بسم الله الرحمن الرحيم

Unhappy post refractive cataract surgery patient

Refractive surprise

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Intraocular lens (IOL) implantation Measurements In Normal Untouched Cornea Depends on

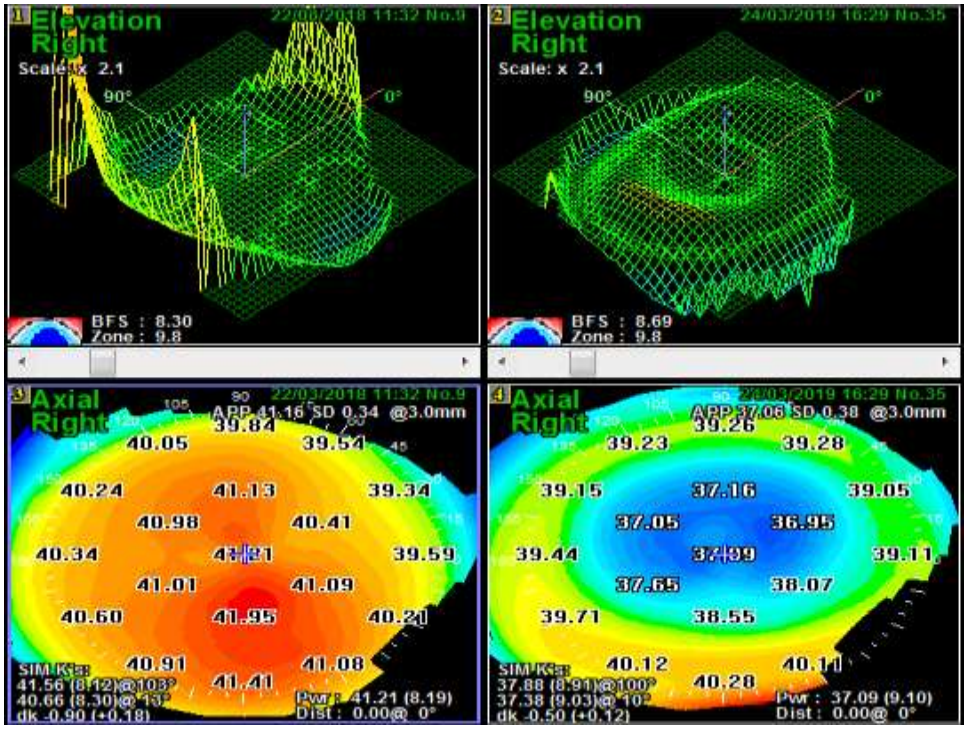
K readings
(Radius of curvature of anterior corneal surface)

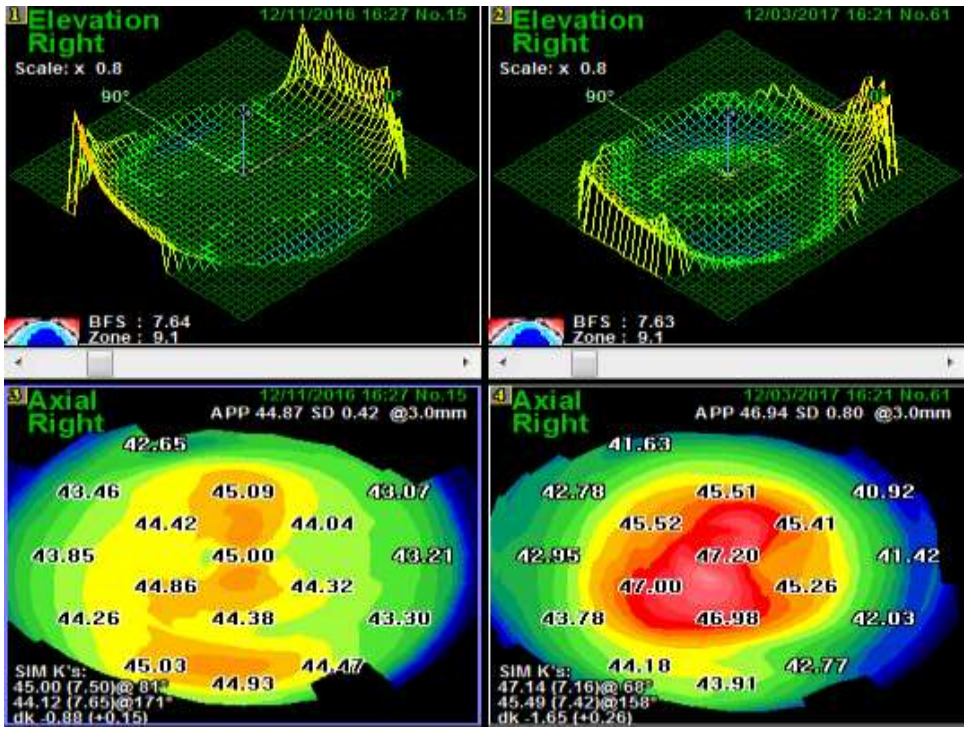
A- Almost stable ant/post corneal surface power
B- Central corneal power can be extrapolated from a circle
C- AC depth is more or less expected by K value
D- Expected Q value for a K value

