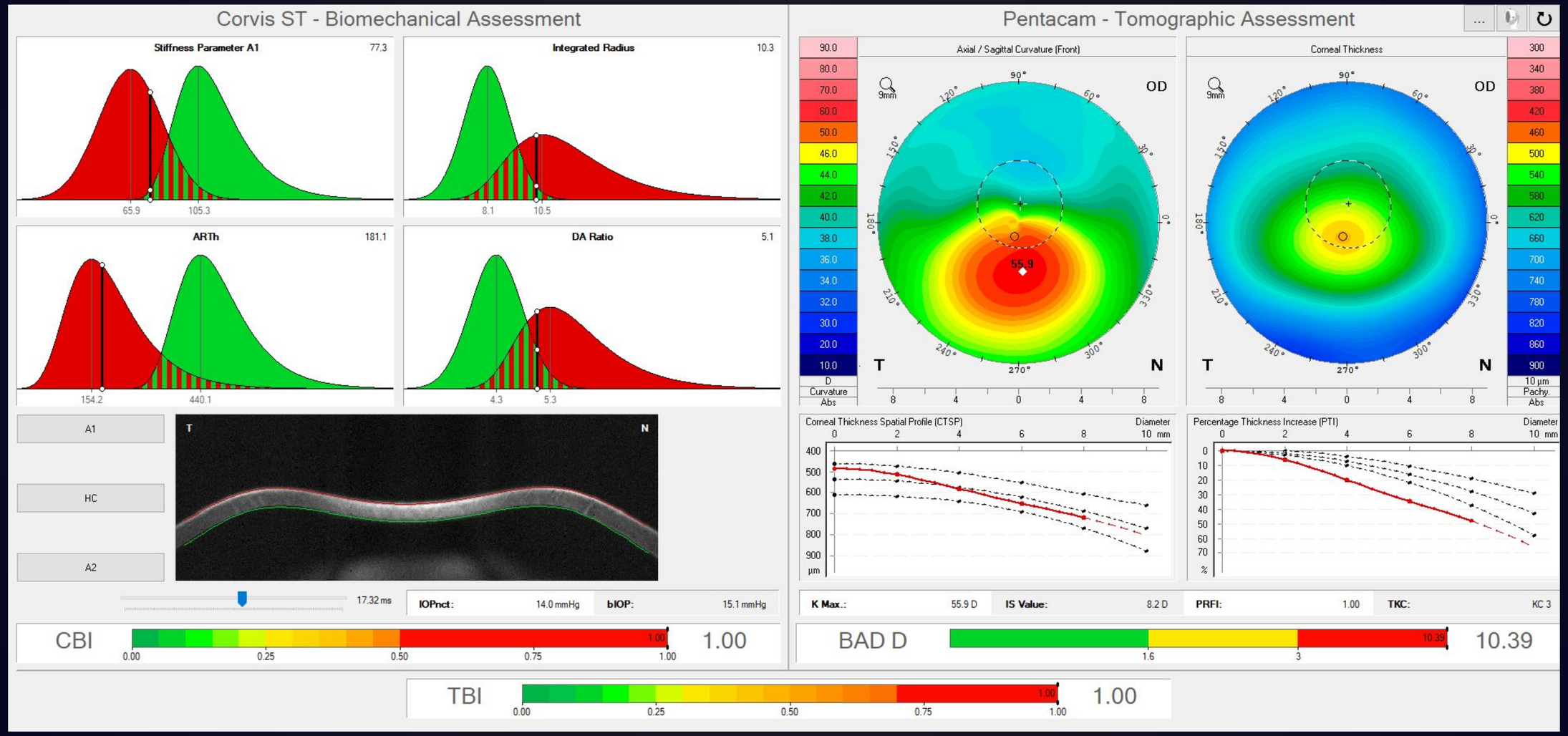
- Biomechanical Failure!!

Why

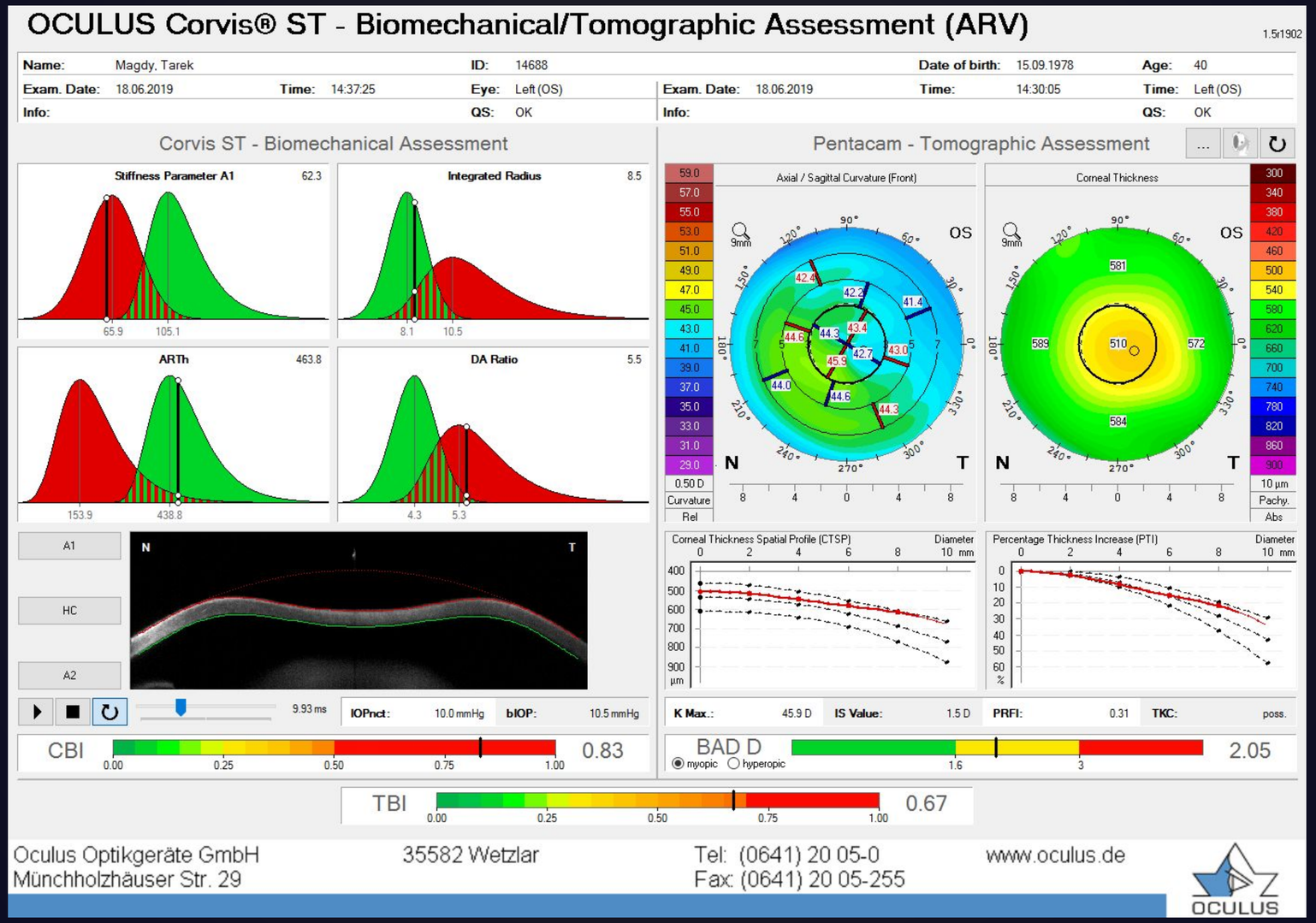
- Preop: Preexisting Ectasia susceptibility
- Intraop: Tissue removal +/- Flap cut
- Postop: Rubbing and sleeping Pattern !!

KC ≠ Ectasia Susceptibility

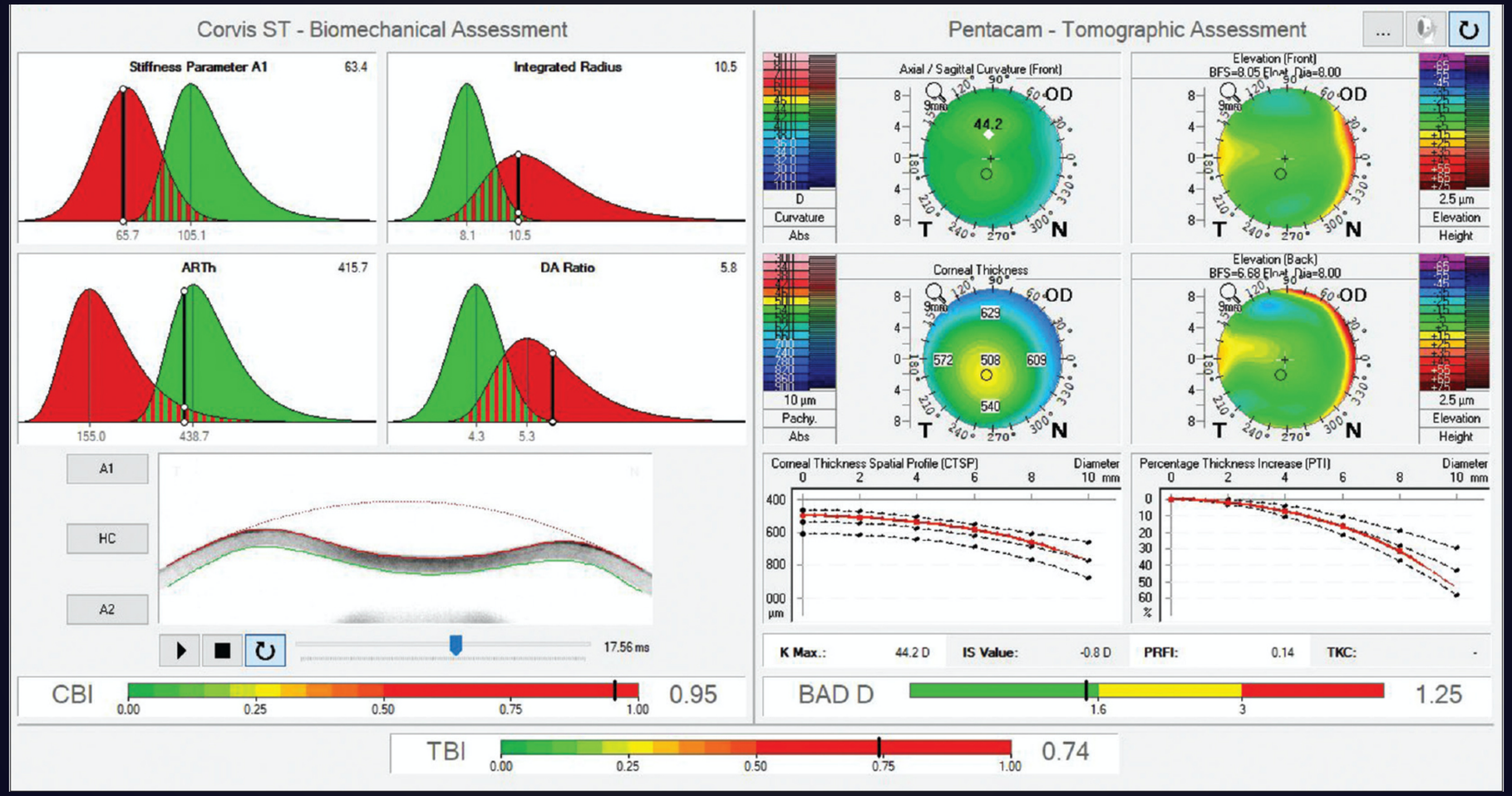
KC


Corvis ST - Biomechanical Assessment
Stiffness Parameter A1
77.3
65.9
105.3
Integrated Radius
10.3
8.1
10.5
ARTh
181.1
154.2
440.1
DA Ratio
5.1
4.3
5.3
A1
HC
A2
T
N
17.32 ms
IOPnct:
14.0 mmHg
bIOP:
15.1 mmHg
CBI
1.00
0.00
0.25
0.50
0.75
1.00
Pentacam - Tomographic Assessment
Axial / Sagittal Curvature (Front)
OD
9mm
55.9
T
N
Curvature
Abs
Corneal Thickness
Pachy.
Corneal Thickness Spatial Profile (CTSP)
Diameter
10 mm
µm
Percentage Thickness Increase (PTI)
%
K Max.:
55.9 D
IS Value:
8.2 D
PRFI:
1.00
TKC:
KC 3
BAD D
10.39
1.6
3
TBI
1.00

Ectasia susceptibility

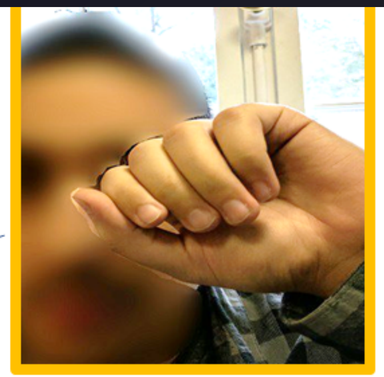


Ectasia susceptibility



Eye Rubbing and sleeping Pattern

Right handed but rubs left eye only at work (right hand on the computer mouse)

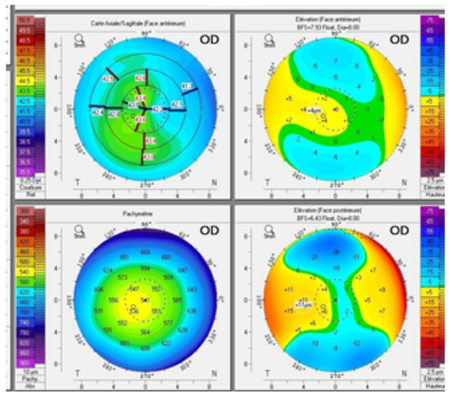


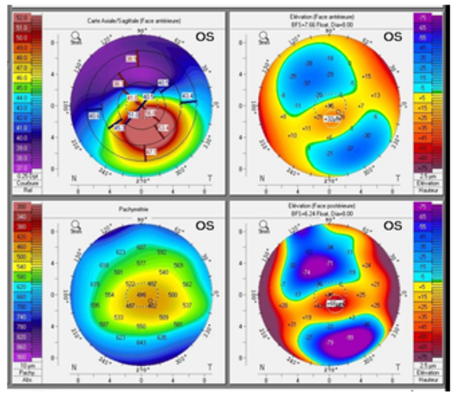
Sleeps on the left side and rubs upon awakening

RIGHT EYE

LEFT EYE

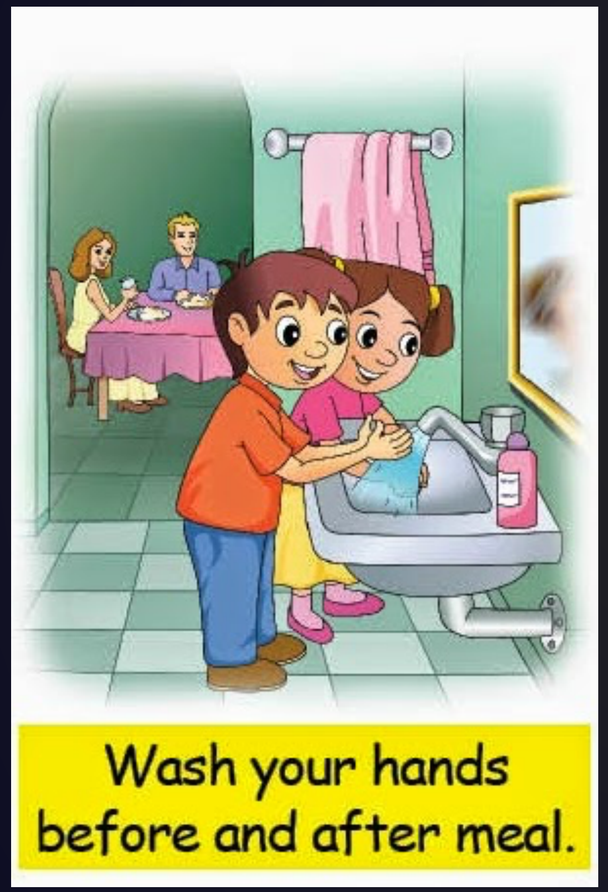
Normal cornea





Advanced KC

Case #34

- 
Wash your hands
before and after meal.


Post PRK Ectasia

PRK

- 37 eyes founded in literature.

Antonio Leccisotti Graefe's. Corneal ectasia after photorefractive keratectomy. Arch Clin Exp Ophthalmol 2007;245:869-75.

Reinstein Dan Z, Sabong Srivannaboon, Archer Timothy J, Dip Comp Sci, Silverman Ronald H, Hugo Sutton, Coleman Jackson D. Probability model of the inaccuracy of residual stromal thickness prediction to reduce the risk of ectasia after LASIK (Part II): Quantifying population risk. Journal of Refractive Surgery November 2006;22(9):861-70.

Randleman JB, Caster AI, Banning CS, Stulting RD. Corneal ectasia after photorefractive keratectomy. J Cataract Refract Surg Aug 2006;32(8):1395-98.

Kim, Hyojin, Choi, Jun-Sub, Joo, Choun-Ki Cornea. Corneal ectasia after PRK: Clinicopathologic case report. August 2006; 25(7):845-48.


JUST THE
TIP

Corneal ectasia after photorefractive keratectomy

J. Bradley Randleman, MD, Andrew I. Caster, MD,
Christopher S. Banning, MD, R. Doyle Stulting, MD, PhD

Two patients developed corneal ectasia after photorefractive keratectomy (PRK). Case 1 had evidence of early keratoconus preoperatively, with manifest refractions of −4.00 +2.50 × 160 (20/20) in the right eye and −7.00 +3.00 × 180 (20/30) in the left eye; thin corneas (472 μm and 441 μm, respectively); and inferior paracentral steepening in the right eye and central steepening in the left eye on topography. Case 2 had manifest refractions of −8.50 +3.75 × 123 ($20/20^{-2}$) in the right eye and −9.25 +4.00 × 077 ($20/20^{-1}$) in the left eye; corneal thickness of 509 μm and 508 μm, respectively; and symmetric bow-tie patterns in both eyes on topography. Case 2 had a family history suspicious for keratoconus, with a sibling who had bilateral corneal transplantation at a young age. Both patients developed bilateral corneal ectasia after PRK.

J Cataract Refract Surg 2006; 32:1395–1398

Corneal ectasia is a rare but well-described complication of laser in situ keratomileusis (LASIK).[1–5] Reported risk factors include high myopia, low residual stromal bed thickness, and keratoconus or forme fruste keratoconus, although cases without preoperative risk factors have been reported.[6,7] Ectasia has rarely been reported after

eye and 20/30 with a manifest refraction of −7.00 +3.00 × 180 in the left eye. Keratometry readings were 45.5/46.5 × 105 and 48.5/50.2 × 104, respectively. The thinnest central corneal thickness readings measured by ultrasound pachymetry were 472 μm in the right eye and 441 μm in the left eye. Topography showed inferior paracentral steepening in the right eye and central steepening in the left eye (Figure 1). The remainder of the

- Onset 3 to 5 years

IJKECD

10.5005/jp-journals-10025-1014

CASE REPORT

Corneal Ectasia after PRK

Jes Nörgaard Mortensen

ABSTRACT

It is well known that jatrogenic ectasia is lower in PRK compared to LASIK. The true incidence of post-LASIK and post-PRK ectasia remains unknown according to Dr Marguerite B McDonald. Corneal ectasia after PRK was reported to start after 3 to 5 years and after LASIK 6 to 18 months. The author reports of a case with corneal ectasia after PRK in both eyes that started after 16 years. Inspite of corneal cross-linking the progression of the ectasia progressed in both eyes.

Keywords: Ectasia, LASIK, PR

How to cite this article: Mortensen JN. Corneal Ectasia after PRK. Int J Keratoco Ectatic Corneal Dis 2012;1(1):73-74.

Source of support: Nil

Conflict of interest: None declared

INTRODUCTION

McDonald only 32 cases of post-PRK were reported in international literature, but that the number was growing, possibility due to the late onset of the post-PRK ectasia.

There is a difference in the start of the iatrogenectasia. After PRK the onset is postponed till 3 to 5 years and after LASIK 6 to 18 months.

Professor Theo Seiler pointed out the different major risk factors most important to consider when performing LASIK: Thickness of the flap, thickness of the residual stroma, forme fruste keratoconus, the tensile strength of the cornea. Professor Marguerite B McDonald agreed on that but even pointed out that an abnormal topography should warn not to perform PRK.

Corneal ectasia after PRK was reported to start after 3 to 5 years, but even later start has been reported, Kim Hyojin[5] reports of a case after 9 years after PRK.

PRK Xtra??

Last Name:
First Name:
ID:
Date of Birth: 05/23/1975 Eye: Right
Exam Date: 10/06/2016 Time: 01:55:25
Exam Info:

Refractive

Cornea Front

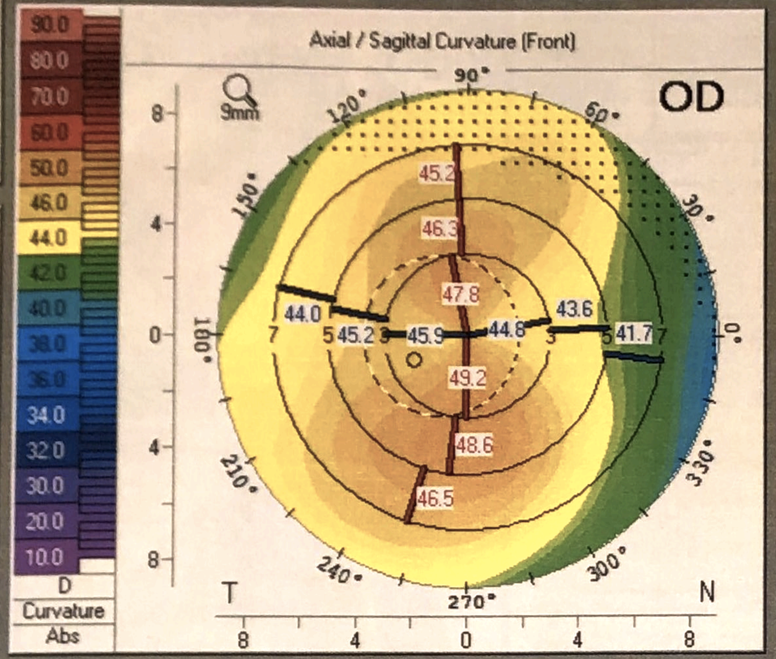
Rf: 7.45 mm K1: 45.3 D
Rs: 6.99 mm K2: 48.3 D
Rm: 7.22 mm Km: 46.8 D
QS: OK Axis: (steep) 96.5 ° Astig: 3.0 D
Q-val.: (8mm) -0.63 Rper: 7.76 mm Rmin: 6.84 mm

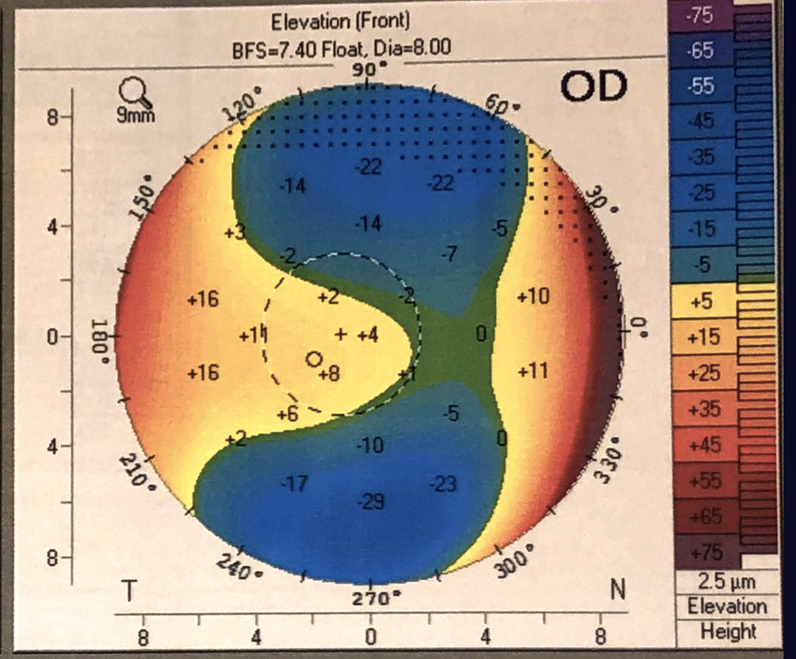
Cornea Back

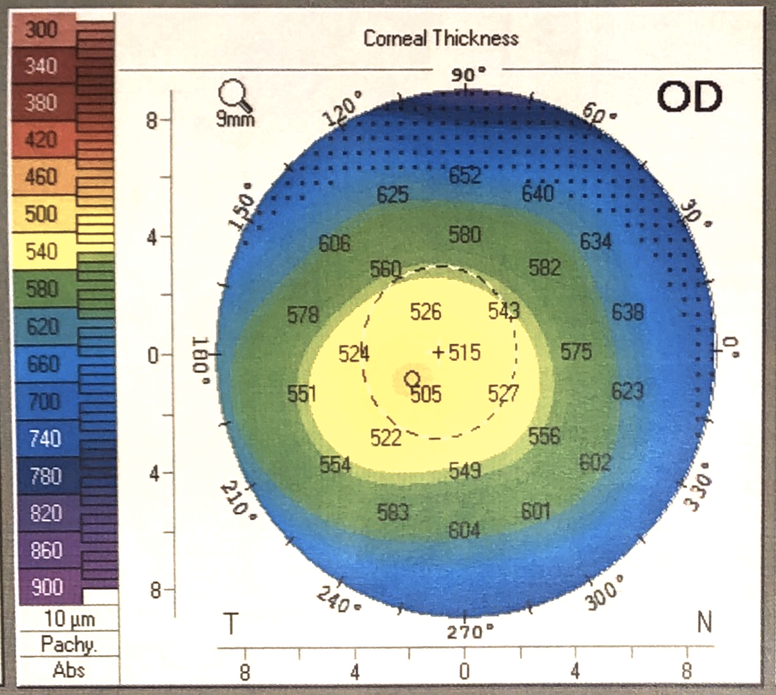
Rf: 6.17 mm K1: -6.5 D
Rs: 5.56 mm K2: -7.2 D
Rm: 5.87 mm Km: -6.8 D
QS: OK Axis: (steep) 98.0 ° Astig: 0.7 D
Q-val.: (8mm) -0.57 Rper: 6.39 mm Rmin: 5.24 mm