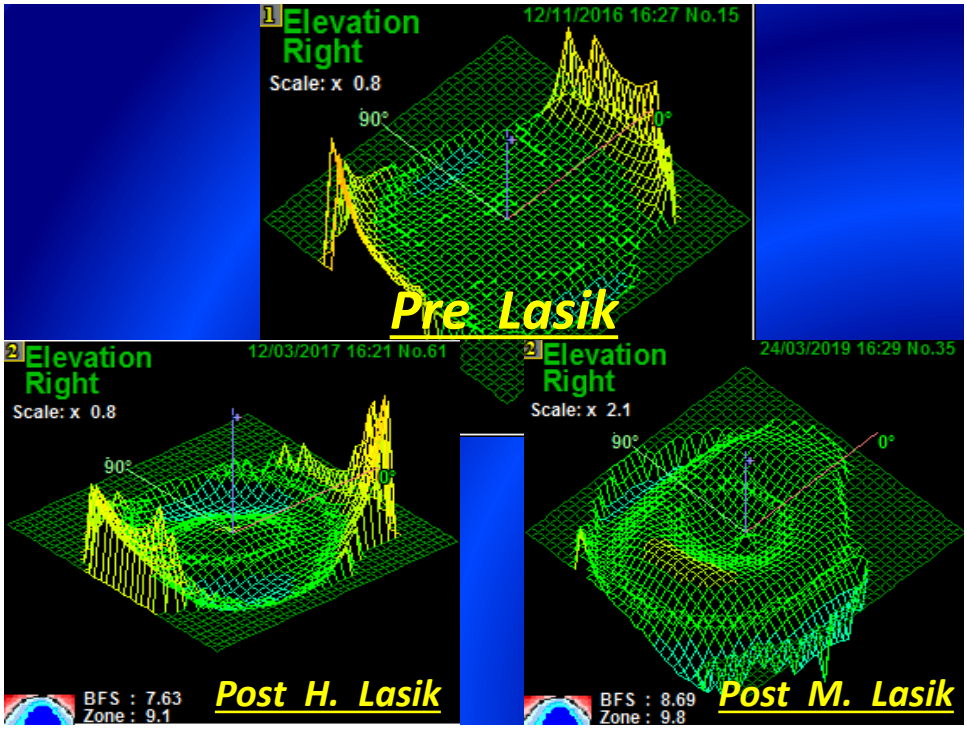
Intraocular lens (IOL) implantation after refractive surgery is a major challenge

1- standard IOL power formulae can lead to significant unintended postoperative refractive errors.

2- forgotten Q value


1 Elevation Right
Scale: x 2.1
90°
0°
BFS : 8.30
Zone : 9.8
2 Elevation Right
24/03/2019 16:29 No.35
Scale: x 2.1
90°
0°
BFS : 8.69
Zone : 9.8
3 Axial Right
APP 41.16 SD 0.34 @3.0mm
39.84
40.05
39.54
40.24
41.13
39.34
40.98
40.41
40.34
41.21
39.59
41.01
41.09
40.60
41.95
40.21
40.91
41.08
41.41
SIM K's:
41.56 (8.12)@103°
40.66 (8.30)@13°
dk -0.90 (+0.18)
Pwr: 41.21 (8.19)
Dist: 0.00@ 0°
4 Axial Right
22/03/2019 16:29 No.35
APP 37.06 SD 0.38 @3.0mm
39.26
39.23
39.28
39.15
37.16
39.05
37.05
36.95
39.44
37.99
39.11
37.65
38.07
39.71
38.55
40.12
40.28
SIM K's:
37.88 (8.91)@100°
37.38 (9.03)@10°
dk -0.50 (+0.12)
Pwr: 37.09 (9.10)
Dist: 0.00@ 0°


1 Elevation Right
12/11/2016 16:27 No.15
Scale: x 0.8
90°
BFS : 7.64
Zone : 9.1
2 Elevation Right
12/03/2017 16:21 No.61
Scale: x 0.8
90°
BFS : 7.63
Zone : 9.1
3 Axial Right
12/11/2016 16:27 No.15
APP 44.87 SD 0.42 @3.0mm
42.65
43.46
45.09
43.07
44.42
44.04
43.85
45.00
43.21
44.86
44.32
44.26
44.38
43.30
45.03
44.47
44.93
SIM K's:
45.00 (7.50)@81°
44.12 (7.65)@171°
dk -0.88 (+0.15)
4 Axial Right
12/03/2017 16:21 No.61
APP 46.94 SD 0.80 @3.0mm
41.63
42.78
45.51
40.92
45.52
45.41
42.95
47.20
41.42
47.00
45.26
43.78
46.98
42.03
44.18
42.77
43.91
SIM K's:
47.14 (7.16)@68°
45.49 (7.42)@158°
dk -1.65 (+0.26)



1- CENTRALLY

K READING

Causes Of Error In Estimating Corneal Power After Excimer Laser Corneal Surgery

A- Changes Of Radius Of Ant . Corneal Surface (ELP)

B- Difficulty Of Measuring The Exact Central Cornea Keratometry

C- Changes Of Total Corneal Power (Ant./ Post. Surfaces Relationship)

A- Changes of Radius of ant. corneal surface

Is considerably
1- increased , becomes flatter (post myopic Lasik)
2- or reduced, becomes steeper (post hyperopic Lasik)

The standard IOL power formulae assume:

– The flatter the k values, means shorter the axial length, and shallower the anterior chamber.
– The steeper the k values, means longer the axial length, and deeper the anterior chamber.

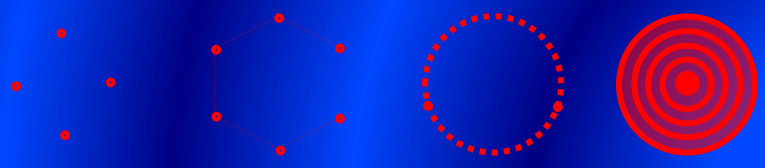
Therefore,

calculating keratometric diopters from anterior radius of curvature is not accurate for estimation of effective lens position (ELP)

B- ACTUAL CENTRAL CORNEA KERATOMETRIC VALUE

**-Keratometric value is important*
**-How to measure the K-value (radius of curvature) of reshaped cornea ?*

**-Keratometry 4 points*
**-IOL Master 6 points*
**-AL-Scan 360 points x 2 rings still on the ring*
**-APP (AVERAGE POWER OF PUPIL, REPRESENT KERATOMETRIC VALUE)*
is area information 8 rings x 360 points



C - Laser Vision Correction procedures modify only the anterior corneal curvature but leave the posterior curvature unchanged,

1- Thereby altering the normal anterior / posterior curvature ratio.