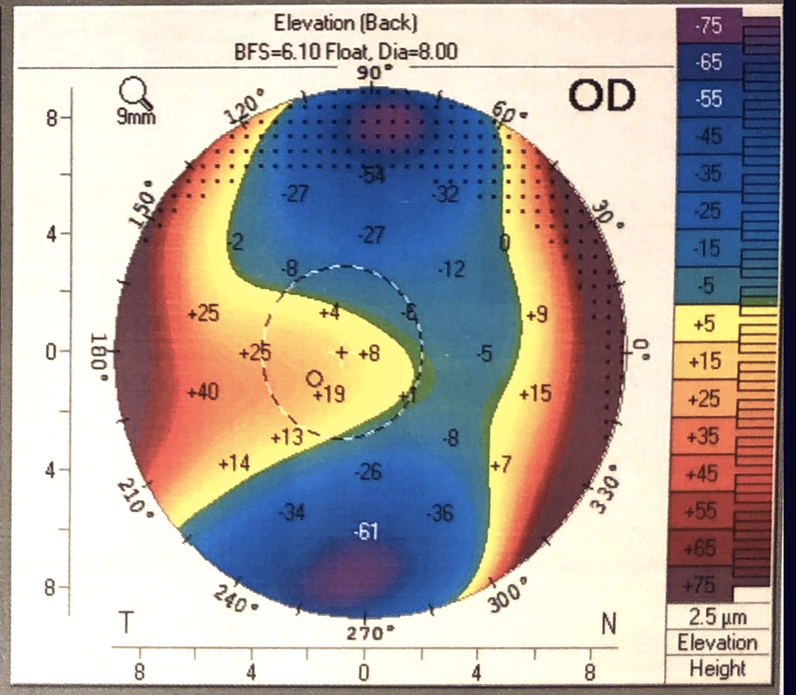
		Pachy:	x[mm]	y[mm]
Pupil Center:	+	509 µm	-0.48	0.00
Pachy Apex:	·	515 µm	0.00	0.00
Thinnest Locat.:	○	503 µm	-0.95	-0.44
K Max. (Front):		49.3 D	+0.13	-1.78

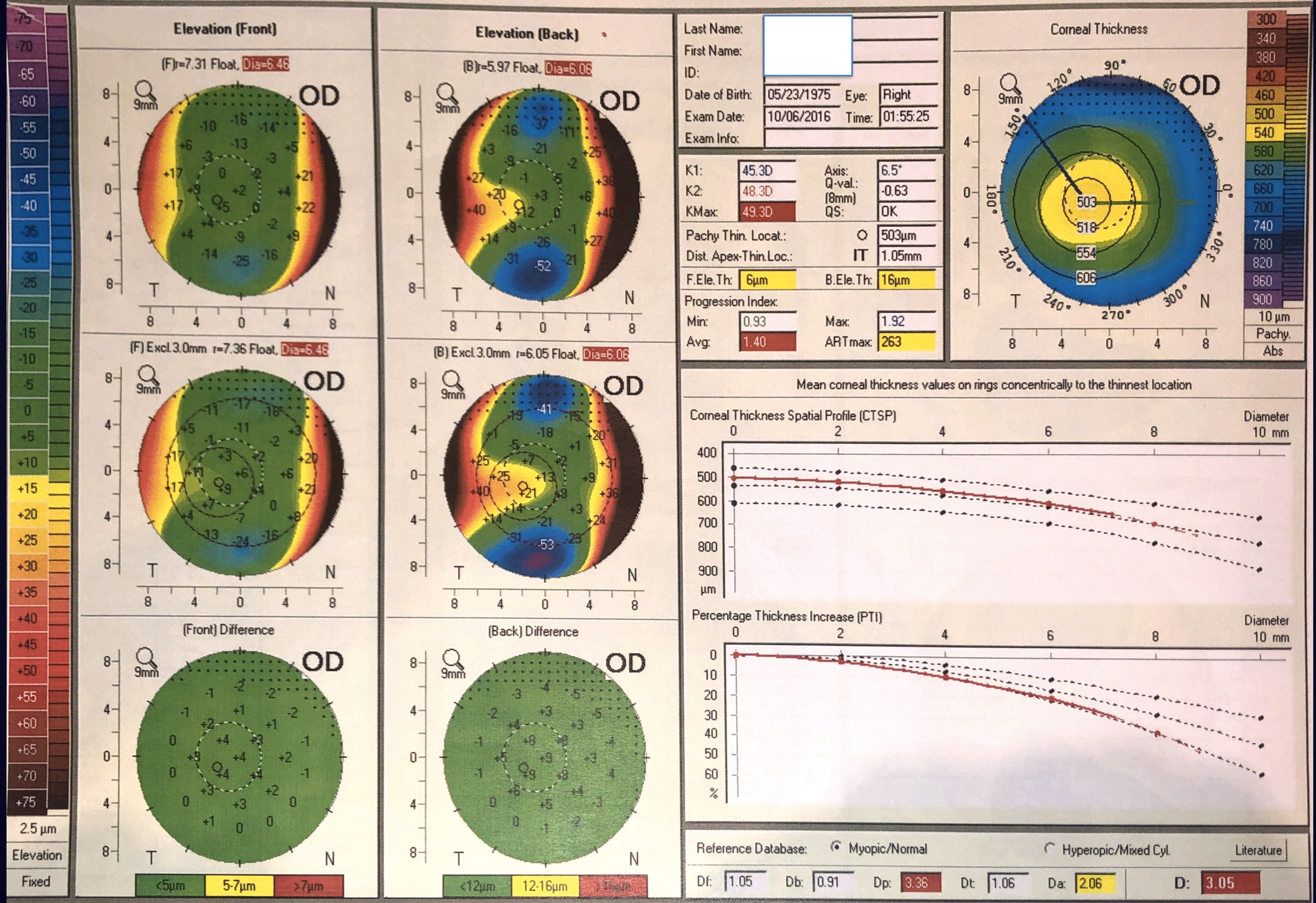
Cornea Volume: 60.0 mm³ Ø Cornea: 11.6 mm
Chamber Volume: 110 mm³ Angle: 28.9 °
A. C. Depth (Ext.): 3.11 mm Pupil Dia: 2.85 mm
Enter IOP IOP(Sum): +1.4 mmHg Lens Th.:










Elevation (Front)
(F)r=7.31 Float, Dia=6.46
Elevation (Back)
(B)r=5.97 Float, Dia=6.06
(F) Excl.3.0mm r=7.36 Float, Dia=6.46
(B) Excl.3.0mm r=6.05 Float, Dia=6.06
(Front) Difference
(Back) Difference
OD
9mm
T
N
<5µm
5-7µm
>7µm
<12µm
12-16µm
2.5 µm
Elevation
Fixed
Last Name:
First Name:
ID:
Date of Birth: 05/23/1975
Eye: Right
Exam Date: 10/06/2016
Time: 01:55:25
Exam Info:
K1: 45.3D
K2: 48.3D
KMax: 49.3D
Axis: 6.5°
Q-val. (8mm): -0.63
QS: OK
Pachy Thin. Locat.: 503µm
Dist. Apex-Thin.Loc.: IT 1.05mm
F.Ele.Th: 6µm
B.Ele.Th: 16µm
Progression Index:
Min: 0.93
Max: 1.92
Avg: 1.40
ARTmax: 263
Corneal Thickness
503
518
554
606
10 µm
Pachy.
Abs
Mean corneal thickness values on rings concentrically to the thinnest location
Corneal Thickness Spatial Profile (CTSP)
Diameter 10 mm
µm
Percentage Thickness Increase (PTI)
%
Reference Database:
Myopic/Normal
Hyperopic/Mixed Cyl.
Literature
Df: 1.05
Db: 0.91
Dp: 3.36
Dt: 1.06
Da: 2.06
D: 3.05

Refractive

Last Name:	
First Name:	
ID:	
Date of Birth:	05/23/1975
Eye:	Right
Exam Date:	02/28/2017
Time:	06:58:35
Exam Info:	

Cornea Front

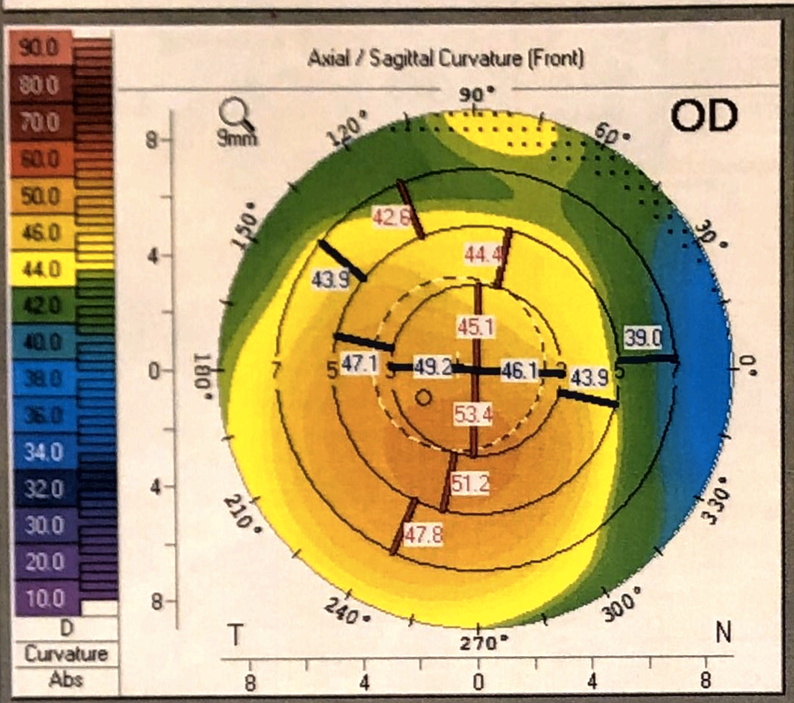
Rf:	7.10 mm	K1:	47.5 D
Rs:	6.90 mm	K2:	48.9 D
Rm:	7.00 mm	Km:	48.2 D
QS:	OK	Axis: (steep)	86.0 °
Astig:	1.4 D		
Q-val: (8mm)	-0.99	Rper:	7.92 mm
Rmin:	6.31 mm		

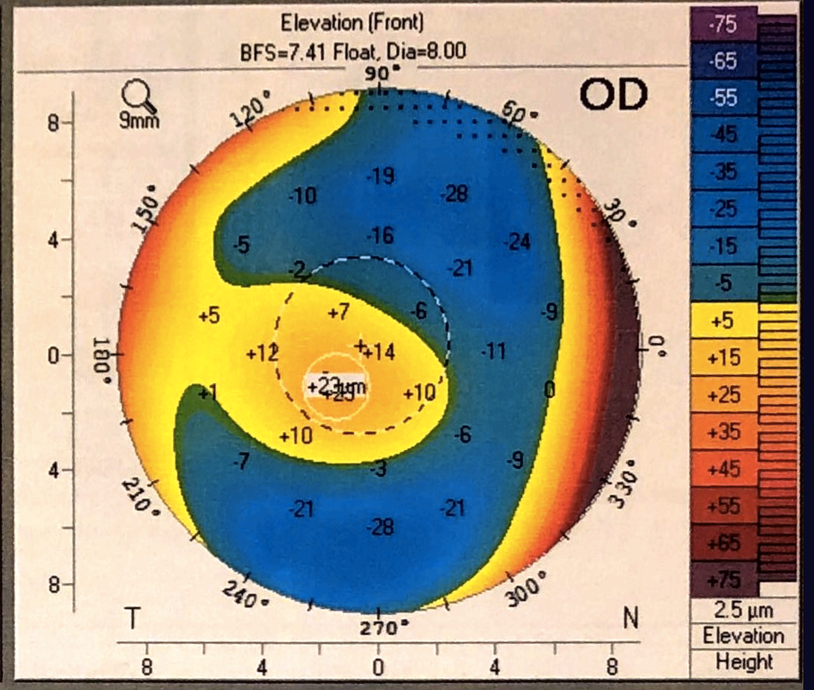
Cornea Back

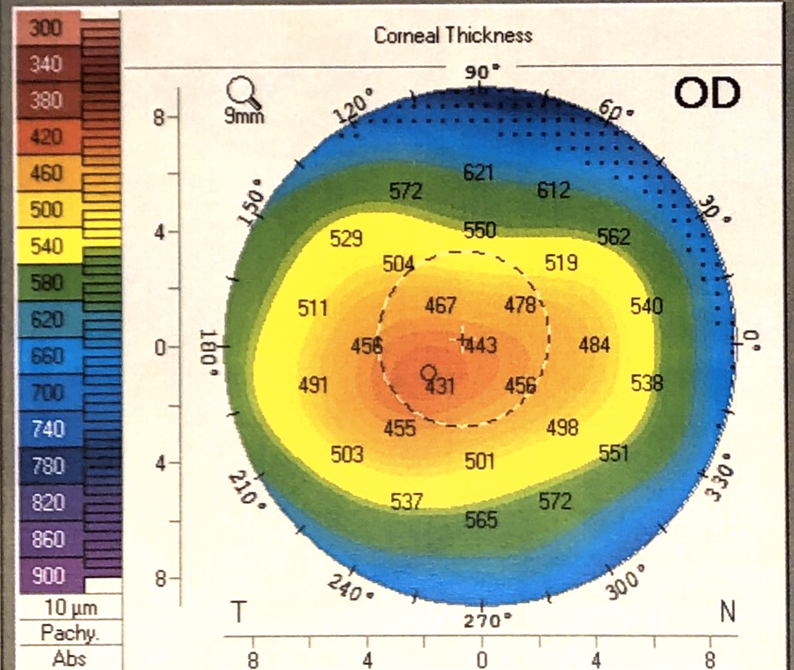
Rf:	6.13 mm	K1:	-6.5 D
Rs:	5.19 mm	K2:	-7.7 D
Rm:	5.66 mm	Km:	-7.1 D
QS:	OK	Axis: (steep)	96.1 °
Astig:	1.2 D		
Q-val: (8mm)	-0.70	Rper:	6.43 mm
Rmin:	4.31 mm		

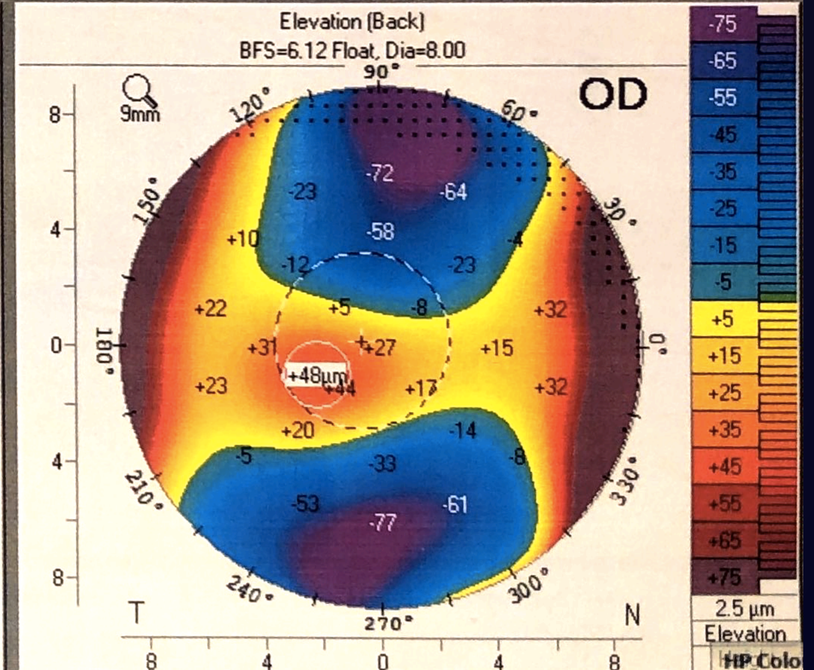
		Pachy:	x[mm]	y[mm]
Pupil Center:	+	442 µm	-0.31	+0.11
Pachy Apex:	·	443 µm	0.00	0.00
Thinnest Locat.:	○	429 µm	-0.93	-0.47
K Max. (Front):		53.5 D	-0.27	-1.33

Cornea Volume:	55.2 mm³	Ø Cornea:	11.5 mm
Chamber Volume:	111 mm³	Angle:	25.5 °
A. C. Depth (Ext.):	3.10 mm	Pupil Dia:	3.02 mm
Enter IOP	IOP(Sum):	+4.3 mmHg	Lens Th.:









Post LASIK Ectasia

Post LASIK Ectasia

- Prof Theo Seiler 1998: first case of Iatrogenic Ectasia after Lasik
- At least 150 case reports
- About 100 million procdeures

LASIK Case

A twenty three male patient

Preoperative refraction	OD -2,50 sph -1,00x170	CDVA 1.2
	OS -2,50 sph -1,00x25	CDVA 1.2

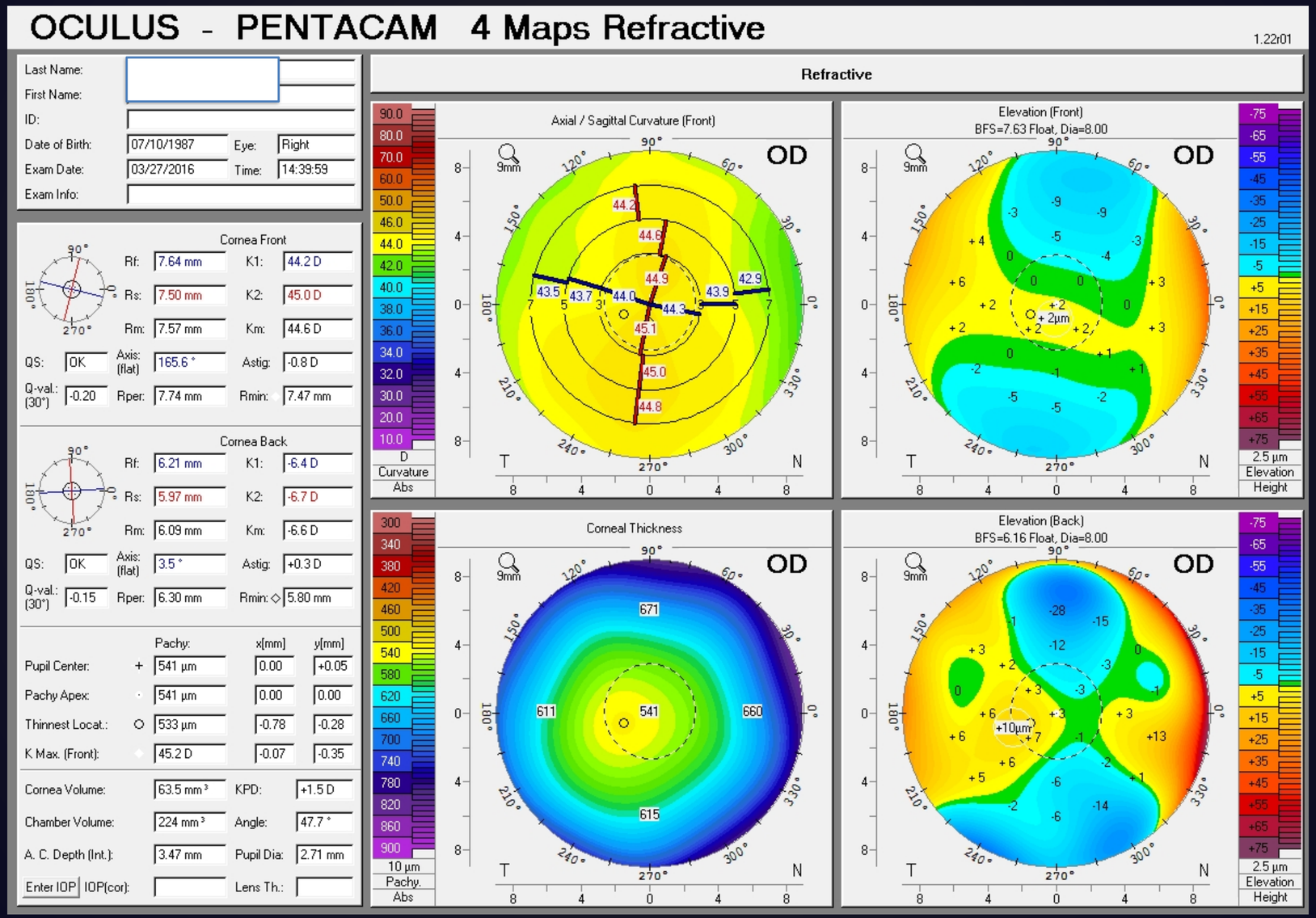
N.B. the vision and refraction were stable for at least 5 years (documented in his file from previous visits

Max ablation depth	OD 63 um
	OS 63 um

Optical zone for OD and OS: 7 mm

conventional LASIK with Moria M2 microkeratome with 130 head

Pre LASIK


OCULUS - PENTACAM 4 Maps Refractive
1.22r01
Last Name:
First Name:
ID:
Date of Birth: 07/10/1987
Eye: Right
Exam Date: 03/27/2016
Time: 14:39:59
Exam Info:
Cornea Front
Rf: 7.64 mm
K1: 44.2 D
Rs: 7.50 mm
K2: 45.0 D
Rm: 7.57 mm
Km: 44.6 D
QS: OK
Axis: (flat) 165.6 °
Astig: -0.8 D
Q-val.: (30°) -0.20
Rper: 7.74 mm
Rmin: 7.47 mm
Cornea Back
Rf: 6.21 mm
K1: -6.4 D
Rs: 5.97 mm
K2: -6.7 D
Rm: 6.09 mm
Km: -6.6 D
QS: OK
Axis: (flat) 3.5 °
Astig: +0.3 D
Q-val.: (30°) -0.15
Rper: 6.30 mm
Rmin: 5.80 mm
Pachy:
x[mm]
y[mm]
Pupil Center: 541 µm 0.00 +0.05
Pachy Apex: 541 µm 0.00 0.00
Thinnest Locat.: 533 µm -0.78 -0.28
K Max. (Front): 45.2 D -0.07 -0.35
Cornea Volume: 63.5 mm³
KPD: +1.5 D
Chamber Volume: 224 mm³
Angle: 47.7 °
A. C. Depth (Int.): 3.47 mm
Pupil Dia: 2.71 mm
Enter IOP
IOP(cor):
Lens Th.:
Refractive
Axial / Sagittal Curvature (Front)
Elevation (Front)
BFS=7.63 Float, Dia=8.00
Corneal Thickness
Elevation (Back)
BFS=6.16 Float, Dia=8.00
OD
D
Curvature
Abs
2.5 µm
Elevation
Height
10 µm
Pachy.

OCULUS - PENTACAM Refractive

1.22r01

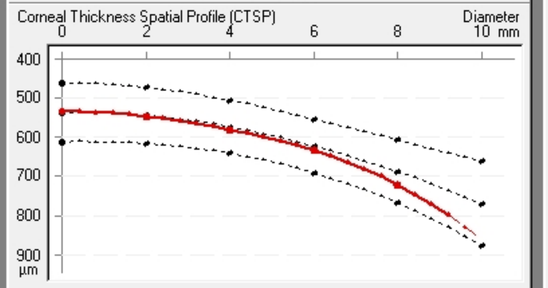
Last Name:	
First Name:	
ID:	
Date of Birth:	07/10/1987
Eye:	Right
Exam Date:	03/27/2016
Time:	14:39:59

Rf:	7.64 mm	K1:	44.2 D	Axis:	165.6 °
Rs:	7.50 mm	K2:	45.0 D	Axis:	75.6 °
Rm:	7.57 mm	Km:	44.6 D	Astig:	-0.8 D
QS:	OK	Q-val. (30°):	-0.20	Rper:	7.74 mm
				Rmin:	7.47 mm

		Pachy:	x[mm]	y[mm]
Pupil Center:	+	541 µm	0.00	+0.05
Thinnest Locat.:	○	533 µm	-0.78	-0.28

A. C. Depth (Int.):	3.47 mm	Pupil Dia:	2.71 mm
Angle:	47.7 °	Lens Th.:	

Mean corneal thickness values on rings concentrically to the thinnest location



Asphericity (Front) of Major Meridians

(Q-val.)	Degrees peripheral 20°	25°	30°	35°	40°
Nas	-0.21	-0.28	-0.37	-0.45	-0.58
Temp	-0.13	-0.13	-0.15	-0.19	-0.24
Inf	-0.08	-0.08	-0.10	-0.12	-0.16
Sup	-0.14	-0.14	-0.17	-0.21	-0.37
Mean	-0.14	-0.16	-0.20	-0.24	-0.34

Indices (in 8mm zone)

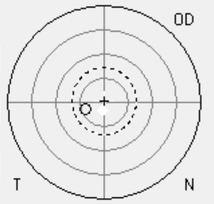
ISV:	12	IHA:	7.8
IVA:	0.08	IHD:	0.008
KI:	1.02	RMin:	7.47
CKI:	1.01	TKC:	-
KISA:	0.333	IS:	0.60

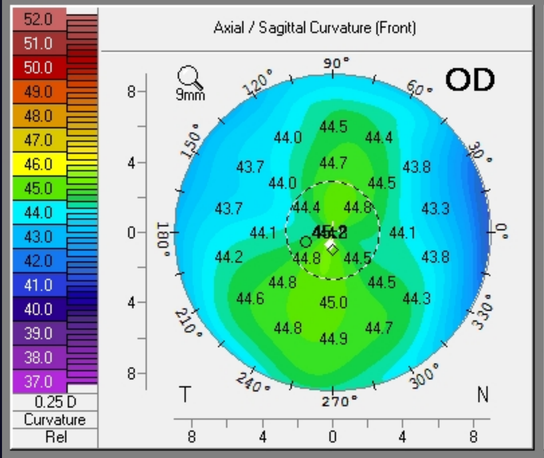
Aspher. (Front) at 30°

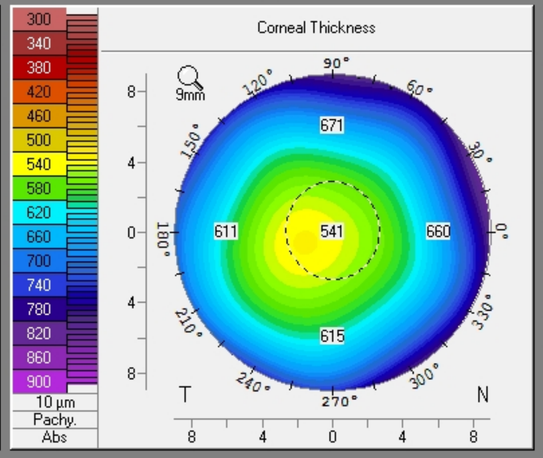
H:	-0.26
V:	-0.14

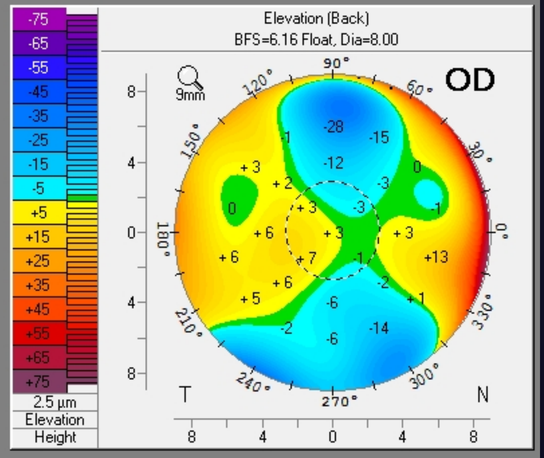
Spot locations in 8mm zone (polar coordinates)

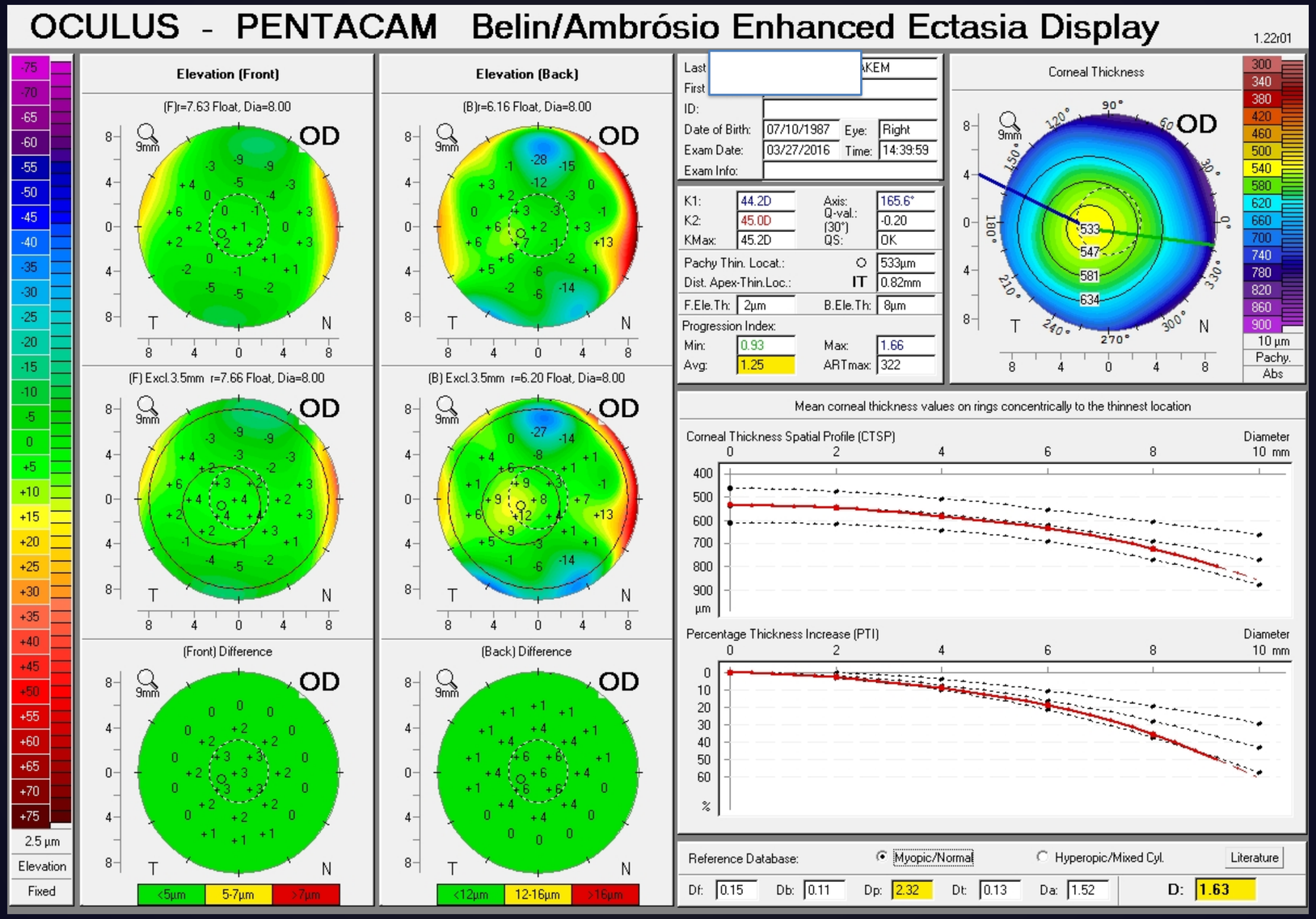
Pupil Center:	+	0.05mm (89.2°)
Thinnest Locat.:	○	0.82mm (200.0°)
K Max. (Front):		0.36mm (258.7°)










OCULUS - PENTACAM Belin/Ambrósio Enhanced Ectasia Display
1.22r01
Elevation (Front)
Elevation (Back)
(F)r=7.63 Float, Dia=8.00
(B)r=6.16 Float, Dia=8.00
(F) Excl.3.5mm r=7.66 Float, Dia=8.00
(B) Excl.3.5mm r=6.20 Float, Dia=8.00
(Front) Difference
(Back) Difference
OD
9mm
T
N
Last
First
ID:
Date of Birth: 07/10/1987 Eye: Right
Exam Date: 03/27/2016 Time: 14:39:59
Exam Info:
K1: 44.2D Axis: 165.6°
K2: 45.0D Q-val.: (30°) -0.20
KMax: 45.2D QS: OK
Pachy Thin. Locat.: 533µm
Dist. Apex-Thin.Loc.: IT 0.82mm
F.Ele.Th: 2µm B.Ele.Th: 8µm
Progression Index:
Min: 0.93 Max: 1.66
Avg: 1.25 ARTmax: 322
Corneal Thickness
533
547
581
634
10 µm
Pachy.
Abs
Mean corneal thickness values on rings concentrically to the thinnest location
Corneal Thickness Spatial Profile (CTSP)
Diameter 10 mm
µm
Percentage Thickness Increase (PTI)
%
2.5 µm
Elevation
Fixed
<5µm
5-7µm
>7µm
<12µm
12-16µm
>16µm
Reference Database:
Myopic/Normal
Hyperopic/Mixed Cyl.
Literature
Df: 0.15 Db: 0.11 Dp: 2.32 Dt: 0.13 Da: 1.52
D: 1.63

OCULUS - PENTACAM 4 Maps Refractive

1.22r01

Last Name:			
First Name:			
ID:			
Date of Birth:	07/10/1987	Eye:	Left
Exam Date:	03/27/2016	Time:	14:41:52
Exam Info:			

Cornea Front

Rf:	7.67 mm	K1:	44.0 D
Rs:	7.57 mm	K2:	44.6 D
Rm:	7.62 mm	Km:	44.3 D
QS: OK	Axis: (flat) 48.0 °	Astig:	+0.6 D
Q-val.: (30°) -0.15	Rper: 7.76 mm	Rmin:	7.52 mm

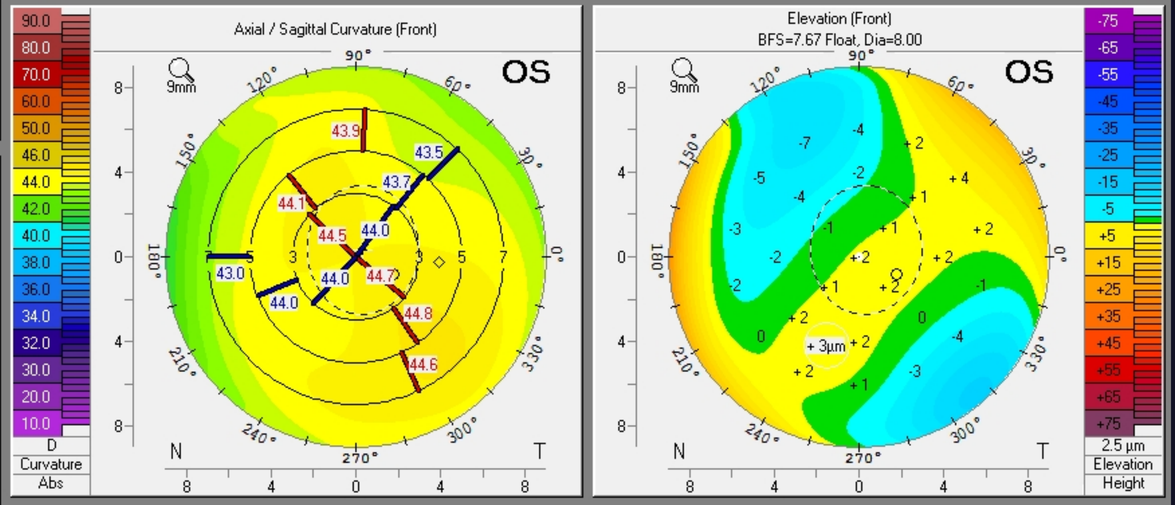
Cornea Back

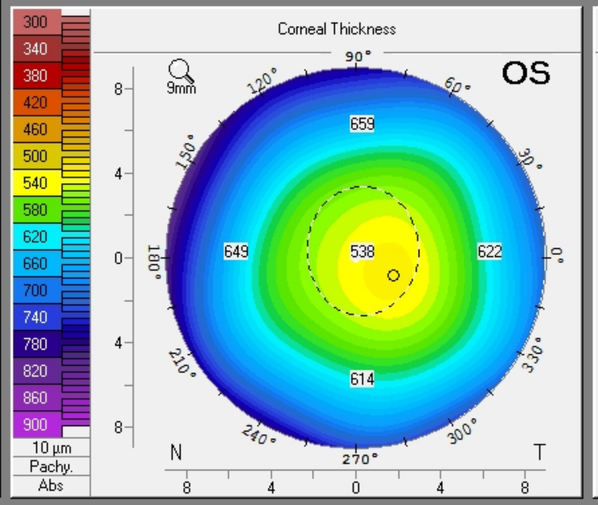
Rf:	6.25 mm	K1:	-6.4 D
Rs:	6.16 mm	K2:	-6.5 D
Rm:	6.20 mm	Km:	-6.4 D
QS: OK	Axis: (flat) 7.0 °	Astig:	+0.1 D
Q-val.: (30°) -0.06	Rper: 6.37 mm	Rmin: ◇	5.86 mm

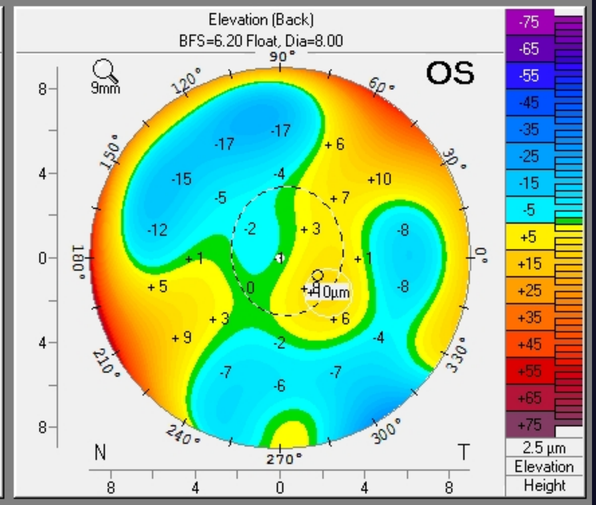
	Pachy:	x[mm]	y[mm]
Pupil Center: +	538 µm	+0.17	+0.16
Pachy Apex: ·	539 µm	0.00	0.00
Thinnest Locat.: ○	530 µm	+0.88	-0.41
K Max. (Front): ◆	44.9 D	+1.90	-2.17

Cornea Volume:	62.5 mm³	KPD:	+1.1 D
Chamber Volume:	211 mm³	Angle:	43.0 °
A. C. Depth (Int.):	3.39 mm	Pupil Dia:	2.83 mm
Enter IOP / IOP(cor):		Lens Th.:	

Refractive







OCULUS - PENTACAM Refractive

1.22r01

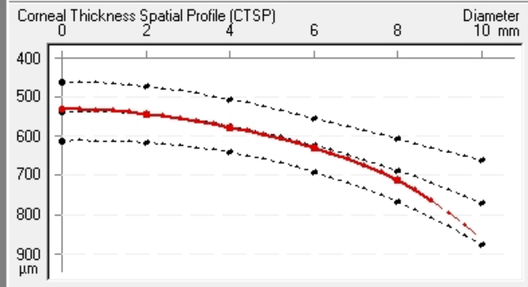
Last Name:	
First Name:	
ID:	
Date of Birth:	07/10/1987
Eye:	Left
Exam Date:	03/27/2016
Time:	14:41:52

Rf:	7.67 mm	K1:	44.0 D	Axis:	48.0 °
Rs:	7.57 mm	K2:	44.6 D	Axis:	138.0 °
Rm:	7.62 mm	Km:	44.3 D	Astig:	+0.6 D
QS:	OK	Q-val. (30°):	-0.15	Rper:	7.76 mm
				Rmin:	7.52 mm

		Pachy:	x[mm]	y[mm]
Pupil Center:	+	538 µm	+0.17	+0.16
Thinnest Locat.:	○	530 µm	+0.88	-0.41

A. C. Depth (Int.):	3.39 mm	Pupil Dia:	2.83 mm
Angle:	43.0 °	Lens Th.:	

Mean corneal thickness values on rings concentrically to the thinnest location



Asphericity (Front) of Major Meridians

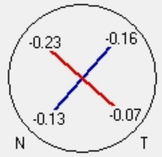
(Q-val.)	Degrees peripheral 20°	25°	30°	35°	40°
Nas	-0.29	-0.27	-0.23	-0.25	-0.50
Temp	0.03	-0.02	-0.07	-0.14	-0.19
Inf	-0.00	-0.07	-0.13	-0.16	-0.30
Sup	-0.15	-0.14	-0.16	-0.17	-0.22
Mean	-0.11	-0.12	-0.15	-0.18	-0.31

Indices (in 8mm zone)

ISV:	10	IHA:	8.4
IVA:	0.08	IHD:	0.010
KI:	1.01	RMin:	7.52
CKI:	1.00	TKC:	-
KISA:	0.800	IS:	0.59

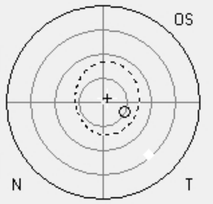
Aspher. (Front) at 30°

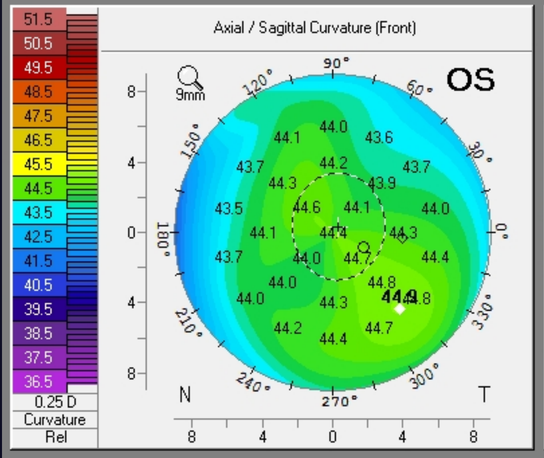
H: -0.15
V: -0.14

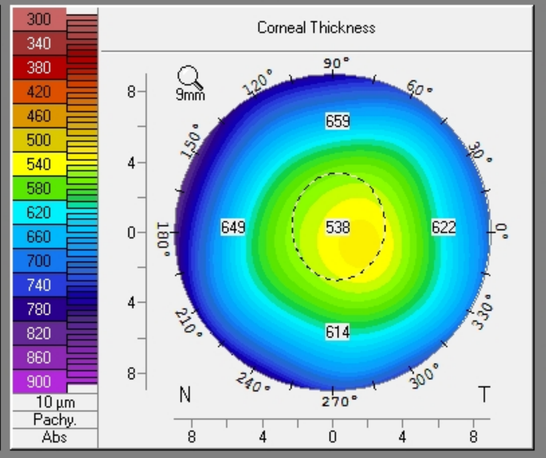


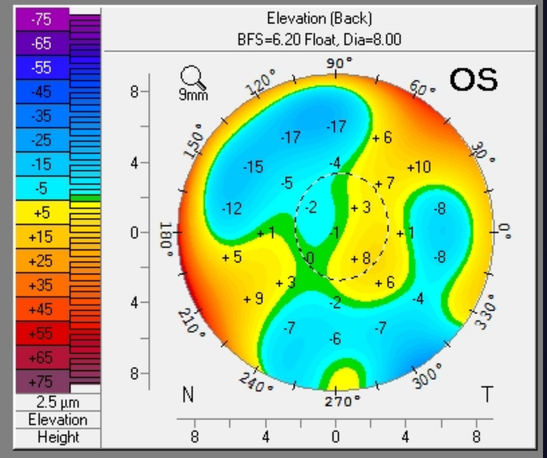
Spot locations in 8mm zone (polar coordinates)

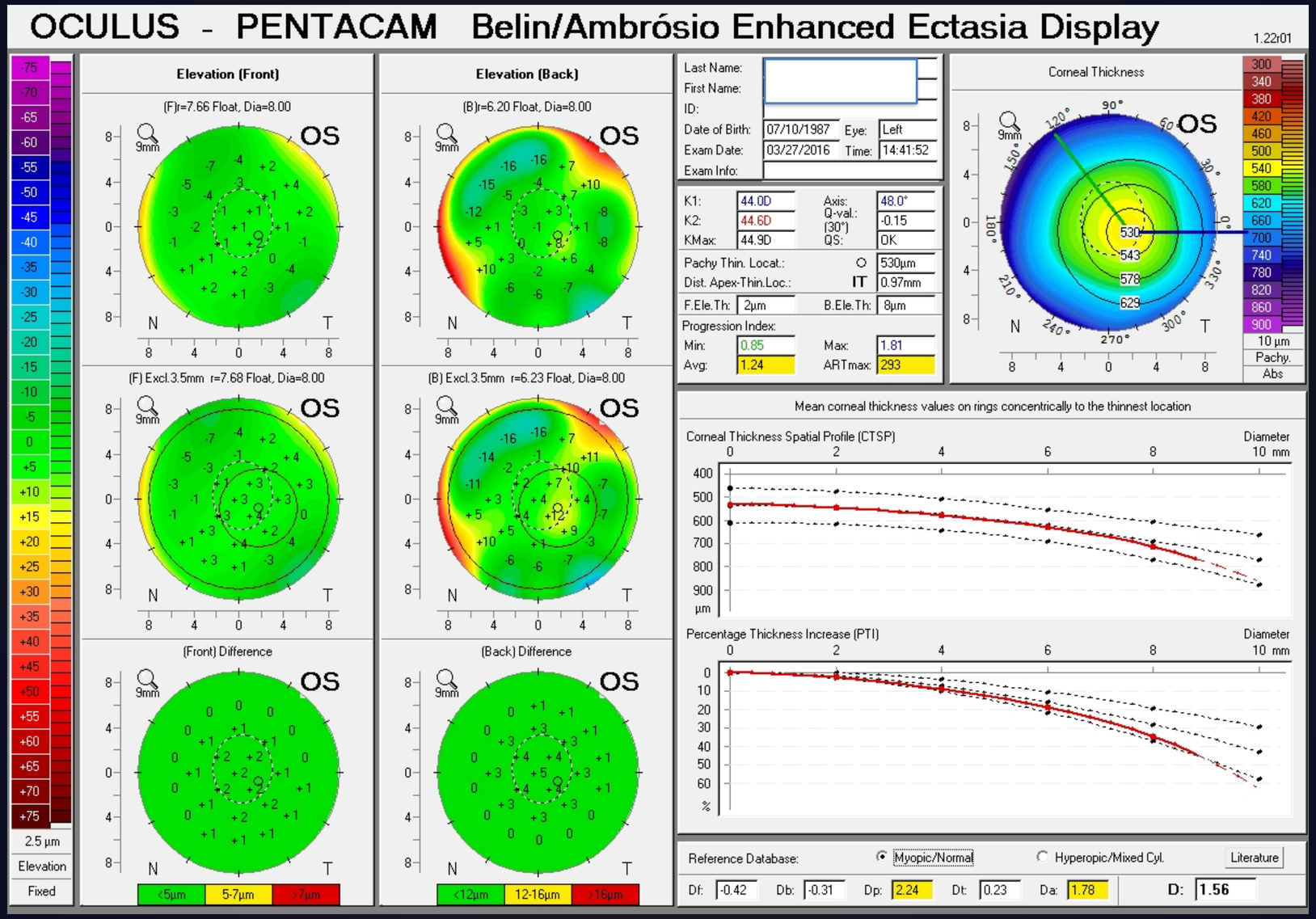
Pupil Center:	+	0.23mm (44.1°)
Thinnest Locat.:	○	0.97mm (335.2°)
K Max. (Front):		2.88mm (311.2°)










OCULUS - PENTACAM Belin/Ambrósio Enhanced Ectasia Display
1.22r01
Elevation (Front)
(F)r=7.66 Float, Dia=8.00
Elevation (Back)
(B)r=6.20 Float, Dia=8.00
(F) Excl.3.5mm r=7.68 Float, Dia=8.00
(B) Excl.3.5mm r=6.23 Float, Dia=8.00
(Front) Difference
(Back) Difference
<5µm
5-7µm
>7µm
<12µm
12-16µm
>16µm
2.5 µm
Elevation
Fixed
Last Name:
First Name:
ID:
Date of Birth: 07/10/1987
Eye: Left
Exam Date: 03/27/2016
Time: 14:41:52
Exam Info:
K1: 44.0D
K2: 44.6D
KMax: 44.9D
Axis: 48.0°
Q-val.: (30°) -0.15
QS: OK
Pachy Thin. Locat.: 530µm
Dist. Apex-Thin.Loc.: IT 0.97mm
F.Ele.Th: 2µm
B.Ele.Th: 8µm
Progression Index:
Min: 0.85
Max: 1.81
Avg: 1.24
ARTmax: 293
Corneal Thickness
530
543
578
629
10 µm
Pachy.
Abs
Mean corneal thickness values on rings concentrically to the thinnest location
Corneal Thickness Spatial Profile (CTSP)
Diameter 10 mm
µm
Percentage Thickness Increase (PTI)
Diameter 10 mm
%
Reference Database:
Myopic/Normal
Hyperopic/Mixed Cyl.
Literature
Df: -0.42
Db: -0.31
Dp: 2.24
Dt: 0.23
Da: 1.78
D: 1.56

Post LASIK

OCULUS - PENTACAM 4 Maps Refractive

1.22r01

Last Name:			
First Name:			
ID:			
Date of Birth:	07/10/1987	Eye:	Right
Exam Date:	12/31/2019	Time:	12:03:01
Exam Info:			

Cornea Front

Rf:	7.88 mm	K1:	42.8 D
Rs:	7.01 mm	K2:	48.2 D
Rm:	7.44 mm	Km:	45.3 D
QS: OK	Axis: (flat) 102.2 °	Astig:	+5.3 D
Q-val.: (30°) -0.21	Rper: 7.84 mm	Rmin:	6.03 mm

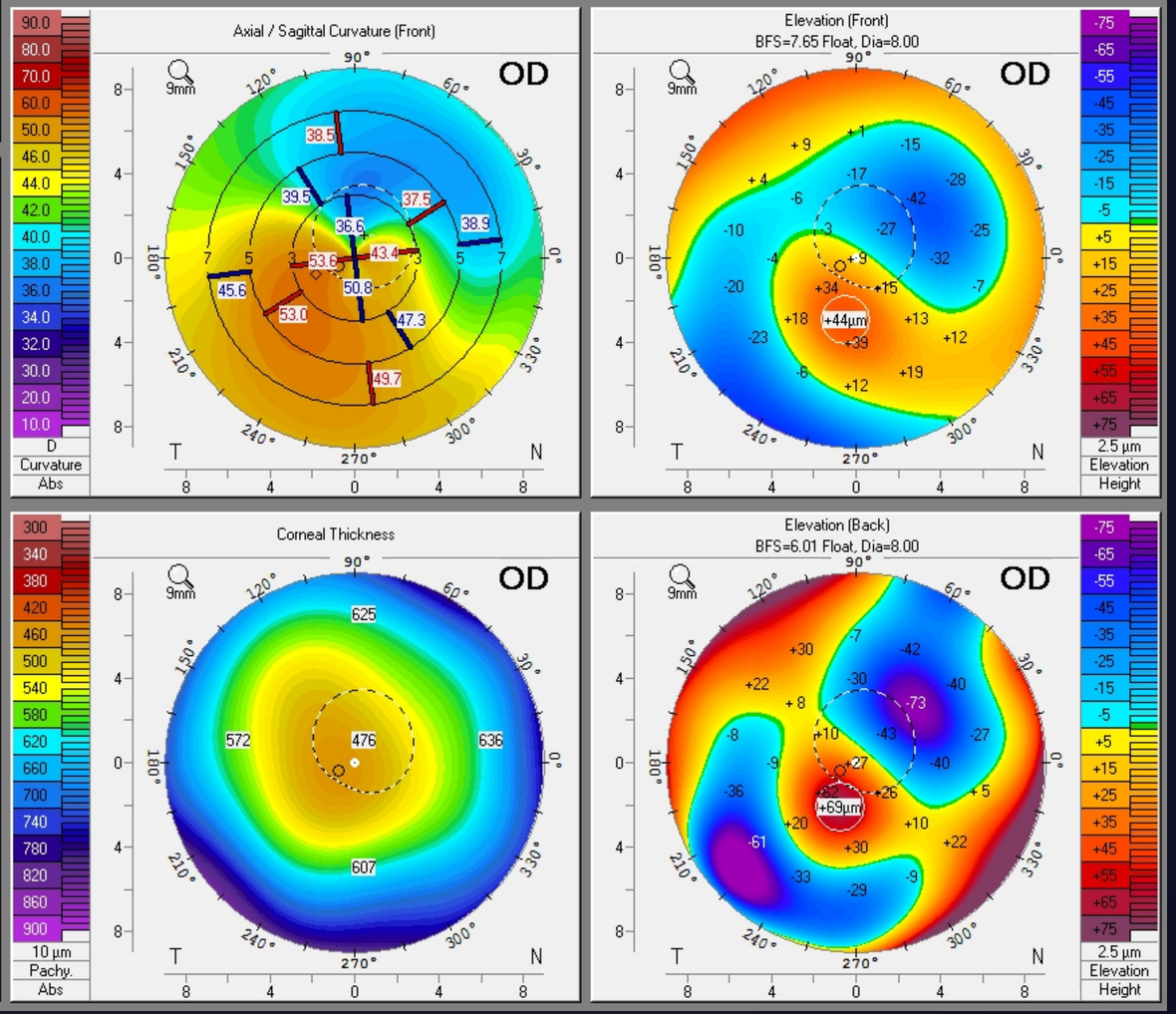
Cornea Back

Rf:	5.96 mm	K1:	-6.7 D
Rs:	5.43 mm	K2:	-7.4 D
Rm:	5.69 mm	Km:	-7.0 D
QS: OK	Axis: (flat) 112.5 °	Astig:	-0.7 D
Q-val.: (30°) -0.36	Rper: 6.35 mm	Rmin: ◇	4.19 mm