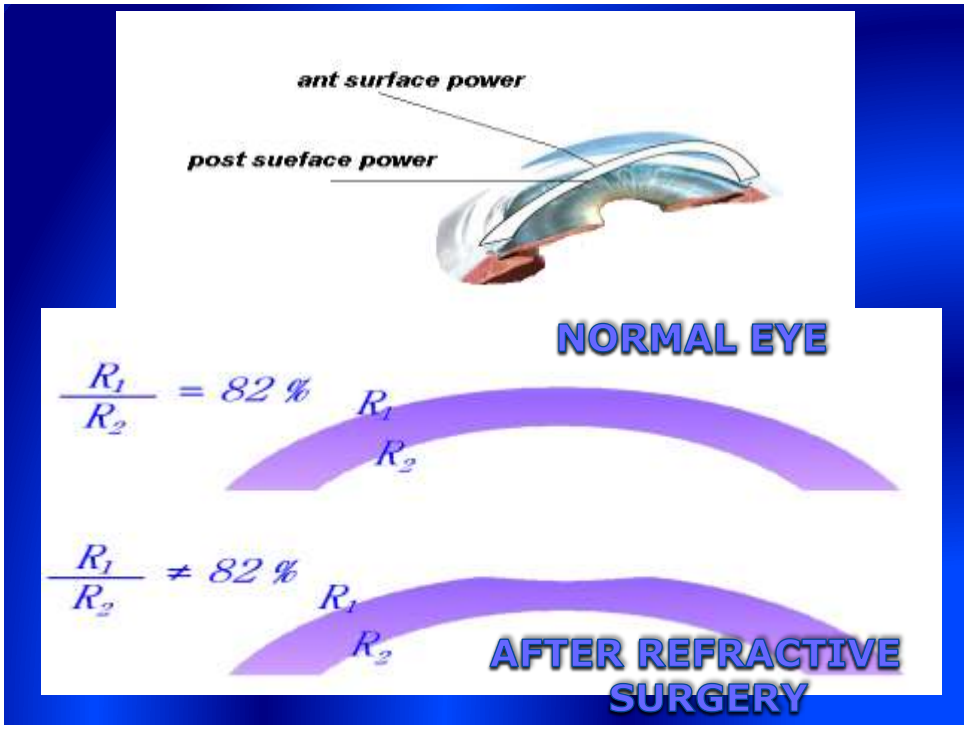
As standard keratometry measures only the anterior corneal curvature, the posterior curvature is usually extrapolated based on the normal anterior/posterior curvature ratio.

This extrapolation is no longer valid after LVC.

2- distance between both refractive anterior and posterior corneal surfaces is decreased.

True total corneal power measurement

The fundamental solution to obtain accurate post-LVC corneal power is to directly measure both anterior and posterior corneal curvature and thereby calculate the net corneal power.



Methods to Obtain the True Corneal Power after Refractive Surgery

1- Clinical history method

K = KPRE - RCC

K: calculated corneal power
KPRE: corneal power before refractive surgery
RCC: change in manifest refraction at the corneal plane

2-Contact lens over-refraction method

K=BCL+PCL+R CL-R No CL

BCL: contact lens base curve
PCL: contact lens power
RCL: contact lens over-refraction
R no CL: spherical equivalent of the manifest refraction without a contact lens

3- Topography-Based Post-LASIK Adjusted Keratometry

Koch and Wang Formula $K=1.14\times TK-6.8$

Shammas Formula $K=1.1141\times TK-6.1$

K: calculated corneal power.
TK: post-LASIK corneal topography central Ks

4- Central ring topography method

Awwad *et al reported that corneal refractive power after RK was best described by averaging the topographic corneal power of the central 3.0 mm area.*
This method may not be suitable for post-LVC cataract cases

5- Masket Formula

$P= PTARG - 0.326 \times RCC - 0.101$

PTARG: IOL power calculated by standard IOL formulas
RCC: surgically induced refractive change
(SRK/T: myopes; Hoffer Q : hyperopes)

6- Ray tracing = total corneal power

GALILLI & PENTACAM

7- ECCP = Effective central corneal power by

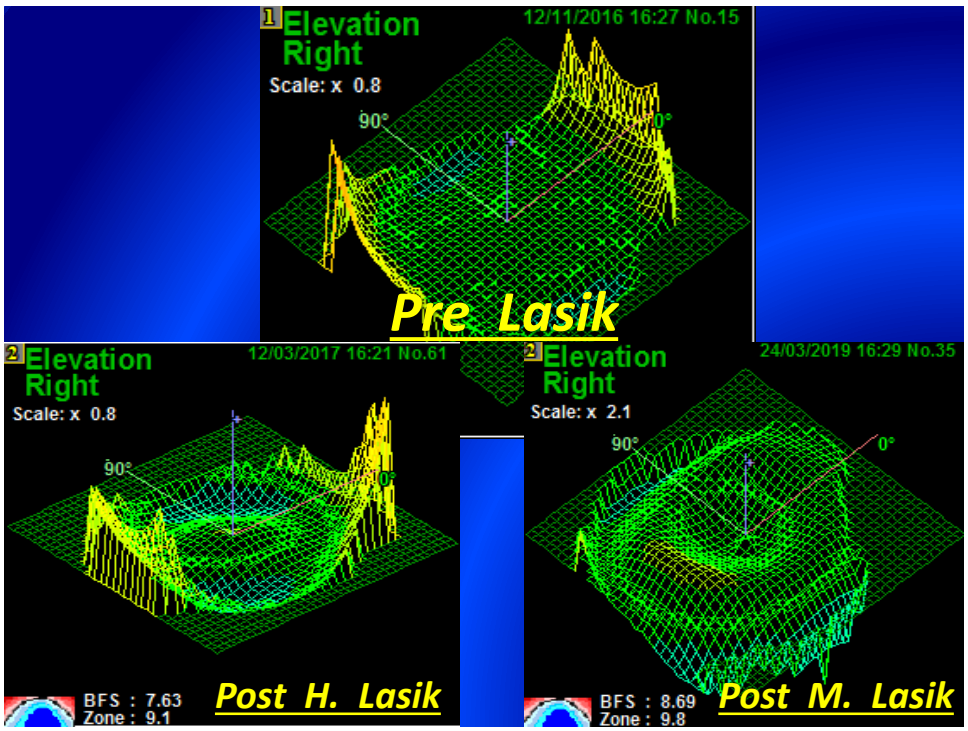
OPD III by NIDEK

1- Peripherally

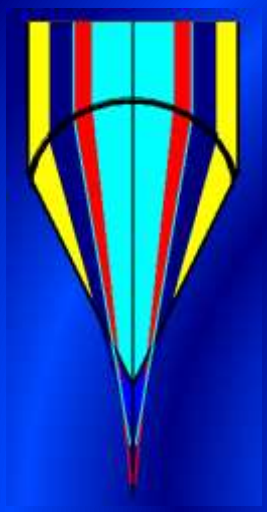
Q value

(asphericity)