		Pachy:	x[mm]	y[mm]
Pupil Center:	+	476 µm	+0.23	+0.53
Pachy Apex:	·	461 µm	0.00	0.00
Thinnest Locat.:	○	456 µm	-0.36	-0.18
K Max. (Front):	◆	55.9 D	-1.22	-0.91

Cornea Volume:	61.3 mm³	HWTW:	11.3 mm
Chamber Volume:	212 mm³	Angle:	38.8 °
A. C. Depth (Int.):	3.48 mm	Pupil Dia:	2.41 mm
Enter IOP / IOP(cor):		Lens Th.:	

Refractive



OCULUS - PENTACAM 4 Maps Refractive

1.22r01

Last Name:			
First Name:			
ID:			
Date of Birth:	07/10/1987	Eye:	Left
Exam Date:	12/31/2019	Time:	12:05:00
Exam Info:			

Cornea Front

Rf:	7.99 mm	K1:	42.2 D
Rs:	7.01 mm	K2:	48.1 D
Rm:	7.50 mm	Km:	45.0 D
QS: OK	Axis: (flat) 79.7 °	Astig:	+5.9 D
Q-val.: (30°) -0.24	Rper: 7.88 mm	Rmin:	6.36 mm

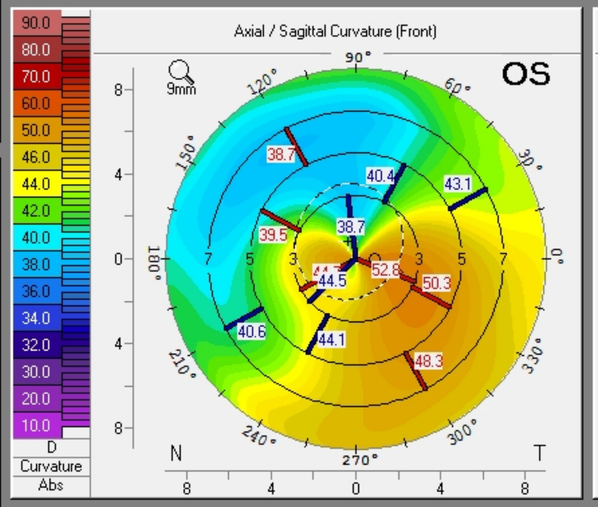
Cornea Back

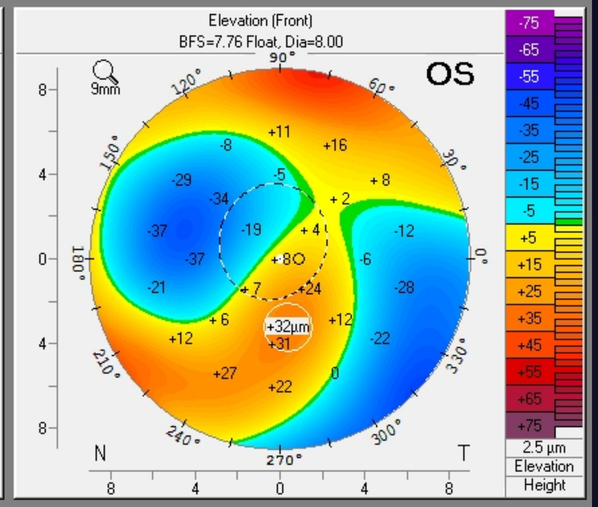
Rf:	6.02 mm	K1:	-6.7 D
Rs:	5.40 mm	K2:	-7.4 D
Rm:	5.71 mm	Km:	-7.0 D
QS: OK	Axis: (flat) 73.0 °	Astig:	-0.8 D
Q-val.: (30°) -0.55	Rper: 6.34 mm	Rmin: ◇	4.38 mm

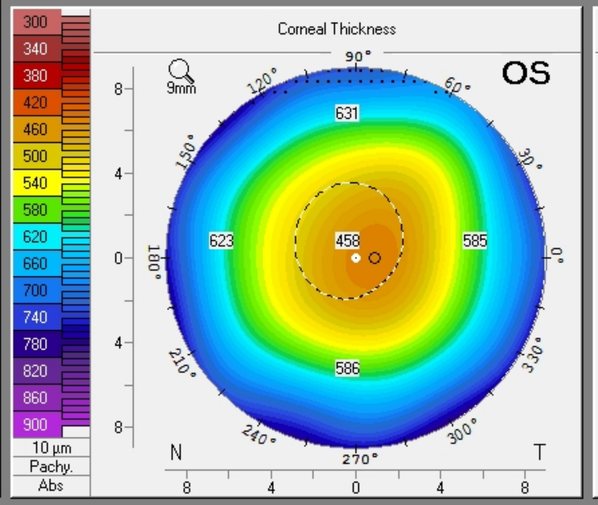
	Pachy:	x[mm]	y[mm]
Pupil Center: +	458 µm	-0.18	+0.41
Pachy Apex: ·	450 µm	0.00	0.00
Thinnest Locat.: ○	445 µm	+0.45	0.00
K Max. (Front): ◆	53.1 D	+1.03	-0.32

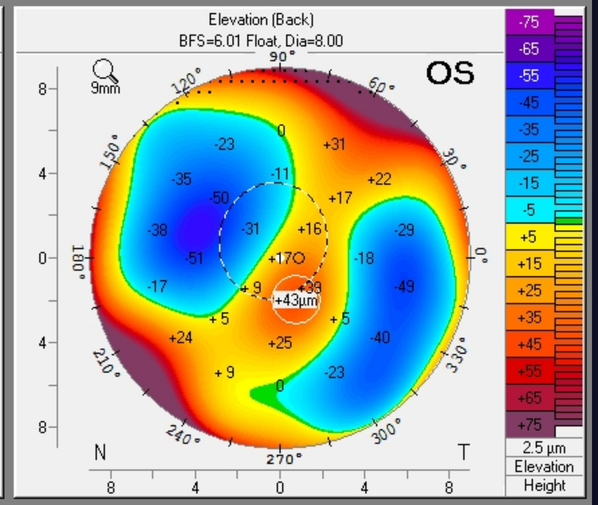
Cornea Volume:	60.3 mm³	HWTW:	11.4 mm
Chamber Volume:	204 mm³	Angle:	37.9 °
A. C. Depth (Int.):	3.40 mm	Pupil Dia:	2.64 mm
Enter IOP / IOP(cor):		Lens Th.:	

Refractive









LASIK Xtra??

Corneal Ectasia After LASIK Combined With Prophylactic Corneal Cross-linking

Suphi Taneri, MD; Saskia Kiessler, Dipl-Ing; Anika Rost, MSc; H. Burkhard Dick, MD

ABSTRACT

PURPOSE: To report a case of unilateral corneal ectasia following LASIK surgery combined with prophylactic corneal cross-linking (CXL) in a young patient.

METHODS: Case report.

RESULTS: Preoperative topography was unremarkable in both eyes with a minimum corneal thickness of 554 µm in the right eye and 546 µm in the left eye. Preoperative corrected distance visual acuity (CDVA) was 1.0 (20/20 Snellen) in both eyes with a refraction of +1.25 -2.75 × 10 in the right eye and +0.50 -2.00 × 163 in the left eye. LASIK combined with CXL was uneventful. After 12 months, postoperative topography was unremarkable with an uncorrected distance visual acuity (UDVA) of 1.0 in both eyes. Two years after surgery, the patient presented with a loss of vision (UDVA 0.25) and an inferior steepening on topography in the left eye. Standard CXL was performed to arrest further progression.

CONCLUSIONS: This report illustrates that the currently used prophylactic CXL protocol in combination with LASIK may not be effectively preventing corneal ectasia in every case.

[*J Refract Surg.* 2017;33(1):50-52.]

Keratectasia after LASIK is a rare complication but may potentially lead to a permanent loss of visual quality.[1] Prophylactic corneal cross-linking (CXL) may be added after laser ablation to increase corneal rigidity, thus reducing the risk of ectasia after LASIK.[2] We report the first case of unilateral corneal ectasia following LASIK combined with prophylactic CXL (LASIK+CXL) in a patient with unremarkable preoperative findings.

From the Center for Refractive Surgery, Eye Department St. Francis Hospital, Muenster, Germany (ST, SK, AR); and Ruhr-University, Eye Clinic, Bochum, Germany (ST, HBD).

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The authors have no financial or proprietary interest in the materials presented herein.

Correspondence: Suphi Taneri, MD, Center for Refractive Surgery, St. Francis Hospital, Hohenzollernring 70, 48145 Muenster, Germany. E-mail: taneri@refraktives-zentrum.de

doi:10.3928/1081597X-20161019-03

CASE REPORT

A healthy 18-year-old man was seeking laser vision correction. His preoperative refraction was +1.25 -2.75 × 10 in the right eye and +0.50 -2.00 × 163 in the left eye. The corrected distance visual acuity (CDVA) was 1.0 (20/20 Snellen) in both eyes. Orbscan results (Orbscan IIz; Bausch & Lomb, Rochester, NY) demonstrated an asymmetric bow tie pattern in the left eye only but were within normal limits with a maximum keratometry value of 43.20 diopters (D) and corneal astigmatism of 2.60 D in the right eye, and 43.20 D with corneal astigmatism of 1.90 D in the left eye, respectively. Minimum corneal thickness was 554 and 546 µm in the right and left eye, respectively (**Figure A**, available in the online version of this article). The following preoperative measurements were performed: slit-lamp examination, wavefront analysis, endothelial specular microscopy, tonometry, Orbscan examination, and dilated fundus examination. No risk factors for ectatic disease was found. The patient denied rubbing his eyes and did not use any long-term medication. He did not have floppy eyelids or sleep apnea. The patient's family history was negative; no relative had high astigmatism or was wearing rigid contact lenses.

Microkeratome-assisted LASIK combined with CXL was uneventful (Zyoptix XP microkeratome with Zero Compression head; Bausch & Lomb; suction ring with 9.5-mm inner diameter). A new microkeratome blade was used for each flap cut. Intended flap thickness was 120 µm in both eyes. Achieved flap thickness was 88 µm in the right eye and 115 µm in the left eye as intraoperatively measured using subtraction ultrasound pachymetry: central corneal thickness was recorded three times using the same ultrasound probe (DGH-500 Pachette; DGH Technology, Inc., Exton, PA) immediately before applying the suction ring. After lifting the flap, the pachymeter was again used three times to determine central corneal bed thickness before ablation. The difference between the mean values was considered to be the flap thickness. Flap diameter was 8.9 mm in the right eye and 9.5 mm in the left eye as measured with a measuring tool in the anterior segment optical coherence tomography (OCT) image 3 months postoperatively. Maximum laser ablation was 59 µm in the right eye and 51 µm in the left eye, leaving a residual stromal thickness of 397 µm in the right eye and 390 µm in the left eye (Technolas 217P laser; Bausch & Lomb). Optical zone was 7 mm in both eyes with a blend zone of 12 × 10.1 mm in the right eye and 11.9 × 9.6 mm in the left eye.

Intraoperative CXL was performed as follows. Immediately after laser ablation, riboflavin phosphate 0.22% (Vibex Xtra; Avedro Inc., Waltham, MA) was

Post SMILE Ectasia

courtesy of Dan Reinstein

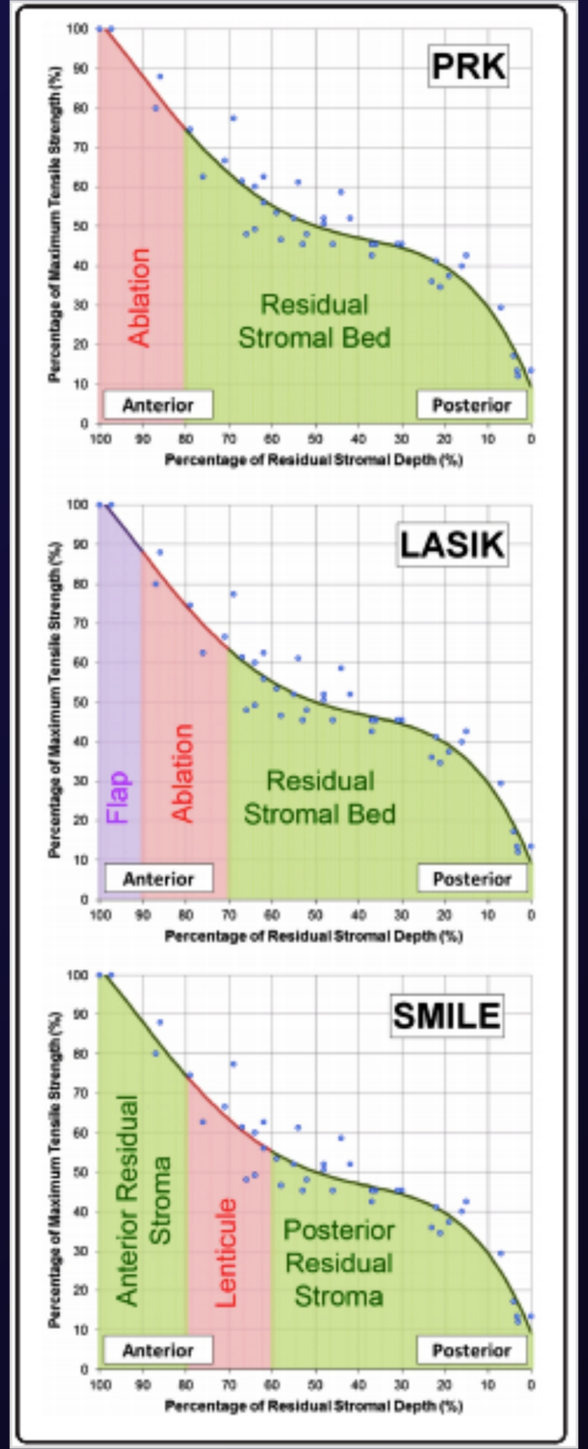


Table 1. Studies analyzing corneal biomechanics after laser refractive surgery techniques.

Study* and Year	Instr
LASIK vs LASEK/PRK	
Kirwan 2008[61]	
Kamiya 2009[62]	
Hassan 2014[63]	C
Shen 2014[64]	C
SMILE vs LASIK	
Shen 2014[64]	C
Pedersen 2014[65]	ORA
Wang 2014[66]	
Wu 2014[67]	C
Agca 2014[68]	
Sefat 2016[69]	C
Osman 2016[70]	
Wang 2016[66,71]	
Zhang 2016[72]	
SMILE vs LASEK/PRK	
Shen 2014[64]	C
Dou 2015[73]	
Yildirim 2016[74]	
Chen 2016[75]	
Al-Nashar 2017[76]	
Technique variations	
Kamiya 2014[77]	
Shen 2014[78]	C
Mastropasqua 2014[79]	C
El-Massry 2015[80]	
Leccisotti 2016[81]	C
Fernández 2016[82]	C

CCT = central corneal thickness; FLEx = femtosecond lenticule extraction; FS-LASI
LASEK = laser-assisted subepithelial keratectomy; LASIK = laser in situ keratomileusis;
tectomy; SMILE = small-incision lenticule extraction; WG = wavefront guided
*$P < 0.05$.

Cornea

Brillouin Optical Microscop

Giuliano Scarcelli,[1,2] *Roberto Pineda,*[3] *and S*

Purpose. The mechanical properties of corneal tissue ar linked to prevalent ocular diseases and therapeutic procedures Brillouin microscopy is a novel optical technology that enable three-dimensional mechanical imaging. In this study, the feasi bility of this noncontact technique was tested for in situ quan titative assessment of the biomechanical properties of the cor nea.

Methods. Brillouin light-scattering involves a spectral shift pro portional to the longitudinal modulus of elasticity of the tissue A 532-nm single-frequency laser and a custom-developed ultra high-resolution spectrometer were used to measure the Brill ouin frequency. Confocal scanning was used to perform Brill ouin elasticity imaging of the corneas of whole bovine eyes The longitudinal modulus of the bovine corneas was compare before and after riboflavin corneal collagen photo-cross-link ing. The Brillouin measurements were then compared witl conventional stress–strain mechanical test results.

Results. High-resolution Brillouin images of the cornea wer obtained, revealing a striking depth-dependent variation o the elastic modulus across the cornea. Along the central axis the Brillouin frequency shift varied gradually from 8.2 GH in the epithelium to 7.5 GHz near the endothelium. The coe ficients of the down slope were measured to be approximatel 1.09, 0.32, and 2.94 GHz/mm in the anterior, posterior, an innermost stroma, respectively. On riboflavin collagen cross linking, marked changes in the axial Brillouin profiles ($P <$ 0.001) were noted before and after cross-linking.

Conclusions. Brillouin imaging can assess the biomechanica properties of cornea in situ with high spatial resolution. Thi novel technique has the potential for use in clinical diagnostic and treatment monitoring. (*Invest Ophthalmol Vis Sci.* 2012 53:185–190) DOI:10.1167/iovs.11-8281

The current standard of corneal diagnosis is structural anal ysis, by pachymetry[1] and tomography,[2] to measure cornea thickness and curvature. In addition to structure, the biome chanical properties of the cornea are also important indicator of corneal health. Keratoconus is a degenerative condition tha involves a loss of corneal rigidity. Corneal ectasia, which ca occur as a rare but serious complication of refractive surgery results from a decrease in corneal stiffness. Corneal cross

From the [1]Wellman Center for Photomedicine, Massachusett General Hospital, Boston, Massachusetts; the [2]Department of Derma tology, Harvard Medical School, Boston, Massachusetts; the [3]Depar ment of Ophthalmology, Massachusetts Eye and Ear Infirmary, Boston Massachusetts; and [4]Harvard-MIT Health Sciences and Technology Cambridge, Massachusetts.

Supported by a Tosteson Fellowship (GS), Grant R21EB00847 from the National Institutes of Health, and Grant CBET-0853773 fron the National Science Foundation.

Submitted for publication July 23, 2011; revised September 8 October 1, and November 3, 2011; accepted November 28, 2011.

Disclosure: **G. Scarcelli**, None; **R. Pineda**, None; **S.H. Yun**, Non

Corresponding author: Seok Hyun Yun, Department of Dermato ogy, Harvard Medical School, 55 Fruit Street, Boston, MA 02114 syun@hms.harvard.edu.

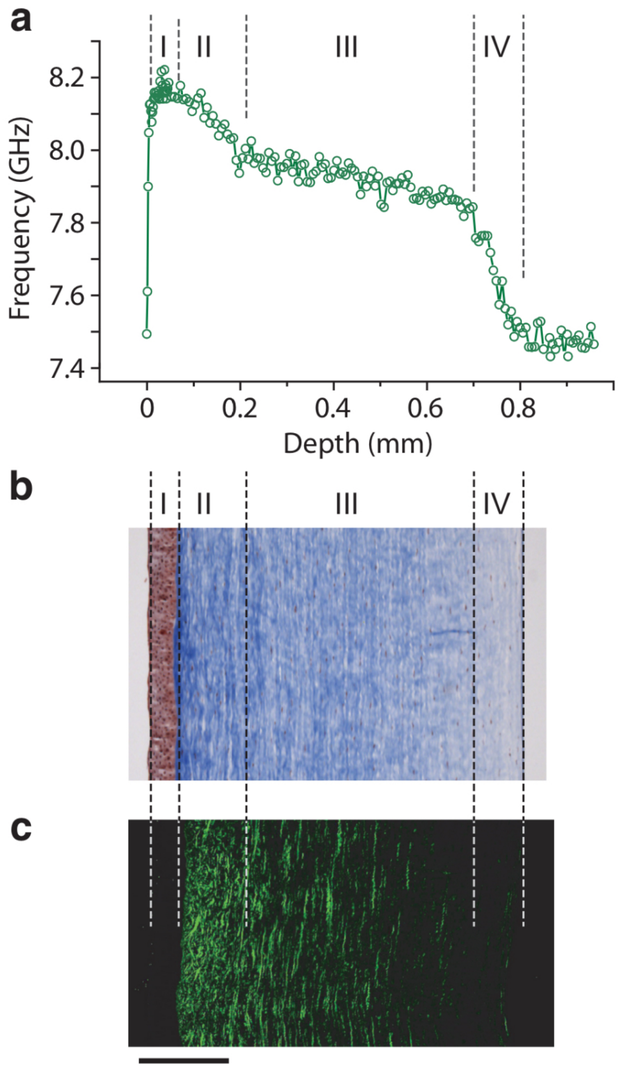


Figure 3. Comparison of Brillouin elasticity and structural images. (**a**) Brillouin depth profile of the entire cornea including the epithelium (I), anterior stroma (II), posterior stroma (III), and the innermost region (IV). (**b**) Masson's trichrome–stained image of 5-μm-thick cornea section. (**c**) An SHG image of 5-μm-thick cornea section. Scale bar, 200 μm.

Tissue Removal

6mm Optical Zone			
	SMILE	Excimer	%
-2.00	37	27	37%
-3.00	50	39	28%
-5.00	75	63	19%
-8.00	110	97	13%

6.5mm Optical Zone			
	SMILE	Excimer	%
-2.00	43	32	34%
-3.00	59	47	25%
-5.00	89	75	18%
-8.00	130	116	12%

April 2015

CASE REPORT

Bilateral ectasia after femtosecond laser–assisted small-incision lenticule extraction

Mohamed Tarek El-Naggar, MD, FRCS

This case report describes clinical and topographic features of bilateral corneal ectasia after femtosecond laser–assisted small-incision lenticule extraction. The case suggests that patients with preoperative forme fruste keratoconus or early keratoconus might develop significant progression of corneal ectasia after the small-incision lenticule extraction procedure and shows that the procedure can affect the corneal biomechanics.

Financial Disclosure: The author has no financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2015; 41:884–888 © 2015 ASCRS and ESCRS

Corneal ectasia after laser in situ keratomileusis (LASIK) is a well-described, relatively rare complication of corneal refractive surgery.[1,2] Several reports of ectasia after photorefractive keratectomy (PRK) have been published.[3–5] To my knowledge, this is the first report of ectasia after femtosecond laser–assisted small-incision lenticule extraction (SMILE, Carl Zeiss

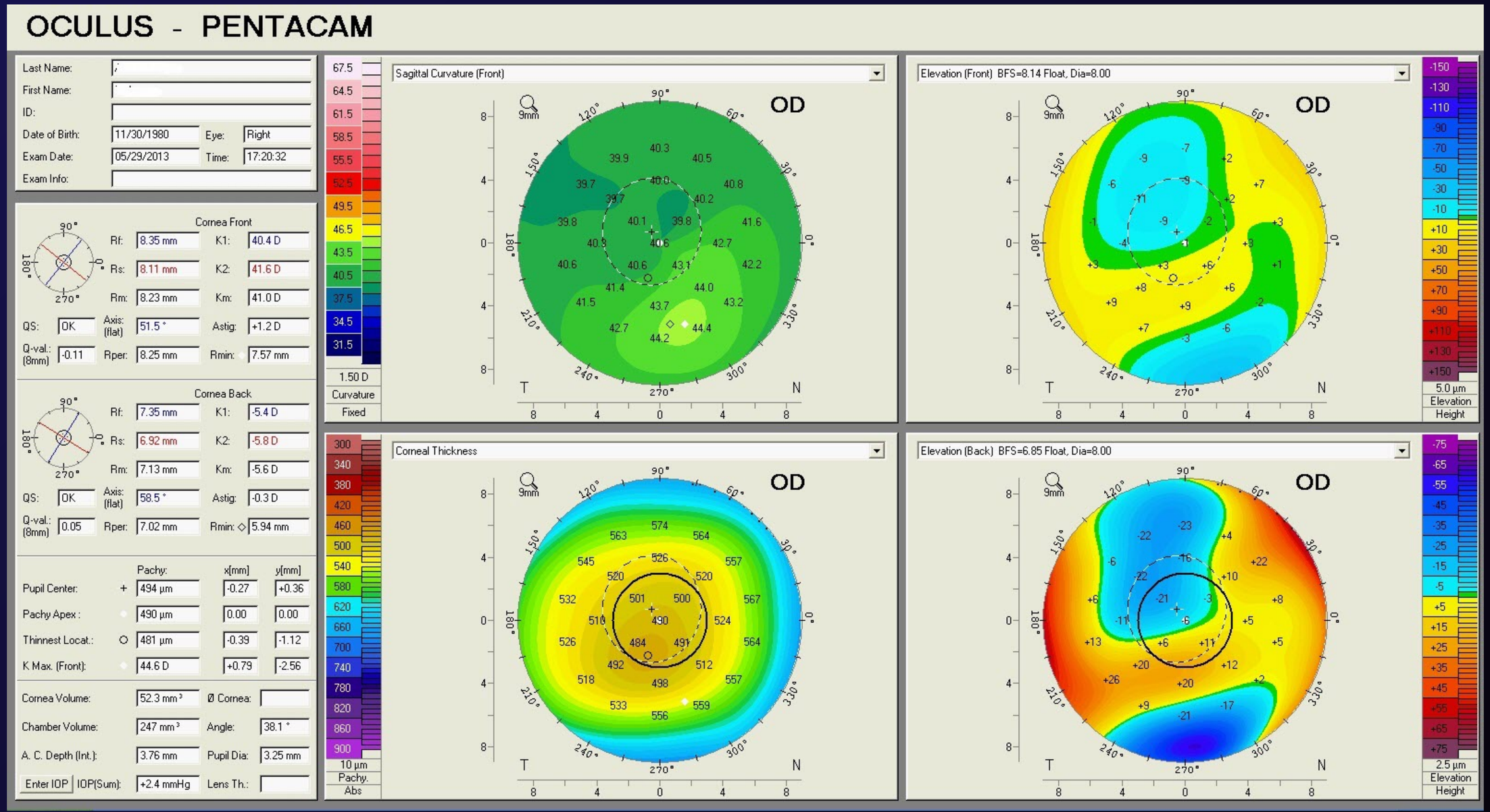
and associated bilateral relative anterior and posterior surface elevation using a best-fit sphere of 8.0 mm diameter. Although the keratometry (K) readings on the anterior corneal surface sagittal map were relatively flat (right eye, 40.4 diopters [D] and 41.6 D; left eye, 40.8 D and 41.6 D), subclinical keratoconus/forme fruste keratoconus was diagnosed and LASIK surgery was not considered an option.