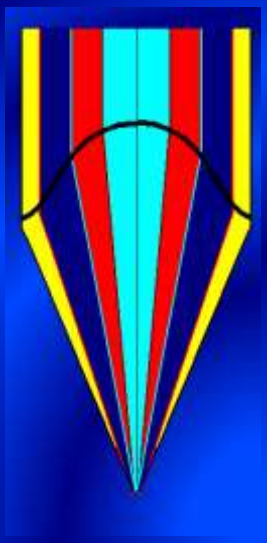
Spherical Aberration

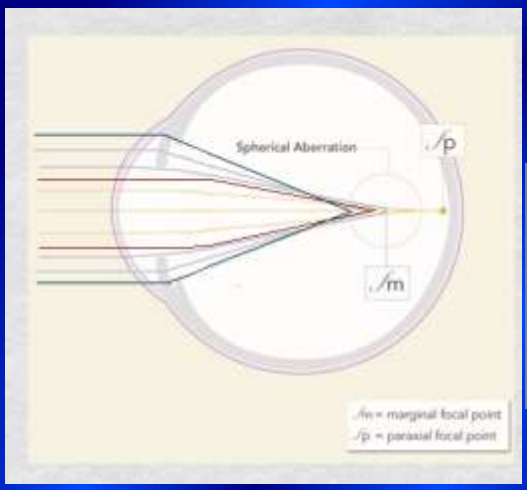


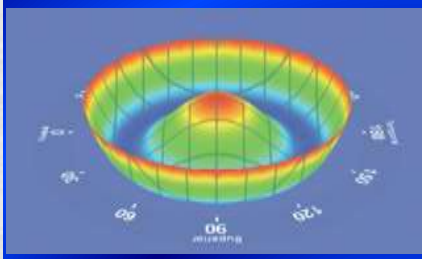
Spherical Refractive Surface

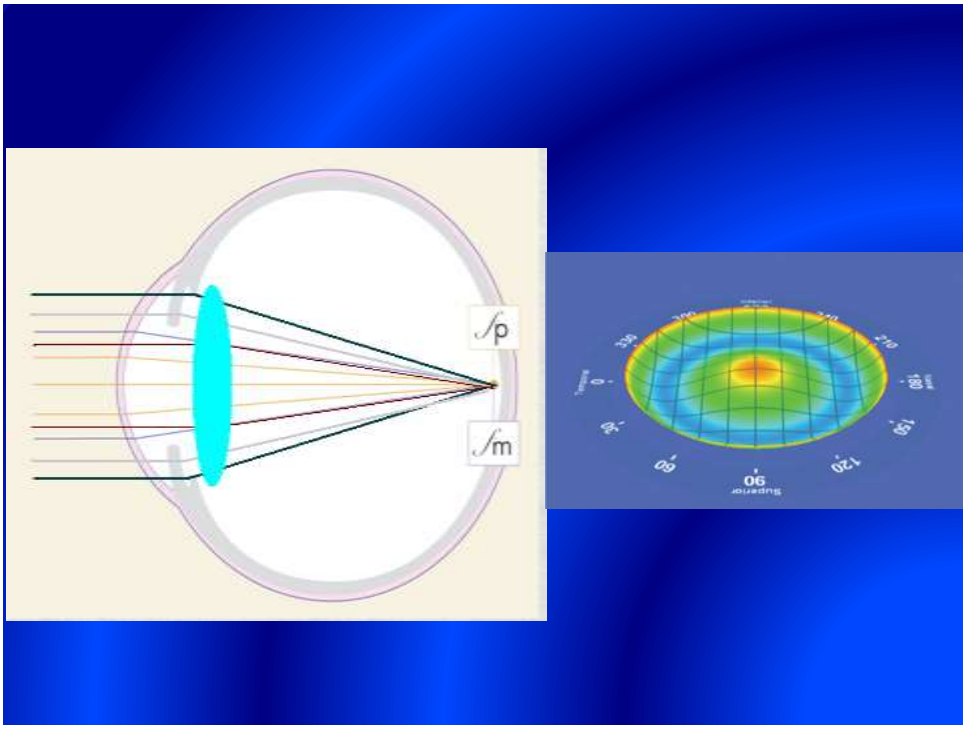


Aspherical Surface Normal Cornea







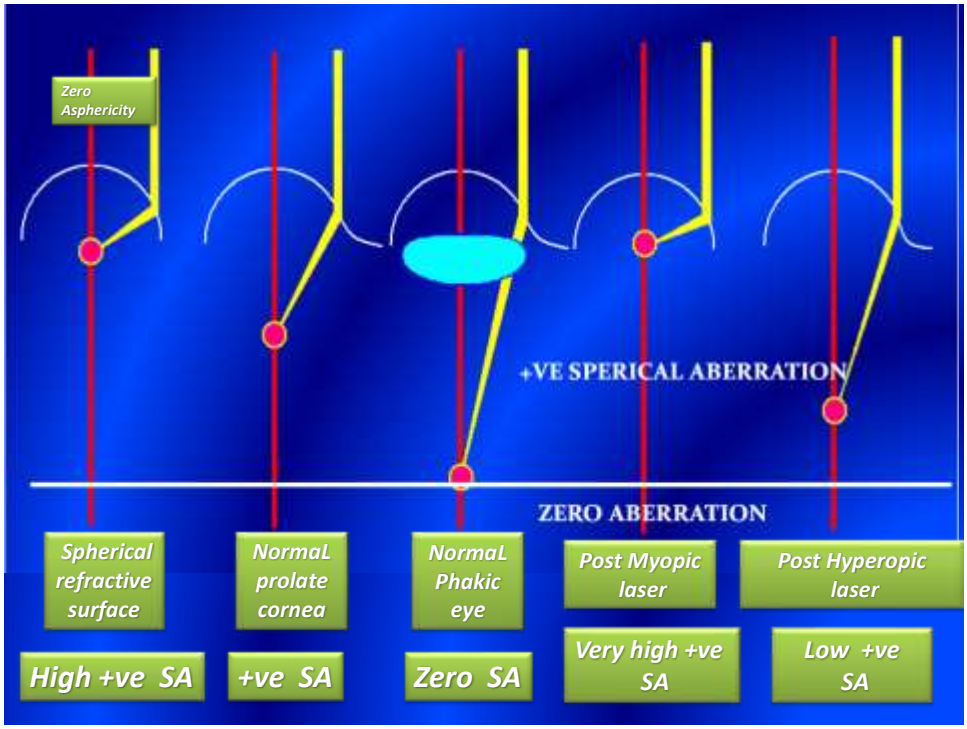


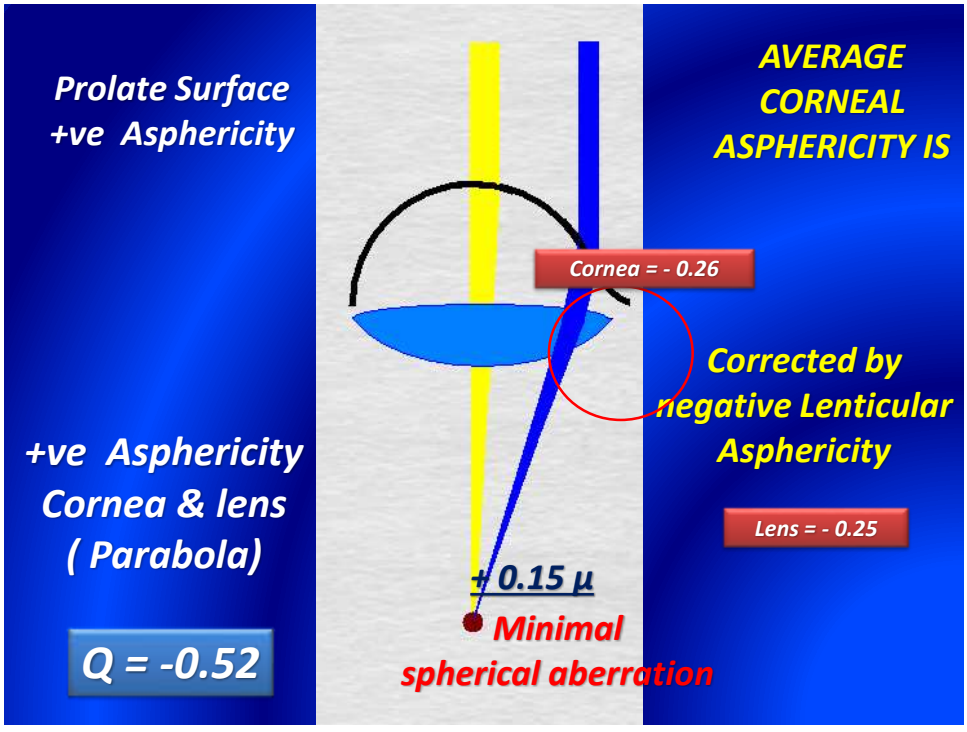
Peripheral (Q value) changes

The shape of the cornea, crystalline lens, or spherical IOL can increase spherical aberration, which may result in a reduction in contrast sensitivity and decreased visual function

- IOL is designed to restore the negative spherical aberration provided by the young crystalline lens in order to counteract the positive spherical aberration of the cornea

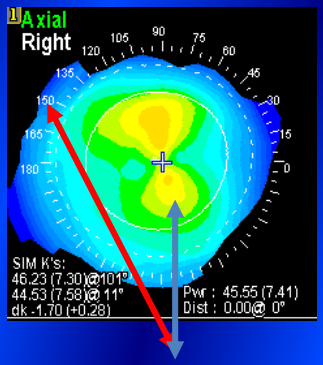