Because the patient had a documented stable refraction for

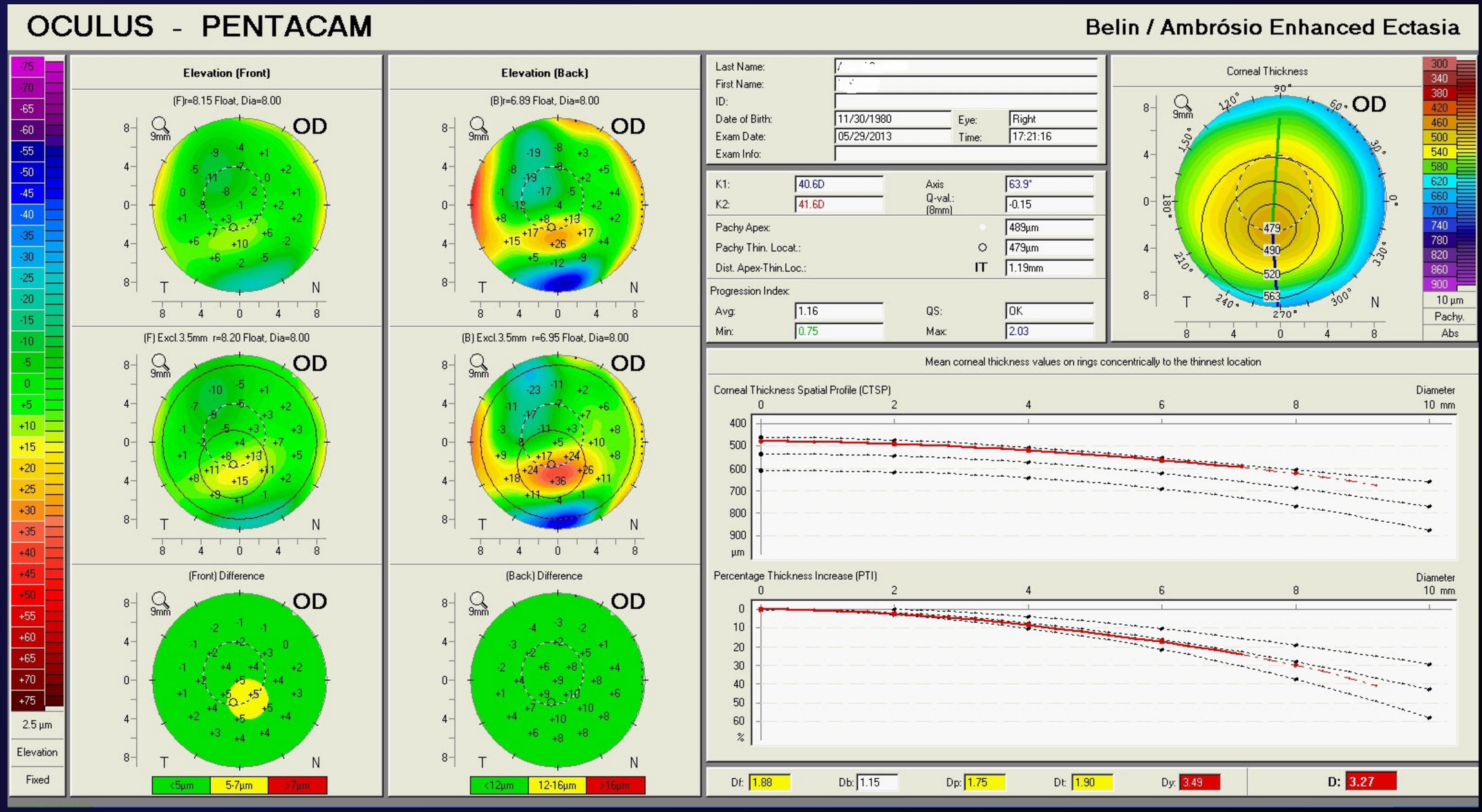
Case Report

- A 33-year-old Caucasian male patient came to our clinic seeking LASIK surgery
- Manifest refraction:
  - ❑-2.00 -1.00 x 65 OD
  - ❑-2.25 -1.25 x 105 OS
- CDVA: 20/15 in both eyes, separately.
- The patient had no significant ocular history, including trauma, amblyopia, or strabismus; and has no family history of keratoconus.
- After careful full ophthalmological examination, nothing significant was detected.

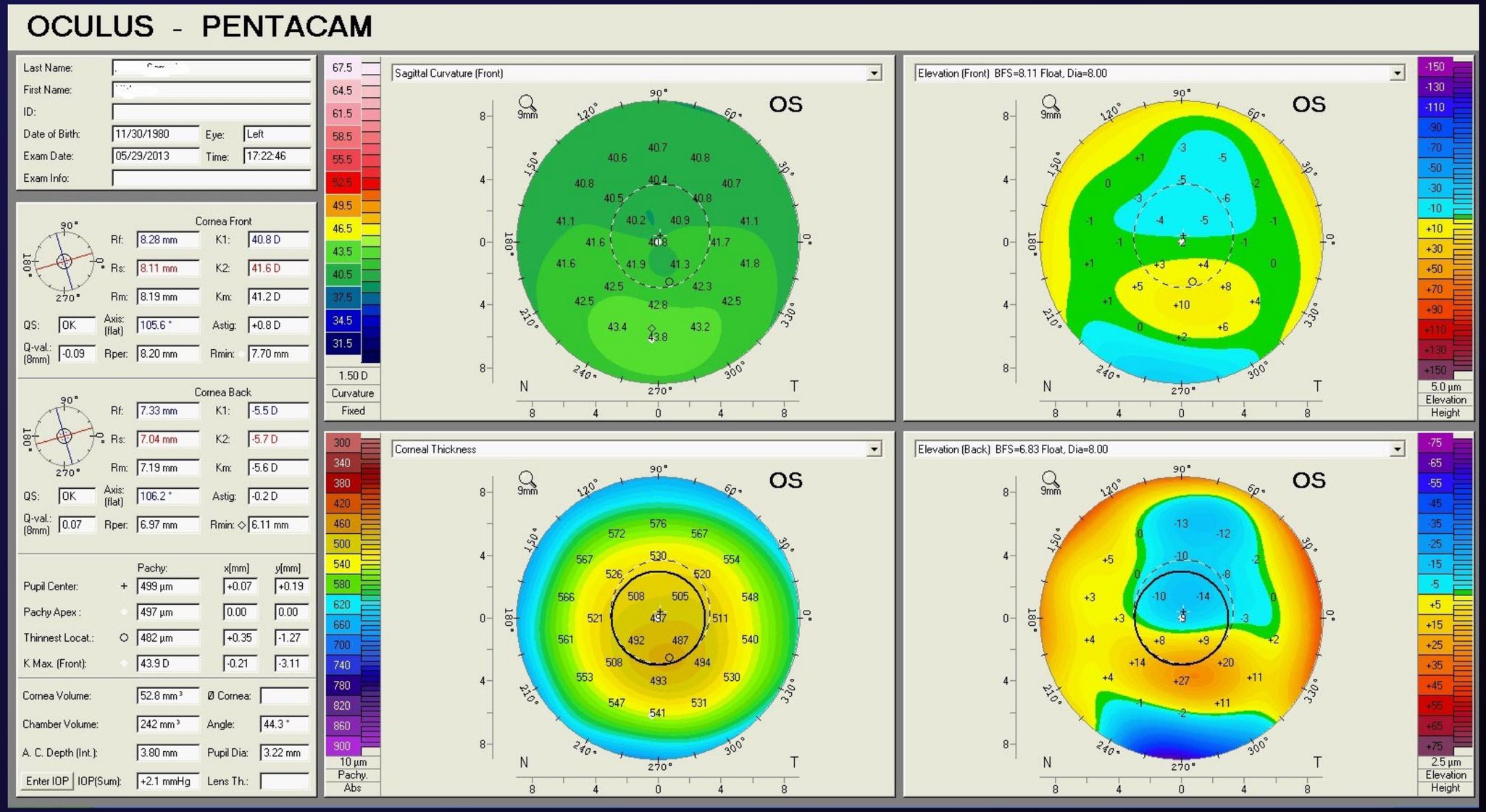
Initial Pentacam exam of the right eye



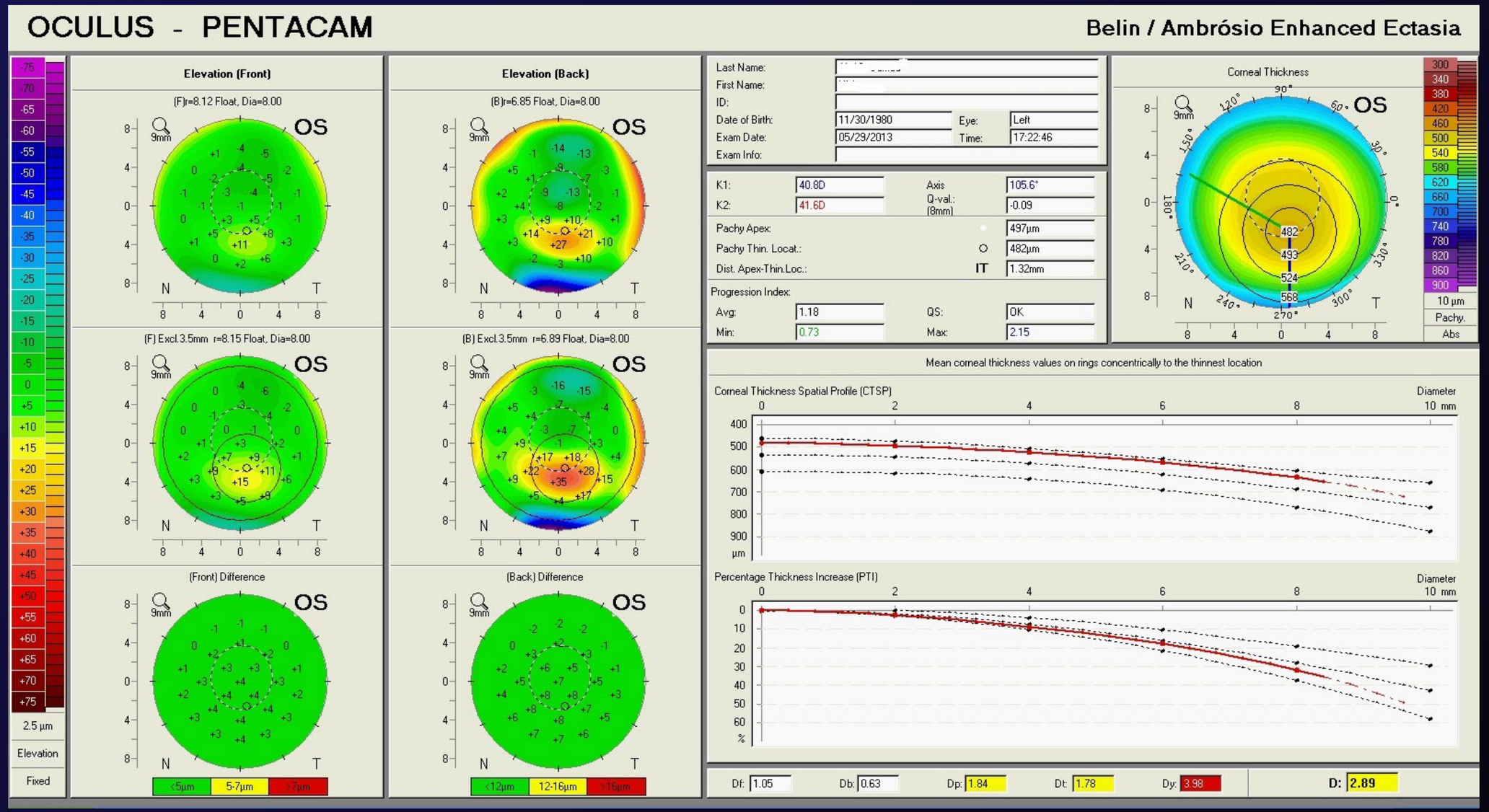
BAD-D


OCULUS - PENTACAM
Belin / Ambrósio Enhanced Ectasia
Elevation (Front)
(F)r=8.15 Float, Dia=8.00
Elevation (Back)
(B)r=6.89 Float, Dia=8.00
(F) Excl.3.5mm r=8.20 Float, Dia=8.00
(B) Excl.3.5mm r=6.95 Float, Dia=8.00
(Front) Difference
(Back) Difference
OD
9mm
T
N
<5µm
5-7µm
>7µm
<12µm
12-16µm
>16µm
2.5 µm
Elevation
Fixed
Last Name:
First Name:
ID:
Date of Birth: 11/30/1980
Eye: Right
Exam Date: 05/29/2013
Time: 17:21:16
Exam Info:
K1: 40.6D
K2: 41.6D
Axis 63.9°
Q-val.: (8mm) -0.15
Pachy Apex: 489µm
Pachy Thin. Locat.: 479µm
Dist. Apex-Thin.Loc.: IT 1.19mm
Progression Index:
Avg: 1.16
Min: 0.75
QS: OK
Max: 2.03
Corneal Thickness
479
490
520
563
10 µm
Pachy.
Abs
Mean corneal thickness values on rings concentrically to the thinnest location
Corneal Thickness Spatial Profile (CTSP)
Diameter
10 mm
µm
Percentage Thickness Increase (PTI)
%
Df: 1.88
Db: 1.15
Dp: 1.75
Dt: 1.90
Dy: 3.49
D: 3.27

Initial Pentacam exam of the left eye



BAD D


OCULUS - PENTACAM
Belin / Ambrósio Enhanced Ectasia
Elevation (Front)
(F)r=8.12 Float, Dia=8.00
(F) Excl.3.5mm r=8.15 Float, Dia=8.00
(Front) Difference
Elevation (Back)
(B)r=6.85 Float, Dia=8.00
(B) Excl.3.5mm r=6.89 Float, Dia=8.00
(Back) Difference
2.5 µm
Elevation
Fixed
<5µm
5-7µm
>7µm
<12µm
12-16µm
>16µm
Last Name:
First Name:
ID:
Date of Birth: 11/30/1980
Eye: Left
Exam Date: 05/29/2013
Time: 17:22:46
Exam Info:
K1: 40.8D
K2: 41.6D
Axis 105.6°
Q-val.: (8mm) -0.09
Pachy Apex: 497µm
Pachy Thin. Locat.: 482µm
Dist. Apex-Thin.Loc.: IT 1.32mm
Progression Index:
Avg: 1.18
Min: 0.73
QS: OK
Max: 2.15
Corneal Thickness
482
493
524
568
10 µm
Pachy.
Abs
Mean corneal thickness values on rings concentrically to the thinnest location
Corneal Thickness Spatial Profile (CTSP)
Diameter 10 mm
µm
Percentage Thickness Increase (PTI)
%
Df: 1.05
Db: 0.63
Dp: 1.84
Dt: 1.78
Dy: 3.98
D: 2.89

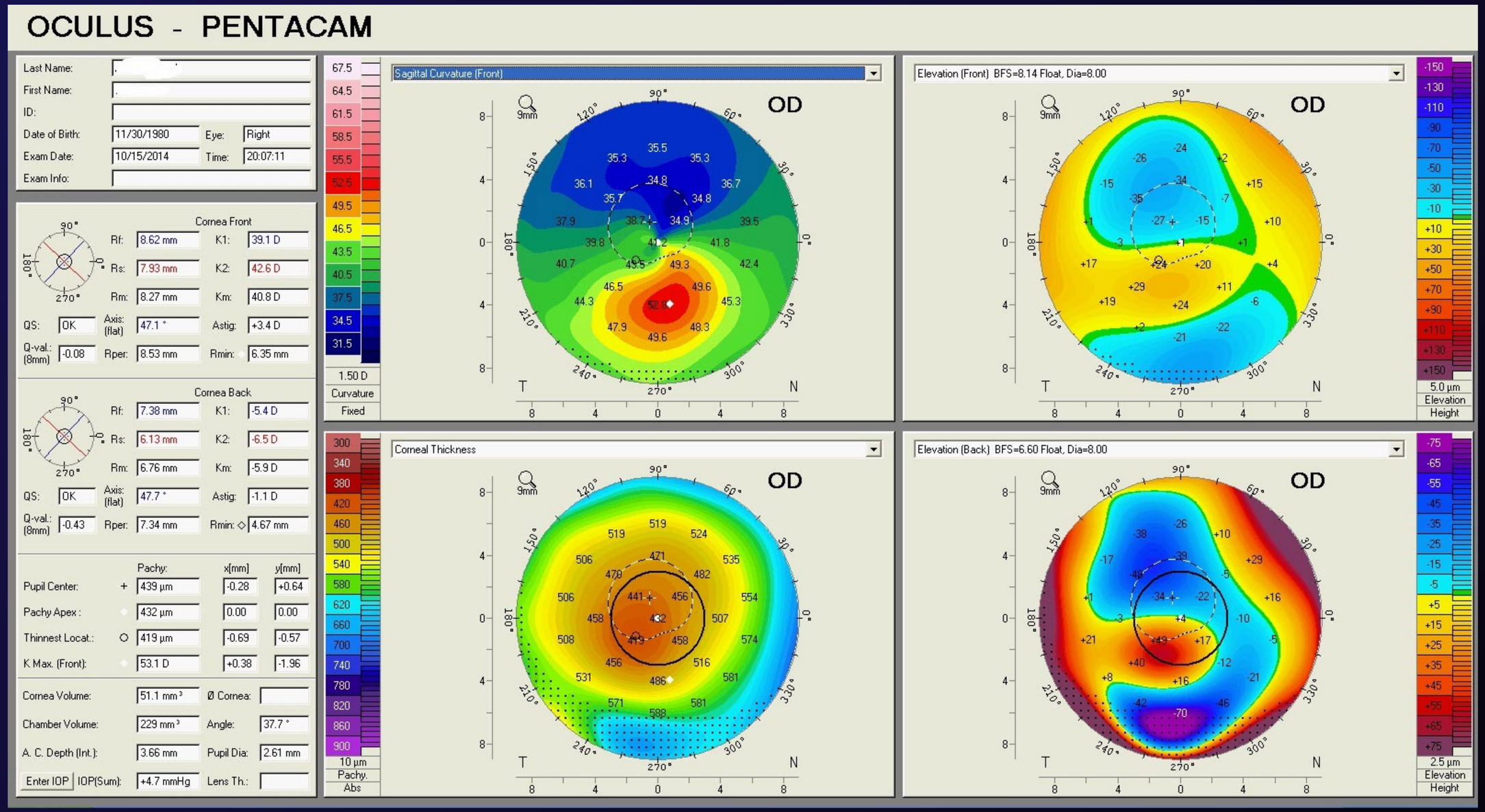
- Although the anterior corneal surface sagittal maps K readings were relatively flat (OD: 40.4D &41.6D, OS: 40.8D& 41.6D), the patient was diagnosed as subclinical keratoconus/Forme fruste keratoconus, and LASIK surgery was refrained.

- Since the patient had a documented stable refraction for the past few years, and considering the patient age and gender, corneal collagen cross linking was deferred until documented progression can be detected.
- He was advised not to do any corneal refractive surgery and be followed up after 6 months to detect any further progression of the condition.

One and a half year later

- The patient came complaining of diminution of vision
- He reported that he underwent a Femtosmile procedure in a different center 6 months ago
- Manifest refraction:
  - OD: -0.50 -2.75 x 35 correcting to 20/30
  - OS: -2.00 -3,00 x 120 correcting to 20/30
- The cornea was centrally clear apart from superior faint scar related to the operation and circumferential faint opacity related to the operation in both eyes

OD Post-SMILE

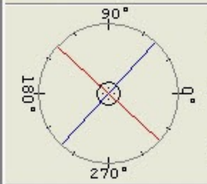


OCULUS - PENTACAM

Name: [redacted] ID: [redacted] Date of Birth: 11/30/1980

Exam
67.5
66.0
64.5
63.0
61.5
60.0
58.5
57.0
55.5
54.0
52.5
51.0
49.5
48.0
46.5
45.0
43.5
42.0
40.5
39.0
37.5
36.0
34.5
33.0
31.5
30.0
1.50 D
Curvature
Fixed

A: 10/15/2014 20:07:11 Right (25) 3D-Scan HR

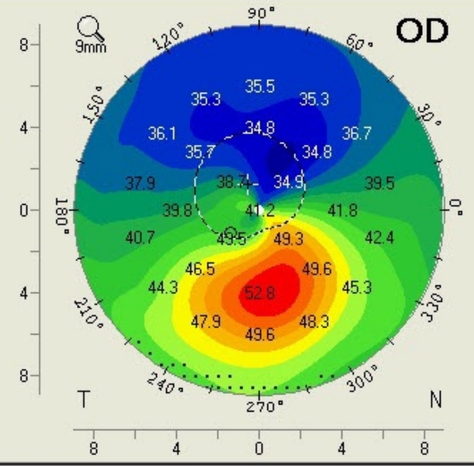


K1:	39.1 D	Astig:	+3.4 D
K2:	42.6 D	Q-val.: (8mm)	-0.08
Axis: (flat)	47.1 °	QS:	OK

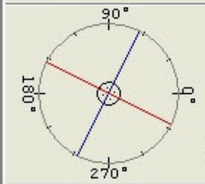
		Pachy:	x[mm]	y[mm]
Pupil Center:	+	439 µm	-0.28	+0.64
Thinnest Locat.:	○	419 µm	-0.69	-0.57

Chamber Volume:	229 mm³	Angle:	37.7 °
A. C. Depth (Int.):	3.66 mm	Pupil Dia:	2.61 mm
IOP(cor):		Lens Th.:	

Sagittal Curvature (Front)



B: 05/29/2013 17:21:16 Right (25) 3D-Scan HR

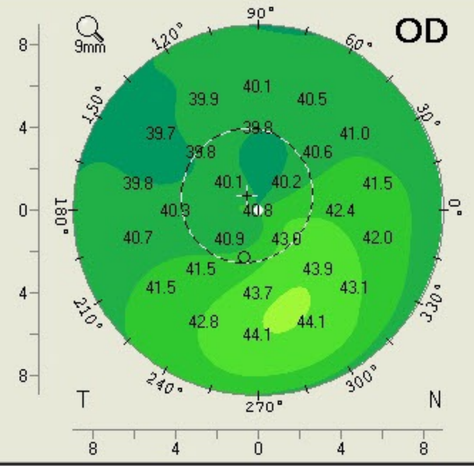


K1:	40.6 D	Astig:	+0.9 D
K2:	41.6 D	Q-val.: (8mm)	-0.15
Axis: (flat)	63.9 °	QS:	OK

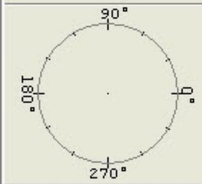
		Pachy:	x[mm]	y[mm]
Pupil Center:	+	493 µm	-0.29	+0.35
Thinnest Locat.:	○	479 µm	-0.34	-1.14

Chamber Volume:	247 mm³	Angle:	40.7 °
A. C. Depth (Int.):	3.76 mm	Pupil Dia:	3.22 mm
IOP(cor):		Lens Th.:	

Sagittal Curvature (Front)



Difference A - B

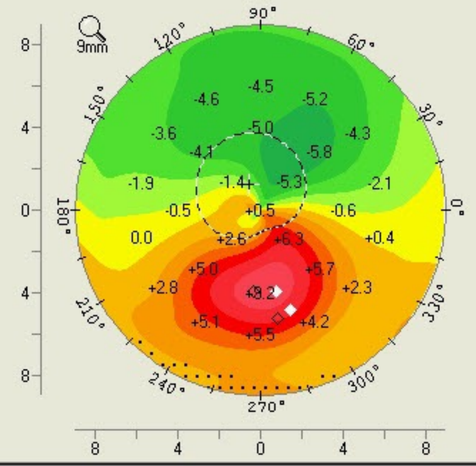


K1:	-1.5 D	Astig:	+2.5 D
K2:	+1.0 D	Q-val.: (8mm)	+0.08
Axis: (flat)	-16.8 °	QS:	

		Pachy:	x[mm]	y[mm]
Pupil Center:	+	-53 µm	+0.01	+0.29
Thinnest Locat.:	○	-60 µm	-0.36	+0.58

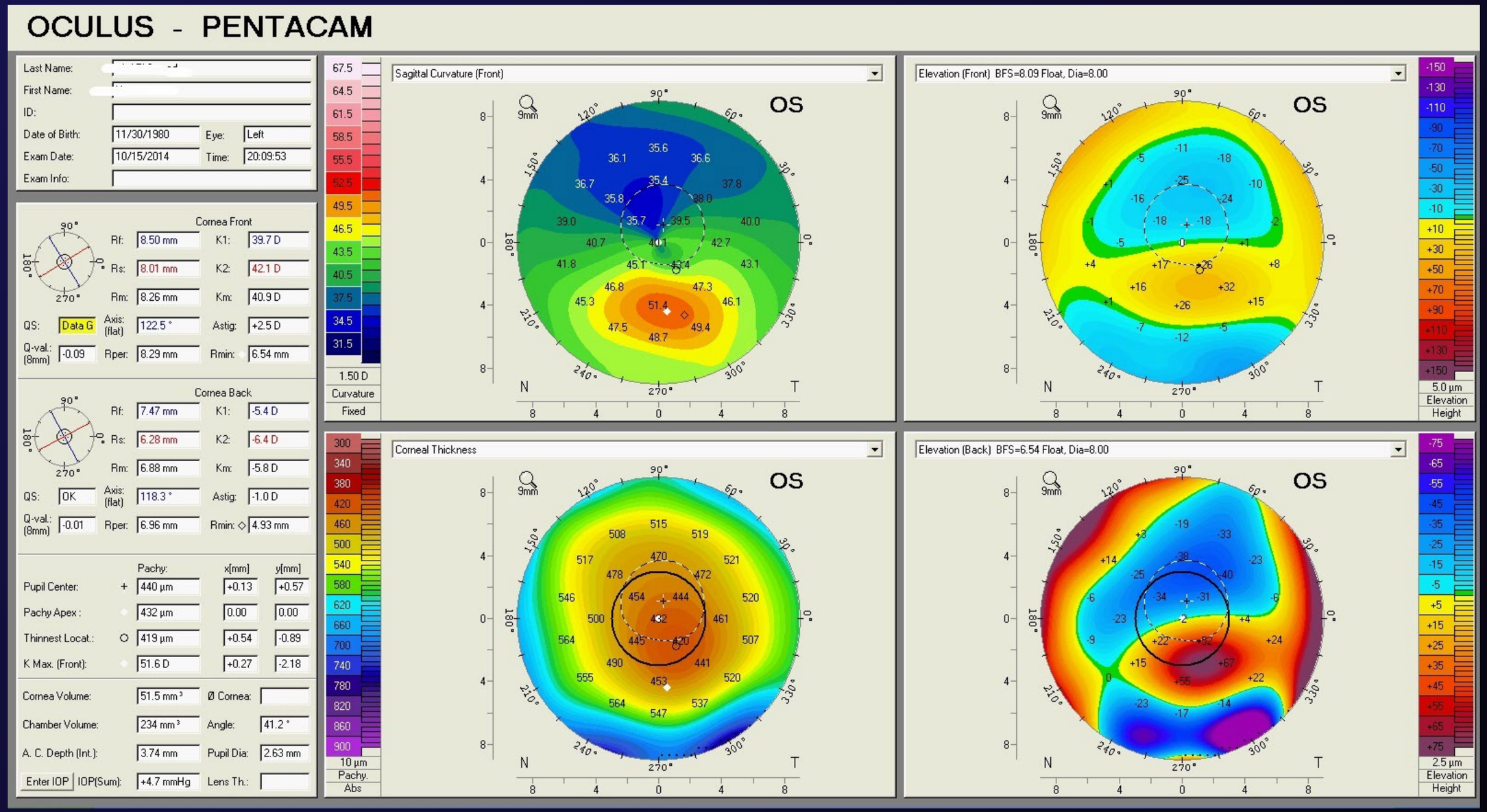
Chamber Volume:	-18 mm³	Angle:	-3.0 °
A. C. Depth (Int.):	-0.10 mm	Pupil Dia:	-0.62 mm
IOP(cor):		Lens Th.:	

Sagittal Curvature (Front)



+21.0
+19.5
+18.0
+16.5
+15.0
+13.5
+12.0
+10.5
+9.0
+7.5
+6.0
+4.5
+3.0
+1.5
0.0
-1.5
-3.0
-4.5
-6.0
-7.5
-9.0
-10.5
-12.0
-13.5
-15.0
-16.5
1.50 D
Curvature
Fixed

OS Post-SMILE



OCULUS - PENTACAM

Name: [redacted] ID: [redacted] Date of Birth: 11/30/1980

Exam

67.5 | 66.0 | 64.5 | 63.0 | 61.5 | 60.0 | 58.5 | 57.0 | 55.5 | 54.0 | 52.5 | 51.0 | 49.5 | 48.0 | 46.5 | 45.0 | 43.5 | 42.0 | 40.5 | 39.0 | 37.5 | 36.0 | 34.5 | 33.0 | 31.5 | 30.0 | 1.50 D | Curvature | Fixed

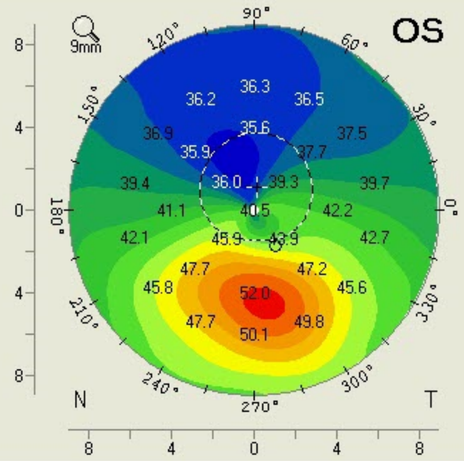
A: 10/15/2014 20:08:19 Left (25) 3D-Scan HR

K1:	39.9 D	Astig:	+2.5 D
K2:	42.4 D	Q-val.: (8mm)	-0.16
Axis: (flat)	121.9 °	QS:	Data Gaps!

	Pachy:	x[mm]	y[mm]
Pupil Center: +	438 µm	+0.05	+0.56
Thinnest Locat.: ○	419 µm	+0.54	-0.87

Chamber Volume:	234 mm³	Angle:	44.3 °
A. C. Depth (Int.):	3.74 mm	Pupil Dia:	2.70 mm
IOP(cor):		Lens Th.:	

Sagittal Curvature (Front)



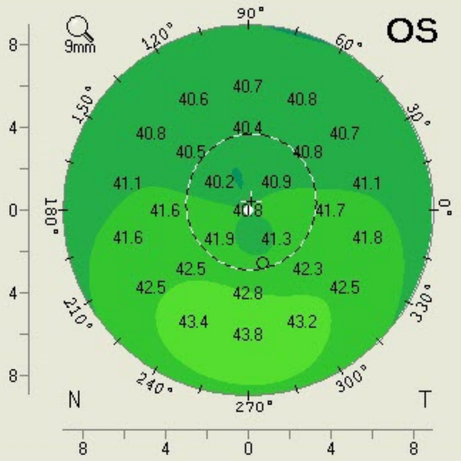
B: 05/29/2013 17:22:46 Left (25) 3D-Scan HR

K1:	40.8 D	Astig:	+0.8 D
K2:	41.6 D	Q-val.: (8mm)	-0.09
Axis: (flat)	105.6 °	QS:	OK

	Pachy:	x[mm]	y[mm]
Pupil Center: +	499 µm	+0.07	+0.19
Thinnest Locat.: ○	482 µm	+0.35	-1.27

Chamber Volume:	242 mm³	Angle:	44.3 °
A. C. Depth (Int.):	3.80 mm	Pupil Dia:	3.22 mm
IOP(cor):		Lens Th.:	

Sagittal Curvature (Front)



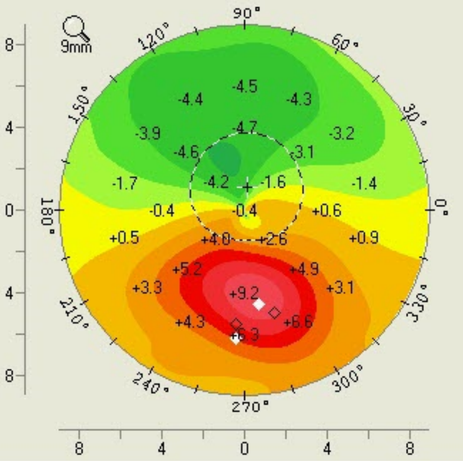
Difference A - B

K1:	-0.8 D	Astig:	+1.6 D
K2:	+0.8 D	Q-val.: (8mm)	-0.07
Axis: (flat)	+16.3 °	QS:	

	Pachy:	x[mm]	y[mm]
Pupil Center: +	-61 µm	-0.02	+0.36
Thinnest Locat.: ○	-63 µm	+0.18	+0.40

Chamber Volume:	-8 mm³	Angle:	0.0 °
A. C. Depth (Int.):	-0.06 mm	Pupil Dia:	-0.53 mm
IOP(cor):		Lens Th.:	

Sagittal Curvature (Front)



+21.0 | +19.5 | +18.0 | +16.5 | +15.0 | +13.5 | +12.0 | +10.5 | +9.0 | +7.5 | +6.0 | +4.5 | +3.0 | +1.5 | 0.0 | -1.5 | -3.0 | -4.5 | -6.0 | -7.5 | -9.0 | -10.5 | -12.0 | -13.5 | -15.0 | -16.5 | 1.50 D | Curvature | Fixed

Ectasia risk: A multifactorial conundrum

Ectasia after corneal refractive surgery remains one of the most insidious and perplexing problems in the day-to-day practice of the refractive surgeon. Although the incidence of ectasia is low, it is the raison d'être for most of the measurements and history obtained in the course of screening patients for refractive surgery.

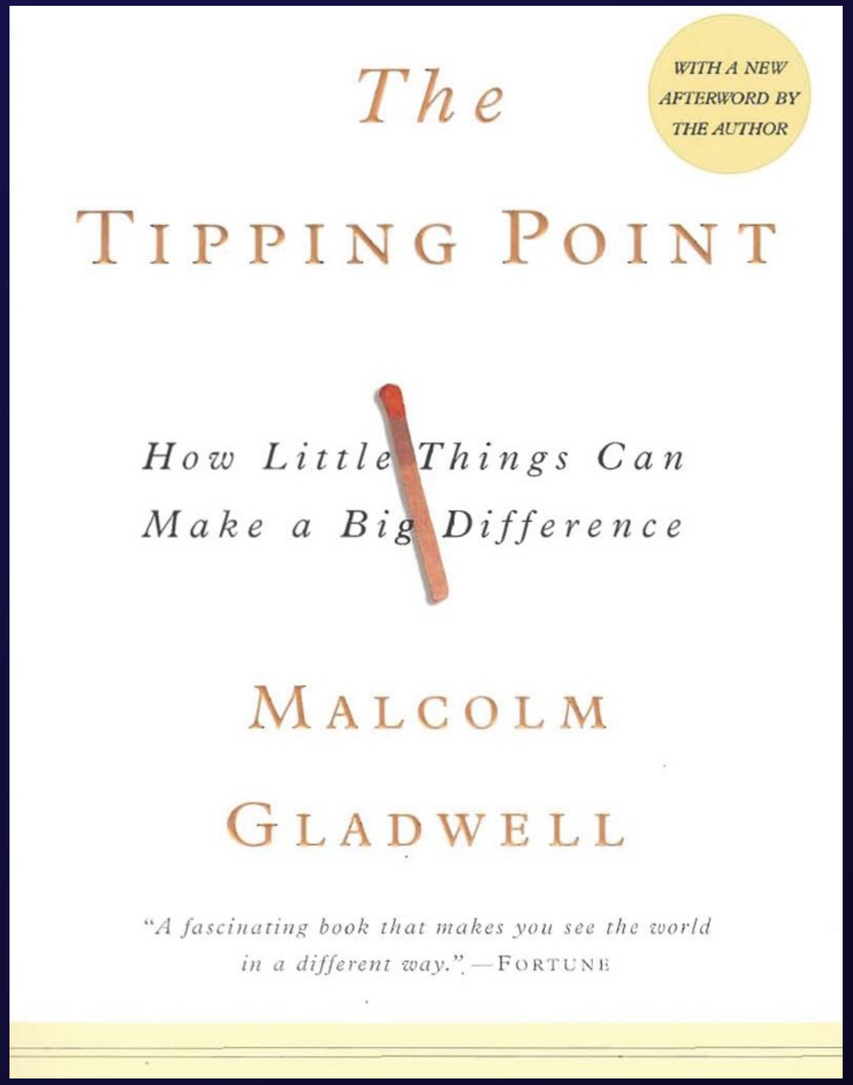
In this issue of the journal, Ziaei and a group of coauthors representing the Cornea Committee of the American Society of Cataract and Refractive Surgery (ASCRS) present a major review of surgical approaches to managing ectasia (pages 842–872). They summarize key advances in treatment, including combinations of treatments aimed at improving corneal optics and stabilizing progressive disease. Although great progress continues to be made on the therapeutic side of this problem, reliable characterization of ectasia risk remains a challenge. And from every vantage point, avoidance or prevention of ectasia at the preoperative planning stage is much preferred to treating it later.

Clinicians can easily assess predisposition for a disorder when a single highly predictive marker is available, such as a specific genetic mutation in a hereditary disease with high expressivity and high penetrance. Unfortunately, refractive surgeons do not have access to a single high-probability marker for ectasia. Ectasia in the setting of refractive surgery is a multifactorial problem, as Randleman et al.[1] illustrated through their landmark retrospective analysis of patient- and procedure-specific risk factors. This reality complicates efforts to quantify risk in the setting of the screening examination, where our ability to both measure and synthesize the major components of risk for a given patient is still incomplete.

Acknowledging the multivariate nature of the problem and appealing to structural principles are critically important for properly conceptualizing risk. From the vantage point of the cornea as a structure, material failure is the final common pathway of ectasia.[2–5] The key challenge, then, is to determine—with a limited amount of information and proxy variables—just where on the spectrum of structural behavior a given eye currently resides and how surgical intervention will change that.

The Case Reports section of this issue features a cautionary example of this process and the clinical stakes of different interpretations of apparent risk. El-Naggar (pages 884–888) presents what might be the first reported cases of corneal ectasia in a patient who had femtosecond small-incision refractive lenticule extraction, an intrastromal procedure that largely preserves the integrity of the anterior stromal collagen structure. Previous publications[8,9] have presented a biomechanical rationale for the potential structural advantages of this approach, and at first glance, the case report could be taken as an indictment of this claim. However, the preoperative tomography showed bilateral evidence of ectatic predisposition suggested by asymmetric inferior topographic steepness, posterior corneal elevation, decentered thinnest corneal points, and low overall corneal thickness. The patient was advised by the author that he was not a laser in situ keratomileusis (LASIK) candidate but then had small-incision refractive lenticule extraction performed elsewhere and returned to the author's clinic 6 months later with evidence of marked progression of inferior steepening and manifest ectasia.

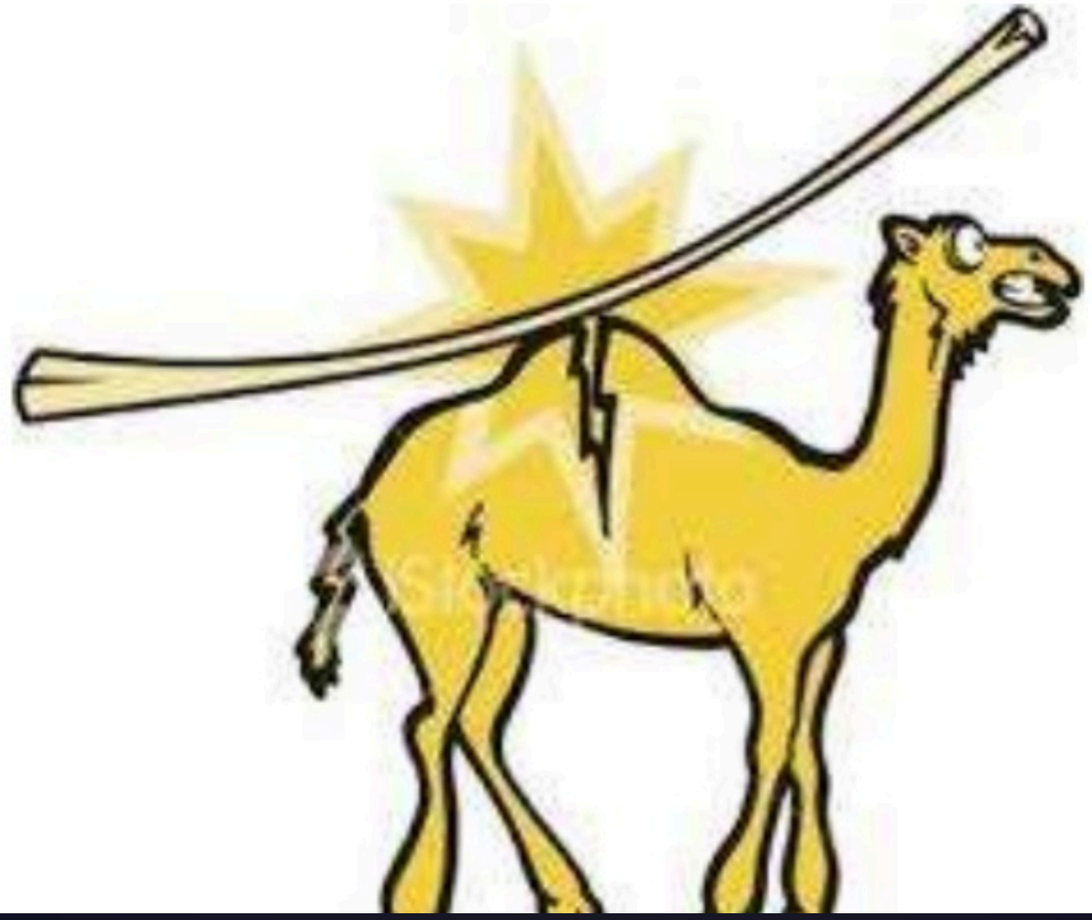
This case offers several learning points. First, ectasia risk assessment is currently sufficiently imprecise that the presence of even 1 perceived risk factor (particularly a topographic risk factor such as inferior steepness) should bias the surgical decision toward observation or tissue-sparing procedures. In the reported case, the patient's older age, low absolute corneal curvatures, refractive stability, and low level of myopic refractive error might have been factored into the decision to proceed with surgery despite the concerns apparent on tomography. This point is


The
WITH A NEW AFTERWORD BY THE AUTHOR
TIPPING POINT
How Little Things Can Make a Big Difference
MALCOLM GLADWELL
"A fascinating book that makes you see the world in a different way."—FORTUNE


TIPPING POINT

Clip slide

The straw that broke the camel's back



May 2015

CASE REPORT

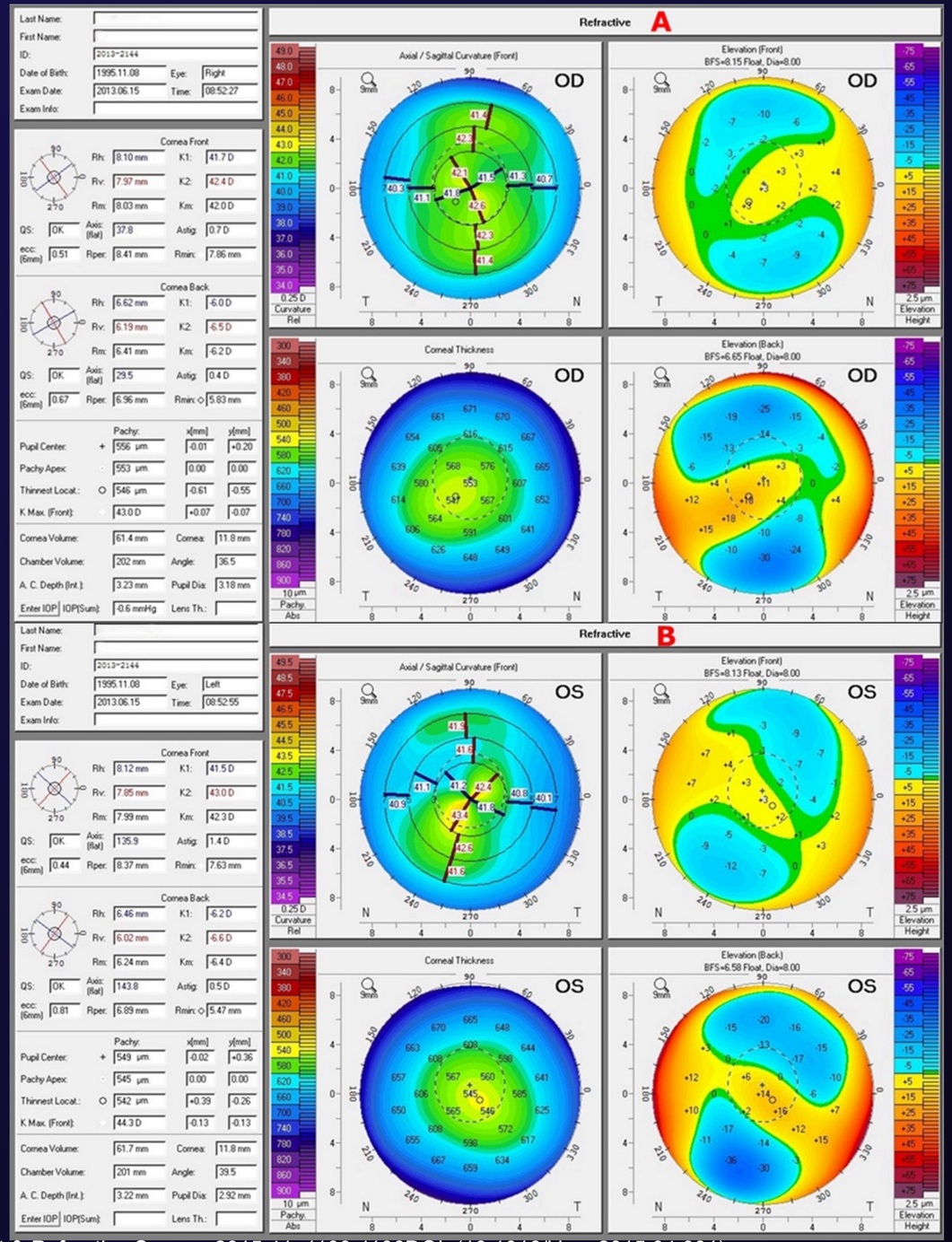
Corneal ectasia 6.5 months after small-incision lenticule extraction

Yumeng Wang, MM, Chuanbo Cui, MD, Zhiwei Li, PhD, Xiangchen Tao, MD, Chunxiao Zhang, MM, Xiao Zhang, MM, Guoying Mu, MD

Our case involves a 19-year-old patient with forme fruste keratoconus. Small-incision lenticule extraction was performed, and 6.5 months after surgery, corneal ectasia was diagnosed. Preoperatively, the minimum central corneal thickness was 546 μm in the right eye and 542 μm in the left eye; the refractive correction was −6.75 −1.00 × 45 and −6.75 −0.75 × 140, respectively; the lenticular thickness was 137 μm and 135 μm, respectively. At 6.5 months, ectasia was diagnosed based on anterior and posterior surface keratometry of 38.4/39.5 diopters (D) and −6.3/−6.8 D, respectively, in the right eye and 38.6/40.8 D and −7.1/−6.6 D, respectively, in the left eye. The keratometry increased gradually and the corneal thickness decreased after surgery, and these trends continued during the 13-month follow-up. This report documents corneal ectasia as a complication of small-incision lenticule extraction and highlights the importance of preoperative evaluation and the need for long-term follow-up.

Financial Disclosure: No author has a financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2015; 41:1100–1106 © 2015 ASCRS and ESCRS



Journal of Cataract & Refractive Surgery 2015 41, 1100-1106DOI: (10.1016/j.jcrs.2015.04.001)

Treatment data

Treatment pack size:	S
Suction time [hh:mm:ss]:	00:00:29

Cap data

Diameter [mm]:	7.60
Thickness [µm]:	120
Side cut angle [°]:	120
Incision position [°]:	90
Incision angle [°]:	53
Incision width [mm]:	3.52

Nomogram info

Refraction, Version 3.0

OD

Lenticule data

Optical zone [mm]:				6.60
Transition zone [mm]:				0.10
Thickness [µm]:	Min:	15	Max:	137
Side cut angle [°]:				110

Refractive correction

Sphere [D]:	-6.75
Cylinder [D]:	-1.00
Axis [°]:	45

Treatment data

Treatment pack size:	S
Suction time [hh:mm:ss]:	00:00:29

Cap data

Diameter [mm]:	7.60
Thickness [µm]:	120
Side cut angle [°]:	120
Incision position [°]:	90
Incision angle [°]:	53
Incision width [mm]:	3.52

Nomogram info

Refraction, Version 3.0

OS

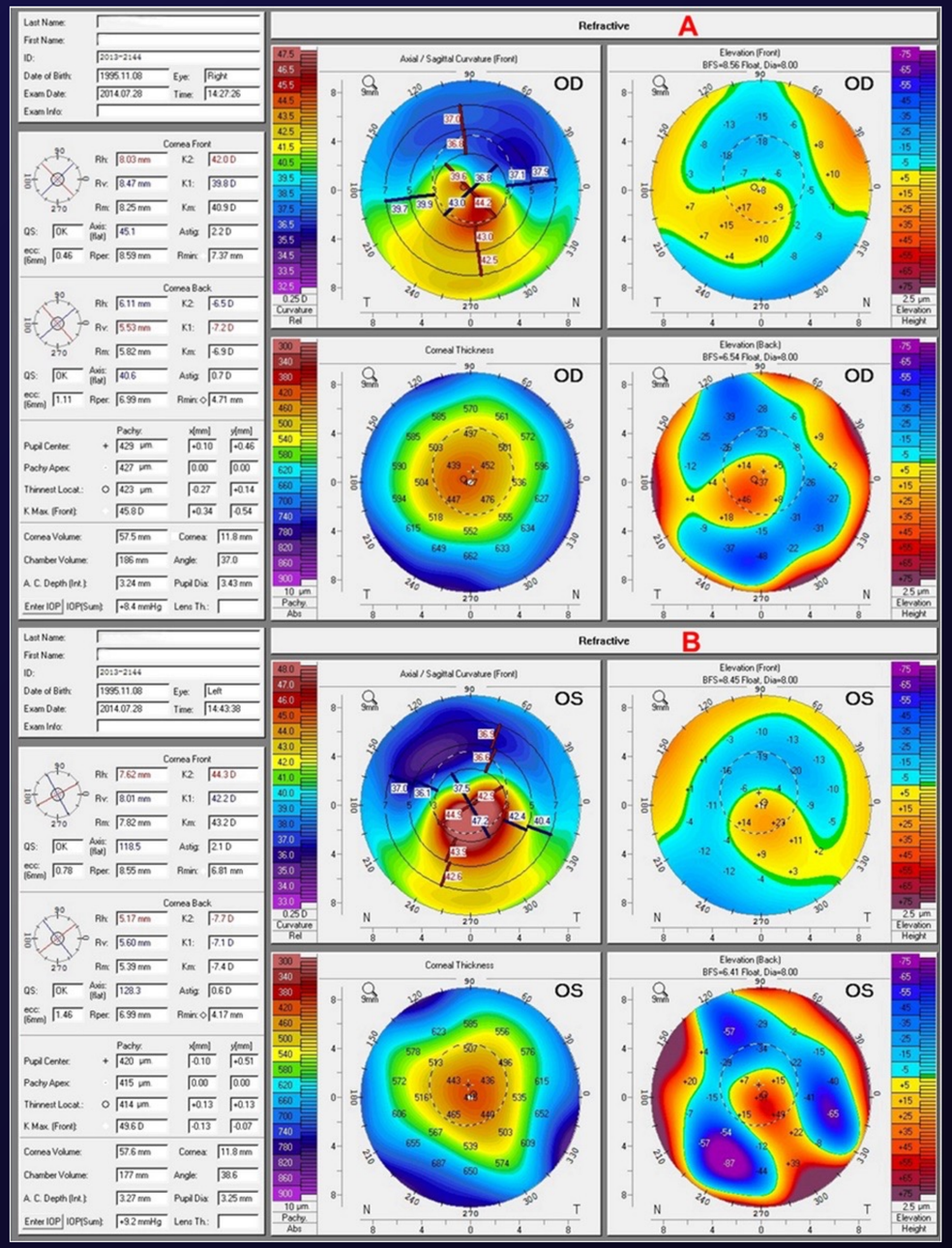
Lenticule data

Optical zone [mm]:				6.60
Transition zone [mm]:				0.10
Thickness [µm]:	Min:	15	Max:	134
Side cut angle [°]:				110

Refractive correction

Sphere [D]:	-6.75
Cylinder [D]:	-0.75
Axis [°]:	140

Journal of Cataract & Refractive Surgery DOI: (10.1016/j.jcrs.2015.04.001)



Journal of Cataract & Refractive Surgery DOI: (10.1016/j.jcrs.2015.04.001)

September 2015

Unilateral corneal ectasia following small-incision lenticule extraction

Gitansha Sachdev, MS, FICO, Mahipal S. Sachdev, MD, Ritika Sachdev, MS, Hemlata Gupta, MS, DNB, FAICO

We describe a case of unilateral corneal ectasia in a 26-year-old man following small-incision lenticule extraction. The preoperative corneal topography was normal, with a minimum corneal thickness of 511 µm and 513 µm in the right eye and left eye, respectively. Lenticules of 85 µm and 82 µm were fashioned to offer a refractive correction of −3.75 −1.50 × 180 and −3.50 −1.50 × 165 in the right eye and left eye, respectively. Twelve months after small-incision lenticule extraction, the patient presented with early signs of ectasia in the left eye on corneal topography, which had worsened at the 18-month examination. Intrastromal corneal ring segment implantation with corneal collagen crosslinking was performed to arrest further progression and to improve uncorrected distance visual acuity. On the last examination, the corrected distance visual acuity was $20/20^{-2}$.

Financial Disclosure: Dr. Mahipal S. Sachdev receives travel grants from Carl Zeiss Meditec AG. No author has a financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2015; 41:2014–2018 © 2015 ASCRS and ESCRS

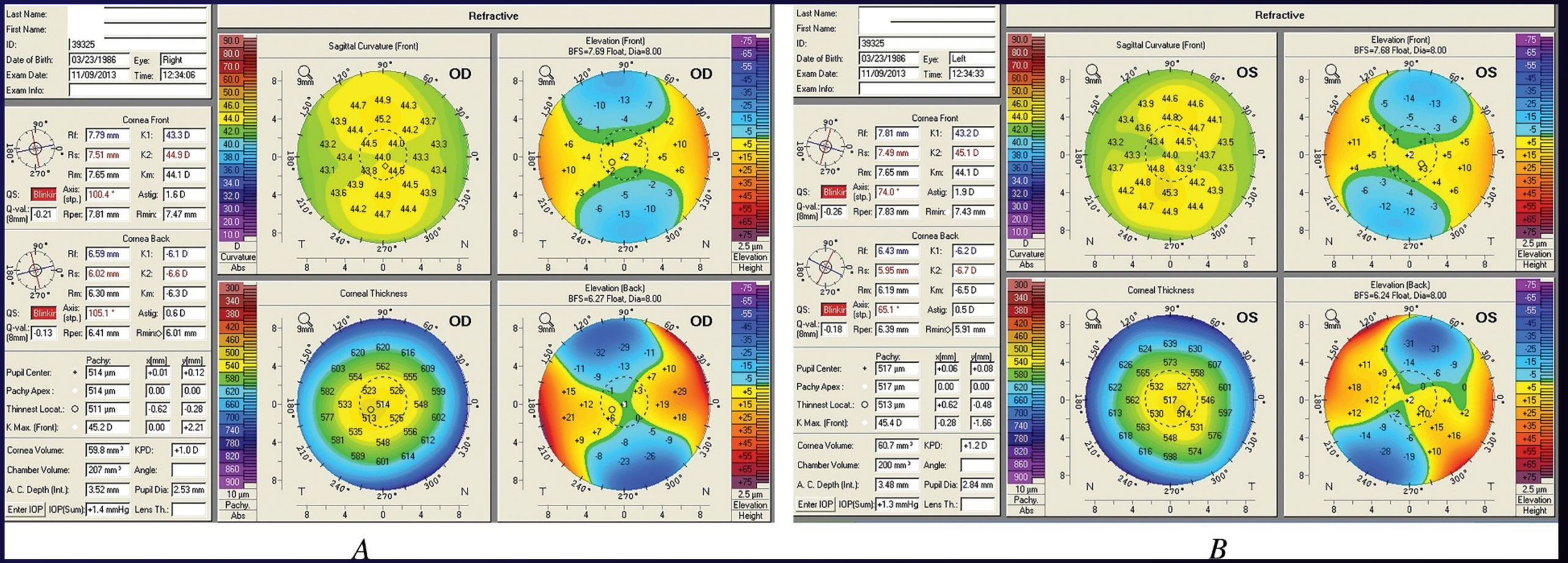
Iatrogenic corneal ectasia, although rare, is possibly the most dreaded complication following refractive surgery. It has been reported after laser in situ keratomileusis (LASIK) and photorefractive keratectomy.[1–4] Two cases of bilateral ectasia following small-incision lenticule extraction (SMILE, Carl Zeiss Meditec AG) were reported in patients with forme fruste keratoconus.[5,6] We report a case of unilateral ectasia following small-incision lenticule extraction in a patient with normal corneal topography.

CASE REPORT

A 26-year-old man presented to our cornea clinic requesting

(CDVA) was 20/20 in both eyes. The patient had no family history of keratoconus. The complete preoperative workup was within normal limits. Scheimpflug imaging (Pentacam, Oculus Optikgeräte GmbH) revealed a normal topography with a maximum keratometry (K) value of 44.9 diopters (D) in the right eye and 45.1 D in the left eye, with minimal thickness of 511 µm and 513 µm, respectively. The anterior and posterior elevation maps were also unremarkable (Figure 1). No significant inferior–superior asymmetry was noted on the curvature maps (Figure 2).

Uneventful femtosecond laser small-incision lenticule extraction was performed. The cap thickness was 110 µm with an optical zone of 6.0 mm and a corneal side cut of 3.0 mm. The lenticule thickness in the right eye and left eye was 85 µm and 82 µm, respectively, with a residual stromal bed (RSB) of 304 µm and 305 µm, respectively



Journal of Cataract & Refractive Surgery 2015 41, 2014-2018DOI: (10.1016/j.jcrs.2015.08.006)

Figure 3

Treatment data

Treatment pack size:	S
Suction time [hh:mm:ss]:	00:00:27

Cap data

Diameter [mm]:	7.10
Thickness [µm]:	110
Side cut angle [°]:	90
Incision position [°]:	90
Incision angle [°]:	48
Incision width [mm]:	3.00

Nomogram info

Refraction, Version 3.0

Lenticule data

Optical zone [mm]:	6.00
Transition zone [mm]:	0.10
Thickness [µm]:	Min: 15 Max: 85
Side cut angle [°]:	90

Refractive correction

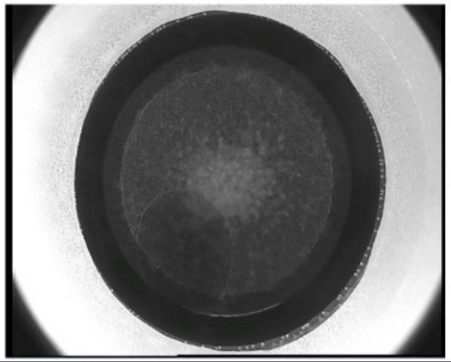
Sphere [D]:	-3.75
Cylinder [D]:	-1.50
Axis [°]:	0

Expected result

SMILE cuts created.

Remaining refraction

Sphere [D]:	0.00
Cylinder [D]:	0.00
Axis [°]:	0
RST [µm]:	304



Treatment data

Treatment pack size:	S
Suction time [hh:mm:ss]:	00:00:28

Cap data

Diameter [mm]:	7.10
Thickness [µm]:	110
Side cut angle [°]:	90
Incision position [°]:	90
Incision angle [°]:	48
Incision width [mm]:	3.00

Nomogram info

Refraction, Version 3.0

Lenticule data

Optical zone [mm]:	6.00
Transition zone [mm]:	0.10
Thickness [µm]:	Min: 15 Max: 82
Side cut angle [°]:	90

Refractive correction

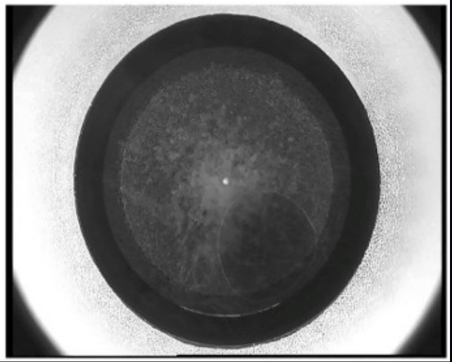
Sphere [D]:	-3.50
Cylinder [D]:	-1.50
Axis [°]:	165

Expected result

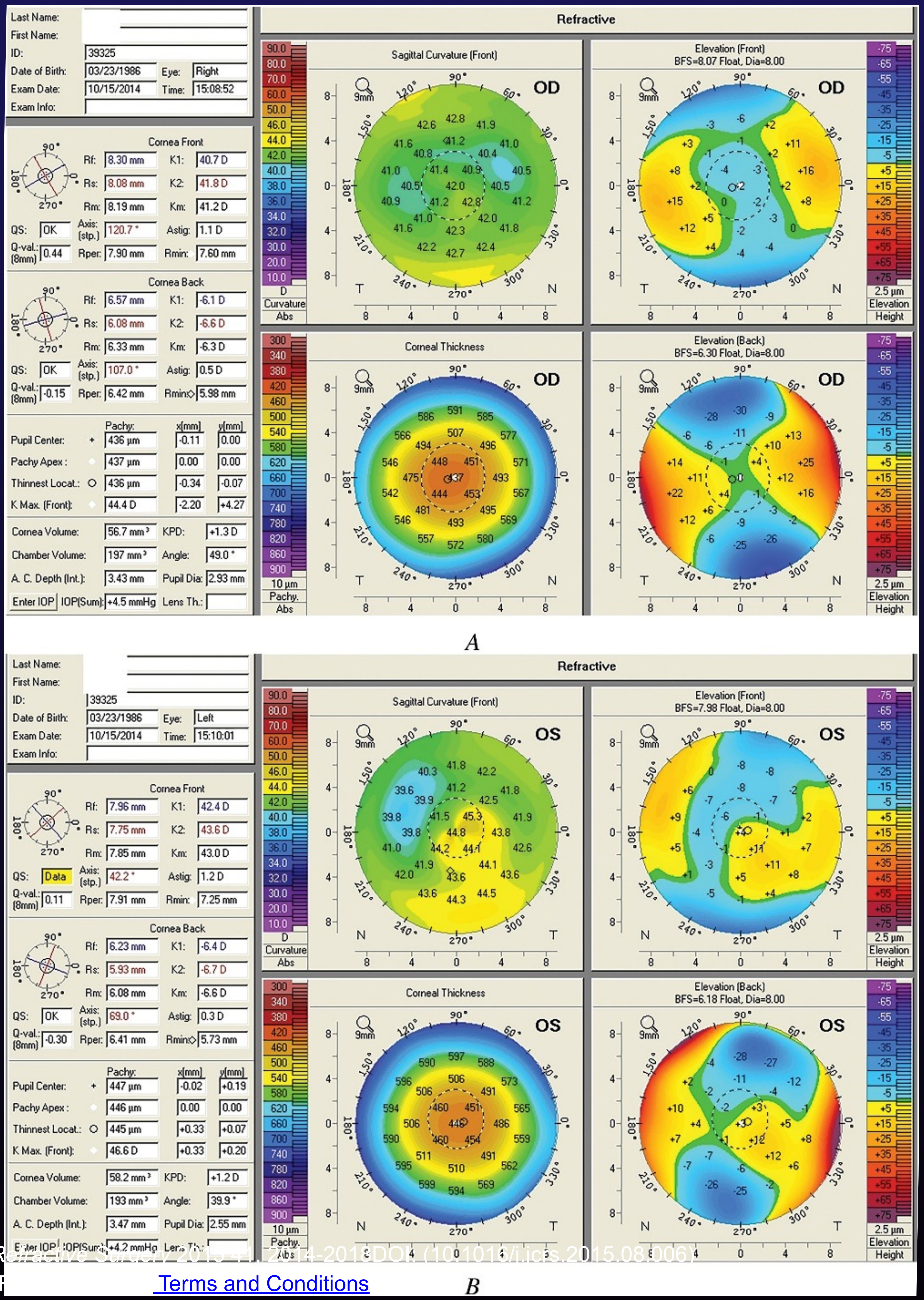
SMILE cuts created.

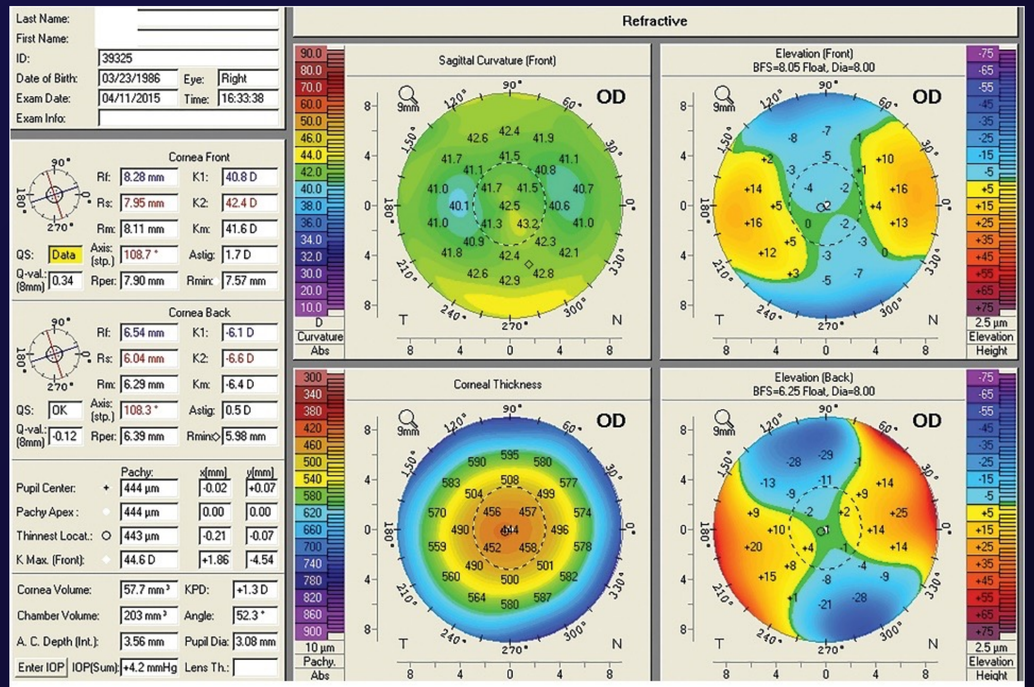
Remaining refraction

Sphere [D]:	0.00
Cylinder [D]:	0.00
Axis [°]:	165
RST [µm]:	305



Journal of Cataract & Refractive Surgery 2015 41, 2014-2018DOI: (10.1016/j.jcrs.2015.08.006)





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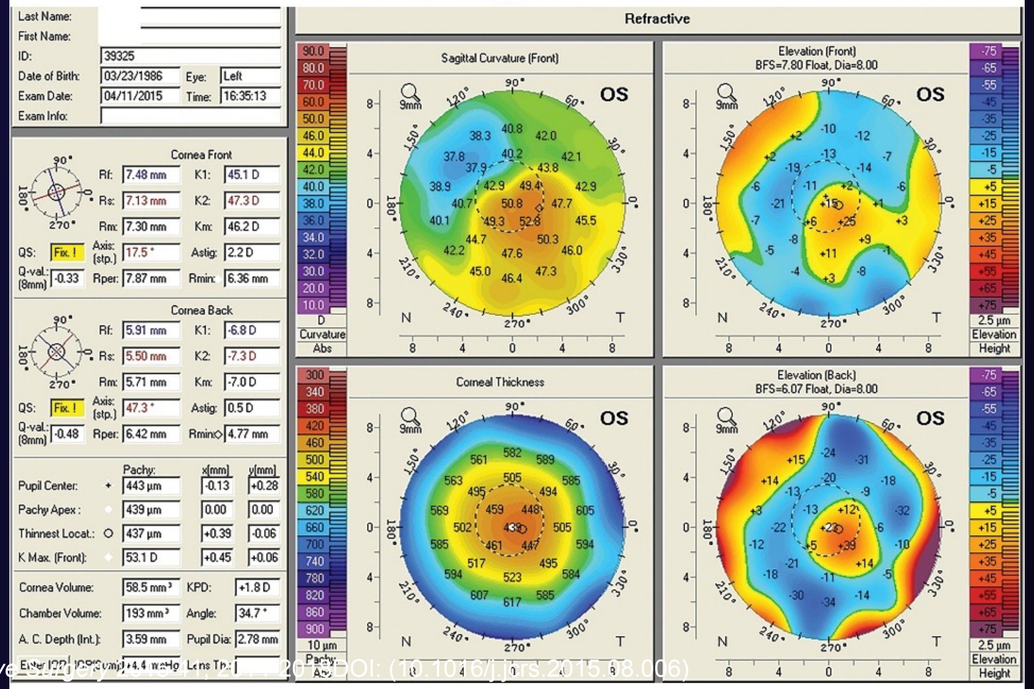

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Journal of Cataract & Refractive [illegible] 2015 DOI: (10.1016/j.jcrs.2015.03.006)

REPORT

Bilateral Ectasia After Femtosecond Laser-Assisted Small Incision Lenticule Extraction (SMILE)

Jaakko S. Mattila, MD; Juha M. Holopainen, MD, PhD

Journal of Refractive Surgery. 2016;32(7):497-500 https://doi.org/10.3928/1081597X-20160502-03

Posted July 13, 2016

Abstract

PURPOSE:
To describe a case of bilateral ectasia after small incision lenticule extraction (SMILE) in a patient with early keratoconus.

METHODS:
Case report.

RESULTS:
Bilateral SMILE was performed on a patient even though preoperative topographies showed changes indicating early keratoconus. The right eye underwent further photorefractive keratectomy enhancement 18 months later. The patient developed a bilateral corneal ectasia.

CONCLUSIONS:
This case underlines the importance of thorough preoperative assessment for possible keratoconus suspect changes with corneal topography to avoid postoperative ectasia.

[*J Refract Surg.* 2016;32(7):497–500.]

Ectasia After Corneal Refractive Surgery: Nothing to SMILE About

J. Bradley Randleman, MD

Since the first reports in 2011,[1,2] small incision lenticule extraction (SMILE) has dramatically entered the landscape of corneal refractive surgical procedures. With offerings of a single laser system, less disruption of the corneal surface, and relative preservation of the anterior lamellar fibers, SMILE has promised excellent refractive outcomes and possible advantages over previous iterations of laser refractive surgery.

One of the postulated advantages is biomechanical. Through maintenance of the anterior lamellae, SMILE in theory maintains a stronger cornea postoperatively. Mathematical modeling[3] and finite element analysis[4] lend some support to this view. Clinically, the extent of this biomechanical benefit remains to be determined.

Postoperative ectasia remains a feared complication of corneal refractive surgery and has driven the development of technology and patient screening protocols for more than a decade. Although there remains controversy in some aspects of screening,[5-8] there are many identified topographic and tomographic patterns that have been shown to place patients at higher risk for postoperative ectasia and that are recognized as at least relative contraindications for excimer laser procedures, including LASIK and surface ablation.[9,10]

Although a relatively new procedure, there are already a handful of reports of ectasia developing after SMILE.[11-14] In this issue, the Journal is contributing an additional case to the literature.[15] To date, all of these cases have exhibited abnormal preoperative topographic patterns, and most if not all would have been excluded from LASIK during screening by most surgeons. *And that is the point of this editorial.*

From Emory Eye Center and Emory Vision, Atlanta, Georgia.

Correspondence: J. Bradley Randleman, MD, Emory Eye Center and Emory Vision, 5671 Peachtree Dunwoody Road, Suite 400, Atlanta, GA 30342. E-mail: jrandle@emory.edu

doi:10.3928/1081597X-20160613-01

LESSONS FROM THE PAST

Corneal refractive surgery has provided immense benefit to our patients worldwide for more than 50 years, with greatest adoption of a few procedures: radial keratotomy, followed by photorefractive keratectomy (PRK), followed by LASIK. Each of those procedures offered unique benefits to patients, and each came with unique risks. With each technique, initial treatment parameters proved too broad and each saw a narrowing of their scope. There were several patients with 16 or more radial keratotomy incisions until surgeons realized that eight cuts or less proved significantly more stable over time. There are many early reports of outcomes for PRK or LASIK up to -20.00 diopters or more, whereas today's excimer lasers are not approved for that range and most surgeons stop well short of treating that degree of myopia. And topographic patterns that placed patients at risk for ectasia were clarified in part through evaluating cases with these patterns that developed the complication.[16,17]

We now have amassed extensive knowledge about how the cornea responds to laser surgical alteration, how preoperative corneal biomechanics, determined through screening topography and tomography, affect candidacy and long-term stability, and how the amount of tissue altered through surgery affects risk.[18] So, let us use this information to our advantage as we perform and study the novel surgical approach that is SMILE.

STARTING CONSERVATIVELY

With SMILE we have an opportunity to do things a better way from the outset, during the phase of possible widespread use of the procedure. This better way includes using a cautious, conservative, and scientific approach relying on evidence-based medicine to drive surgical decision-making. We can use the information from screening patients for 20 years for PRK and LASIK, especially what we've learned in the past 10 years, and apply those standards to SMILE.

We have identified many abnormal topographic patterns as contraindications for LASIK. We know from

Clinical Ophthalmology

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REVIEW

Ectasia following small-incision lenticule extraction (SMILE): a review of the literature

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Majid Moshirfar[1,2]
Julio C Albarracin[3]
Jordan D Desautels[1,4]
Orry C Birdsong[1]
Steven H Linn[1]
Phillip C Hoopes Sr[1]

[1]HDR Research Center, Hoopes Vision, Draper, [2]John A Moran Eye Center, Department of Ophthalmology and Visual Sciences, University of Utah School of Medicine, Salt Lake City, UT, [3]Department of Ophthalmology, McGovern Medical School, University of Texas Health Science Center at Houston, Houston, TX, [4]Department of Ophthalmology, Warren Alpert Medical School of Brown University, Providence, RI, USA

Purpose: Four cases of corneal ectasia after small-incision lenticule extraction (SMILE) have been reported. In this review, we provide an overview of the published literature on corneal ectasia after SMILE and risk factors associated with this complication.

Methods: Case reports were identified by a search of seven electronic databases for pertinent heading terms between 2011 and July 2017. We identified patient characteristics and surgical details including preoperative topography, central corneal thickness, and anterior keratometry (Km). Residual stromal bed (RSB) values not reported were computed using VisuMax ReLEx SMILE software Version 2.10.10. Preoperative ectasia risk was measured using the Randleman Ectasia Risk Score System (ERSS). Percent tissue alteration was calculated for each patient as described by Santhiago et al.

Results: Seven eyes of four patients developed corneal ectasia post SMILE. Two patients had abnormal topography in both eyes. One patient had abnormal topography in one eye. Only one patient was noted to have normal topography in both eyes and later developed ectasia in one eye in the absence of any known risk factors. The mean Randleman ectasia risk score was 4±3 (range: 1–8). The mean calculated percent tissue altered (PTA) was 38%±6% (range: 30%–47%).

Conclusion: A majority of reported ectasia cases occurred in patients with subclinical keratoconus. These conditions may be exacerbated by SMILE and should be considered abso-

Misinterpretation of topographic early keratoconus, with consequent post small-incision lenticule extraction ectasia

Sherif A. Eissa

Department of Ophthalmology, Cairo University, Cairo, Egypt

Correspondence to Sherif Eissa, MD, FRCS, Department of Ophthalmology, Cairo University, Kasr El Ainy, Cairo, 11451, Egypt; Tel: + 20 100 917 6594; fax: +20223636504; e-mail: drsjesus3@hotmail.com

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Delta Journal of Ophthalmology
2017, 18:182–184

The purpose of this paper is to describe an infrequent complication of small-incision lenticule extraction. Bilateral corneal ectasia that was discovered 6 months postoperatively is described here. The case has shown that the procedure can aggravate early keratoconus cases without any advantage over laser in-situ keratomileusis or surface ablation procedures. Placido disk imaging with correct scaling and color coding of Scheimpflug images is essential in the preoperative assessment of small-incision lenticule extraction patients.

Keywords:
ectasia, keratoconus, placido, Scheimpflug, SMILE

DJO 18:182–184

1110-9173

Introduction

Femtosecond lenticule extraction and small-incision lenticule extraction (SMILE) have not been thoroughly investigated. However, they have shown encouraging results in the treatment of myopia and myopia with mild to moderate astigmatic error [1,2]. SMILE represents a less invasive alternative to laser in-situ keratomileusis (LASIK) for the correction of myopic error, without disruption of the Bowman's layer. However, microdistortions have been observed in the Bowman's layer in patients who had SMILE, which resulted from unavoidable tissue compression from shortening of the cap's arc length, without adversely affecting vision [3].

Case history

A 26-year old Egyptian male patient presented with a history of previous SMILE (Carl Zeiss Meditec AG, Jena, Germany) procedure in Egypt 5 months earlier. He complained of progressively decreasing vision in his left eye with glare and halos in both eyes (OU). His visual acuity was 20/30 in the right eye that corrects to 20/25 with −0.75/−0.75×10. Left eye visual acuity was 20/400

Corneal thickness spatial profile showed normal pattern both eyes. Keratometry readings on the anterior corneal surface sagittal map were relatively flat (right eye: 41.9 and 42.5 D and left eye: 43.0 and 43.6 D), which tempted the surgeon to proceed with SMILE, especially with cold color code and wrong scaling on the posterior elevation map (5 µm). However, the surgeon overlooked suspicious indices, especially in the absence of placido disk imaging on preoperative assessment. Suspicious findings included posterior elevation of +20 µm in both eyes at the border of the central 5 mm circle, high index of height decentration and index of height asymmetry, especially in the left eye, and high I–S ratio on sagittal map left eye, with an early vortex pattern.

Discussion

Although Wu and Wang [4] have found a statistically significant elevation in corneal hysteresis and corneal resistance factor in SMILE, compared with femtosecond laser-assisted LASIK, the superiority of biomechanical stability with SMILE has not been convincingly demonstrated and future analysis should clarify this aspect [4].

CASE REPORT

Unilateral corneal ectasia after small-incision lenticule extraction in a 43-year-old patient

Jean Christophe Gavrilov, MD, Raphael Atia, MD, Vincent Borderie, MD, PhD, Laurent Laroche, MD, Nacim Bouheraoua, MD, PhD

Unilateral corneal ectasia developed after small-incision lenticule extraction for mild myopia in a 43-year-old man with preoperative asymmetric astigmatism. The ectasia was diagnosed 4 years postoperatively. Preoperative data showed asymmetric astigmatism with no signs of forme fruste keratoconus. Inferior anterior curvature steepening exceeded 2.00 diopters without bulging of the posterior curvature, and pachymetric thickness exceeded 515 µm. Corneal ectasia can occur after small-incision lenticule extraction in patients older than 40 years with preoperative asymmetric astigmatism.

J Cataract Refract Surg 2018; 44:403–406 © 2018 ASCRS and ESCRS

March 2018

Since the first description of small-incision lenticule extraction (SMILE, Carl Zeiss Meditec AG) in 2011 by Sekundo et al.,[1] the number of procedures performed to correct myopia and astigmatism with this new technique has steadily increased. The incidence of corneal ectasia after laser in situ keratomileusis (LASIK) has been estimated at 1 in 2500.[2] Because small-incision lenticule extraction is a flapless procedure, it has been suggested that the risk for corneal ectasia after small-incision lenticule extraction is lower than after LASIK.[3] To date, 4 reports of corneal ectasia have been published.[4–8] We report a case of unilateral corneal ectasia 4 years after small-incision lenticule extraction for mild myopia in a patient older than 40 years with preoperative asymmetric

eyes, representing a steepening of more than 2.00 diopters (D) in the right eye and 1.80 D in the left eye. Moreover, Scheimpflug camera images showed an absence of posterior curvature bulging and no correspondence between the steeper anterior curvature and the thinner points of the cornea.

Small-incision lenticule extraction was performed uneventfully with the Visumax femtosecond laser system (Carl Zeiss Meditec AG). The caps were 7.30 mm in diameter and 120 µm thick in both eyes. The diameter of the optical zone was 6.50 mm in both eyes. The maximum and minimum lenticule thicknesses were 94 µm and 15 µm, respectively, in the right eye and 109 µm and 15 µm, respectively, in the left eye, with a residual stromal bed (RSB) of 308 µm in the right eye and 286 µm in the left eye. The immediate postoperative course was uneventful, with an uncorrected distance visual acuity of 20/20 in both eyes at the 1-month examination.

Four years after the initial small-incision lenticule extraction,

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DOI: 10.1002/jbio.201800253

Journal of BIOPHOTONICS

FULL ARTICLE

Corneal tomographic features of postrefractive surgery ectasia

Pooja Khamar[1] | Ritika Dalal[1] | Rachana Chandapura[2] | Mathew Francis[2] | Rohit Shetty[1] | Everette J. R. Nelson[3] | Rudy M. M. A. Nuijts[4] | Abhijit Sinha Roy[2]*

[1]Department of Cornea and Refractive Surgery, Narayana Nethralaya Eye Hospital, Bangalore, India

[2]Imaging, Biomechanics and Mathematical Modeling Solutions, Narayana Nethralaya Foundation, Bangalore, India

[3]School of Biosciences and Technology, VIT University, Vellore, India

[4]University Eye Clinic Maastricht, Maastricht University Medical Center, Maastricht, the Netherlands

***Correspondence**
Abhijit Sinha Roy, Narayana Nethralaya Foundation, #258A Hosur Road, Bommasandra, Bangalore 560099, India.
Email: asroy27@yahoo.com

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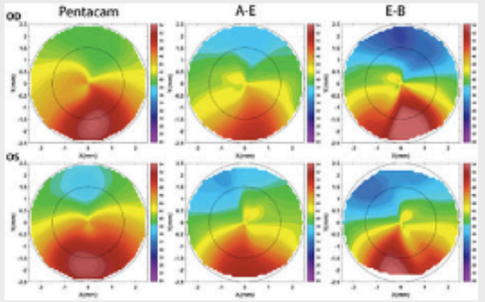
Indo-German Science and Technology Center, Grant/Award Number: SIBAC

The purpose of this study was to evaluate the tomographic features of postrefractive surgery eyes. This was a retrospective evaluation of clinical data. Three patients with post-LASIK (laser-assisted in situ keratomileusis) and two patients with post-SMILE (small incision lenticule extraction) ectasia were imaged with Scheimpflug imaging (SI, Pentacam) and optical coherence tomography (OCT, RTVue). Curvature and wavefront aberrations of the air-epithelium interface (A-E) and epithelium-Bowman's layer interface (E-B) were derived. OCT of normal and keratoconic eyes from an earlier study were compared with the data of the ectasia eyes. Curvature and aberrometry of the A-E interfaces were statistically similar between SI and OCT. However, OCT revealed a steeper and more aberrated E-B interface than A-E though correlation between them was inferior to the correlation for keratoconic eyes. Furthermore, the magnitude of differences between the A-E and E-B interfaces was greater in the ectasia eyes than the keratoconic eyes. OCT could possibly assist better in selecting appropriate treatment plan for postrefractive surgery ectasia eyes than conventional tomographers.



KEYWORDS
ectasia, cornea, SMILE, LASIK, tomography, OCT, Bowman's layer

September 2018

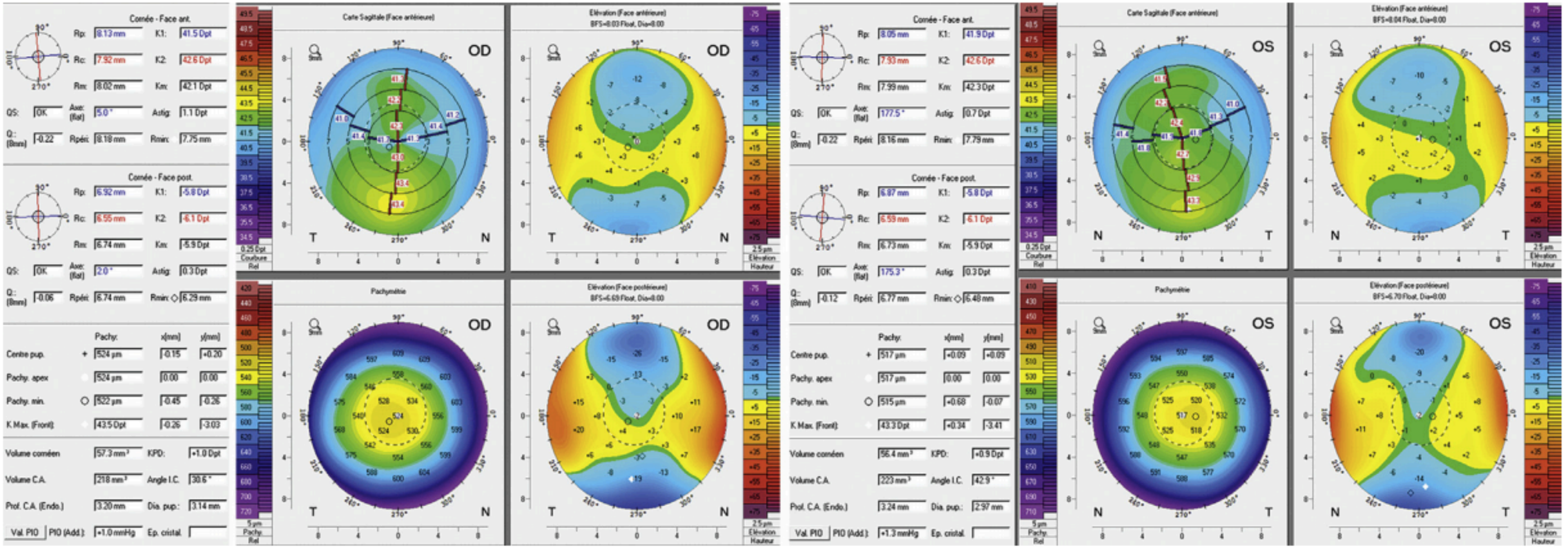


Figure 1. Scheimpflug-based corneal topography showing sagittal map, pachymetry map, anterior elevation map, and posterior elevation map before small-incision lenticule extraction (N = nasal; T = temporal).

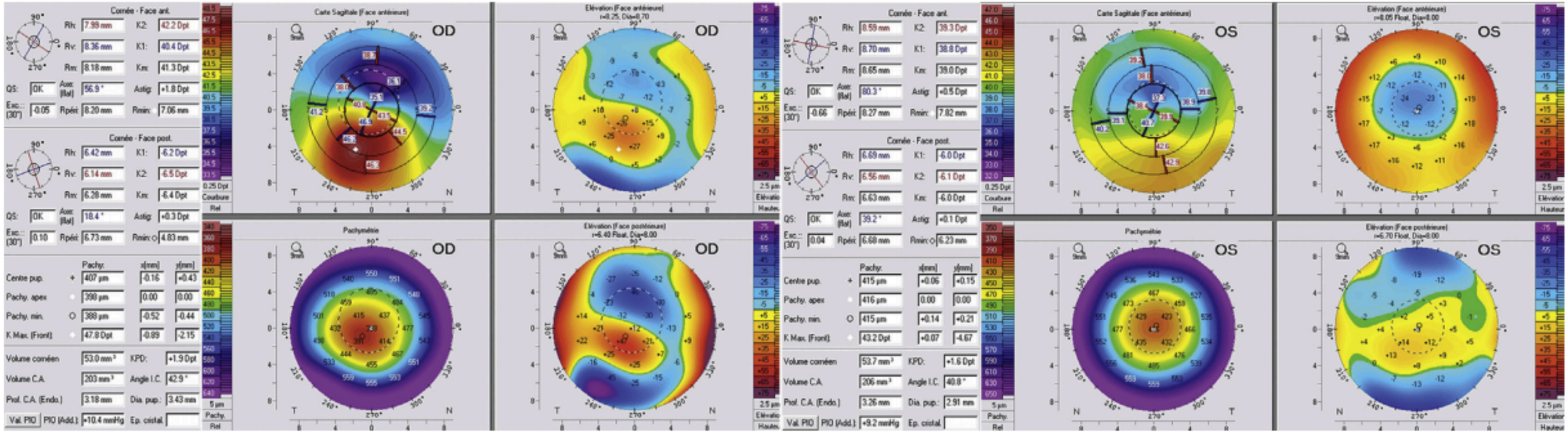


Figure 3. Scheimpflug-based corneal topography showing sagittal map, pachymetry map, anterior elevation map, and posterior elevation map 4.5 years after small-incision lenticule extraction (N = nasal; T = temporal).

CASE REPORT

Unilateral ectasia after small-incision lenticule extraction

Eric E. Pazo, MSc, MD, PhD, Richard N. McNeely, BSc, PhD, Samuel Arba-Mosquera, MSc, PhD, Christoph Palme, MD, Jonathan E. Moore, PhD, FRCOphth

December 17, 2018

A 23-year-old man developed unilateral corneal ectasia after bilateral small-incision lenticule extraction (SMILE). The preoperative corneal topography was normal, with a minimum corneal thickness of 582 µm and 586 µm in the right eye and left eye, respectively. The refractive correction was −3.00 diopters (D) sphere in the right eye and −3.50 D sphere in the left eye. At the 12-month postoperative visit, corneal topography showed early signs of ectasia in the right eye; the ectasia had deteriorated by the 15-month examination. Corneal crosslinking was performed to arrest further progression. At the last examination, the uncorrected distance visual acuity in the right eye was 0.1 logarithm of the minimum angle of resolution (logMAR) and the corrected distance visual acuity, −0.1 logMAR.

J Cataract Refract Surg 2018; ■:■–■

At present, the prevalence of ectasia after laser in situ keratomileusis (LASIK) has been estimated to be between 0.04% and 0.6%.[1] A review article by Moshirfar et al.[2] found that at the time of publication, only 4 cases of corneal ectasia after small-incision lenticule extraction (SMILE, Carl Zeiss Meditec AG) had been documented and reported.[3–6] A proposed advantage of small-incision lenticule extraction is a stronger postoperative biomechanical effect as a result of the anterior stromal lamellae being maintained. This theory is supported by mathematical modeling[7] and finite element analysis[8]; however, the practicality of this benefit remains to be proven clinically.

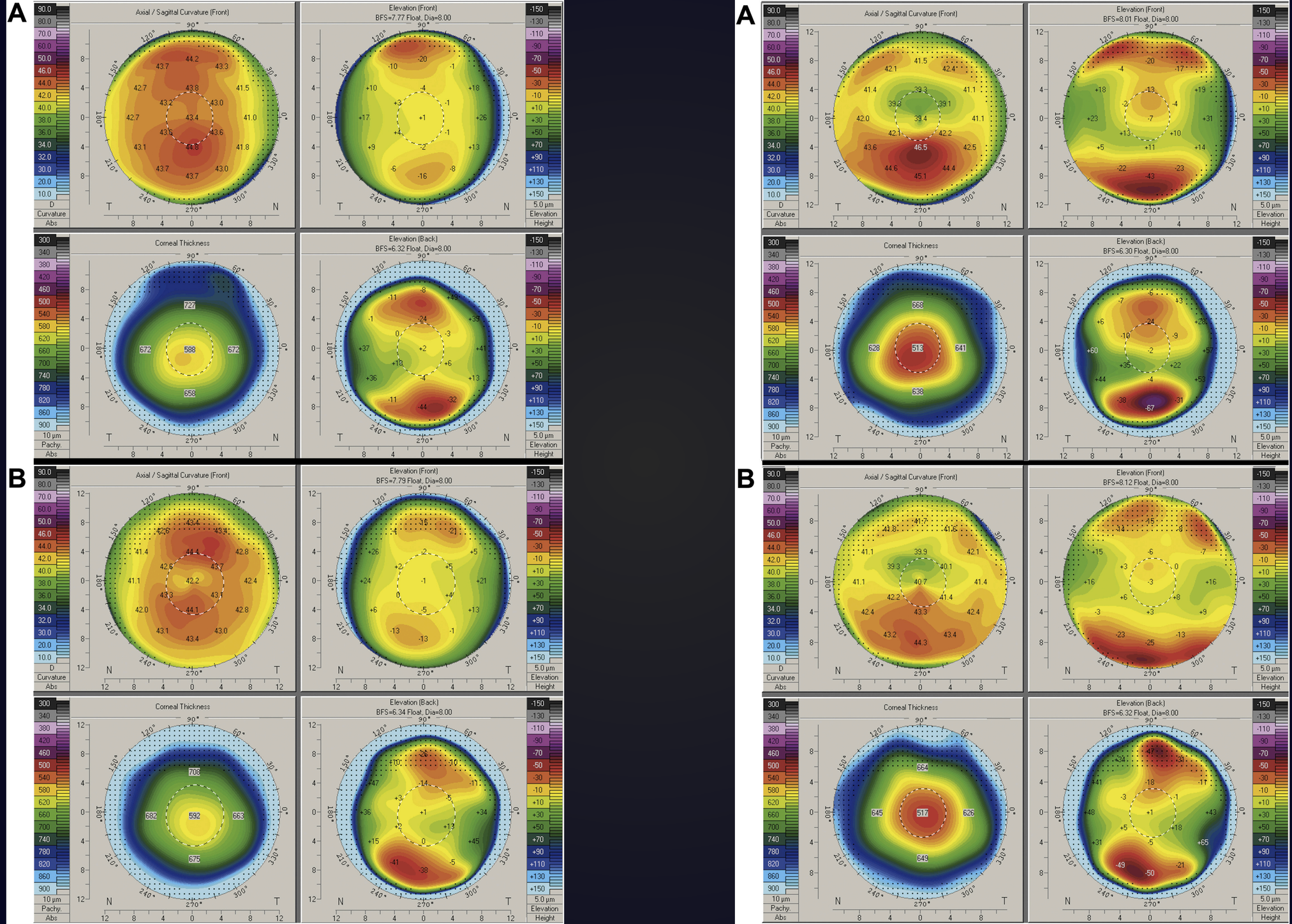
CASE REPORT

A 23-year-old man presented to the clinic requesting corneal refractive surgery for myopic correction. He had no history or symptoms of dry eye, atopy, or allergies of which he was aware. The preoperative refractive error was −3.00 diopters (D) sphere in the right eye and −3.50 D

family history of keratoconus and had a stable refraction for more than 2 years. A complete preoperative ophthalmologic examination was performed and all parameters were within normal limits. Scheimpflug imaging (Pentacam, Oculus Optikgeräte GmbH) showed normal topography with a maximum keratometry (K) value of 44.9 D in the right eye and 45.0 D in the left eye and a minimum thickness of 582 µm and 586 µm, respectively. The anterior and posterior elevation maps were also unremarkable (Figure 1). No significant inferior–superior asymmetry was noted on the curvature maps. The fluorescein tear breakup time (TBUT) was 15 seconds in the right eye and 14 seconds in the left eye.

Uneventful bilateral small-incision lenticule extraction was performed. The cap thickness was 135 mm with an optical zone of 6.50 µm and a corneal side cut of 2.41 mm. The lenticule thickness was 63 µm in the right eye and 71 µm in the left eye with a residual stromal bed (RSB) of 384 µm and 380 µm, respectively (Figure 2).

The immediate postoperative course was uneventful


A
Axial / Sagittal Curvature (Front)
Elevation (Front)
BFS=7.77 Float, Dia=8.00
Corneal Thickness
Elevation (Back)
BFS=6.32 Float, Dia=8.00
B
Axial / Sagittal Curvature (Front)
Elevation (Front)
BFS=7.79 Float, Dia=8.00
Corneal Thickness
Elevation (Back)
BFS=6.34 Float, Dia=8.00
A
Axial / Sagittal Curvature (Front)
Elevation (Front)
BFS=8.01 Float, Dia=8.00
Corneal Thickness
Elevation (Back)
BFS=6.30 Float, Dia=8.00
B
Axial / Sagittal Curvature (Front)
Elevation (Front)
BFS=8.12 Float, Dia=8.00
Corneal Thickness
Elevation (Back)
BFS=6.32 Float, Dia=8.00

Bilaterally Asymmetric Corneal Ectasia Following SMILE With Asymmetrically Reduced Stromal Molecular Markers

January 14, 2019

Rohit Shetty, MD, FRCS, PhD; Nimisha Rajiv Kumar, MSc; Pooja Khamar, MS; Matthew Francis, M.Tech; Swaminathan Sethu, PhD; J. Bradley Randleman, MD; Ronald R. Krueger, MD; Abhijit Sinha Roy, PhD; Arkasubhra Ghosh, PhD

ABSTRACT

PURPOSE: To evaluate extracellular matrix regulators and inflammatory factors in a patient who developed ectasia after small incision lenticule extraction (SMILE) despite normal preoperative tomographic and biomechanical evaluation.

METHODS: The SMILE lenticules from both eyes of the patient with ectasia and three control patients (5 eyes) matched for age, sex, and duration of follow-up were used for gene expression analysis of lysyl oxidase (LOX), matrix metalloproteinase 9 (MMP9), collagen types I alpha 1 (COLIA1) and IV alpha 1 chain (COLIVA1), transforming growth factor-beta (TGF-beta), bone morphogenetic protein 7 (BMP7), interleukin-6 (IL-6), cathepsin K, cluster of differentiation 68, integrin beta-1, and tissue inhibitor of metalloproteinase-1 (TIMP1). Furthermore, the functional role of LOX was assessed in vitro by studying the collagen gel contraction efficiency of LOX overexpressing in primary human corneal fibroblast cells.

RESULTS: Preoperatively, manifest refraction was -9.25 diopters (D) in the right eye and -10.00 D in the left eye. Corneal thickness, Pentacam (OCULUS Optikgeräte GmbH, Wetzlar, Germany) tomography, and Corvis biomechanical indices (OCULUS Optikgeräte GmbH) were normal. The ectatic eye lenticule (left) had reduced expression of LOX and COLIA1 compared to controls without ectasia. Increased mRNA fold change expression of TGF-beta, BMP7, IL-6, cathepsin K, and integrin beta-1 was noted in the ectatic left eye compared to controls; however, MMP9 and TIMP1 levels were not altered. Ectopic LOX expression in human corneal fibroblast induced significantly more collagen gel contraction, confirming the role of LOX in strengthening the corneal stroma.

CONCLUSIONS: Reduced preexisting LOX and collagen levels may predispose clinically healthy eyes undergoing refractive surgery to ectasia, presumably by corneal stromal weakening via inadequately cross-linked collagen. Preoperative molecular testing may reveal ectasia susceptibility in the absence of tomographic or biomechanical risk factors.

[*J Refract Surg*. 2019;35(1):6-14.]

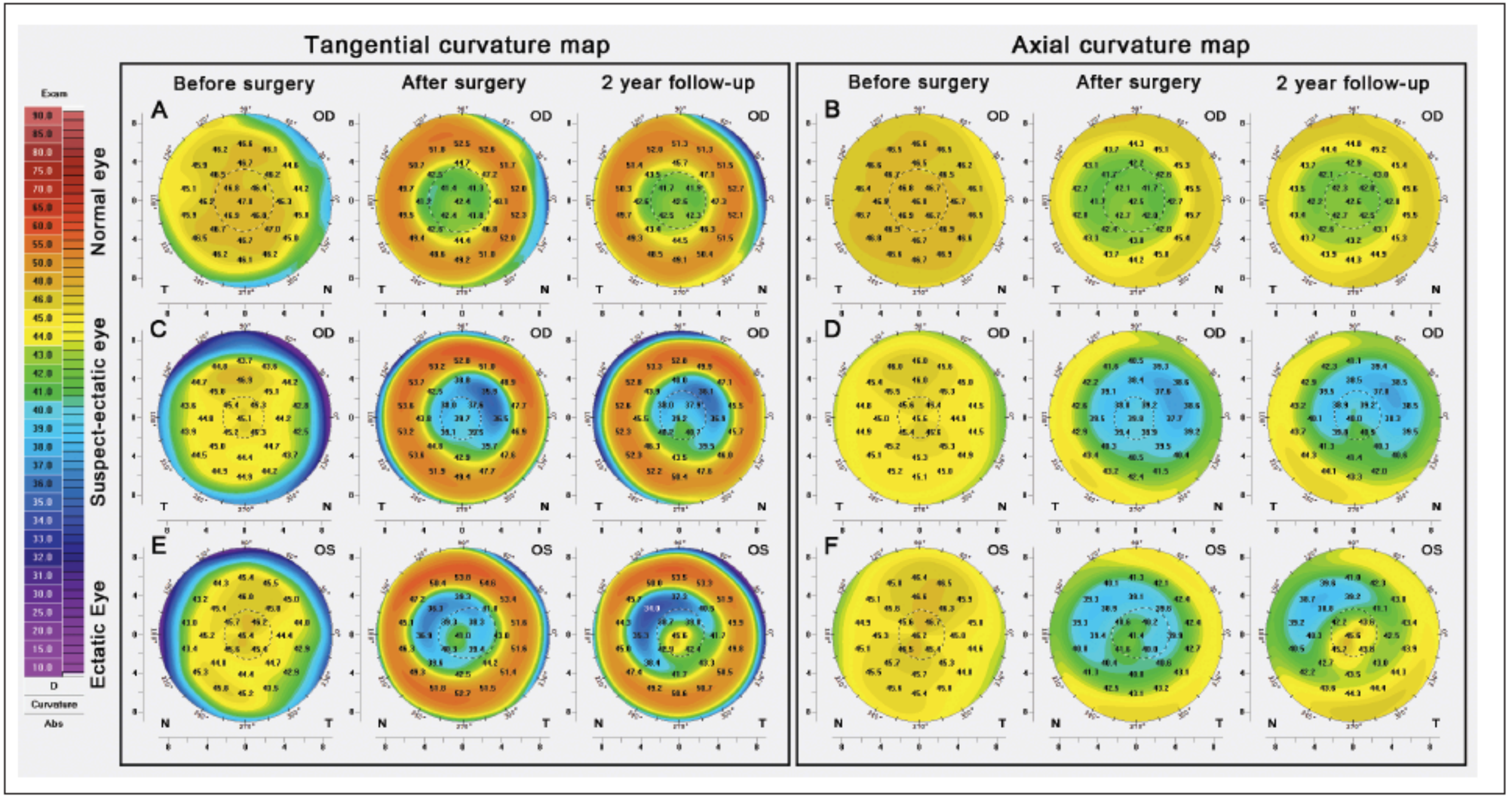
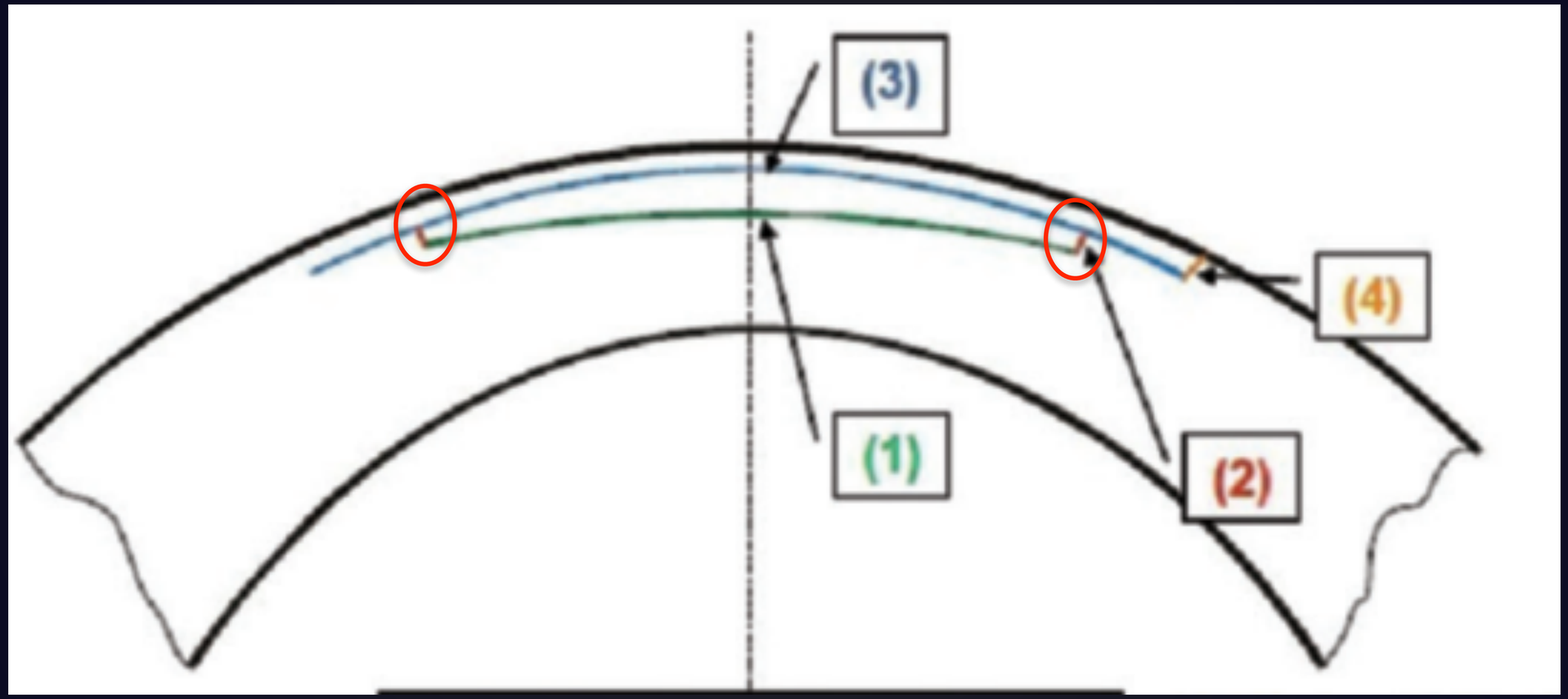


Figure A. Tangential (A, C, and E) and axial (B, D, and F) anterior curvature maps from Pentacam HR (OCULUS Optikgeräte, Wetzlar, Germany) (absolute American style color bar in diopters) for before surgery, after surgery, and 2-year follow-up time points, respectively. (A and B) Normal eye curvature maps are shown in the first row, (C and D) suspect-ectatic eye curvature maps are shown in the second row, and (E and F) ectatic eye curvature maps are shown in the third row.

Why?



Vertical sidecuts/Empty space/Eye rubbing

Conclusion

- No procedure is absolutely safe
- Avoid abusing of new techniques
- Be cautious!!

Take Home Message

Not fit for LASIK=Not fit for SMILE

If you are facing a suspicious cornea

Thank you