- In the young adult human eye, a moderate amount (approximately 0.1μm) of residual positive spherical aberration is present and contributes to peak visual performance


Zero Asphericity
+VE SPERICAL ABERRATION
ZERO ABERRATION
Spherical refractive surface
NormaL prolate cornea
NormaL Phakic eye
Post Myopic laser
Post Hyperopic laser
High +ve SA
+ve SA
Zero SA
Very high +ve SA
Low +ve SA


Prolate Surface
+ve Asphericity
+ve Asphericity
Cornea & lens
(Parabola)
Q = -0.52
AVERAGE CORNEAL ASPHERICITY IS
Cornea = - 0.26
Corrected by negative Lenticular Asphericity
Lens = - 0.25
+ 0.15 µ
Minimal
spherical aberration

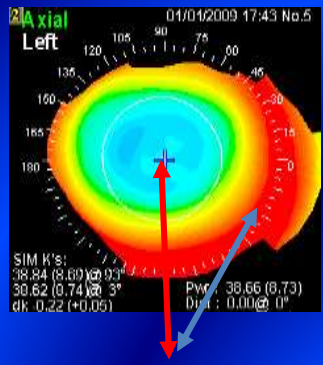
Spherical Aberration

Aspheric Cornea



Relative Myopic central area
To Hyperopic peripheral area

Spherical Ablation



Relative Myopic peripheral area
To Hyperopic central area

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THEORITICAL GOAL IS ZERO

AVERAGE CORNEAL ASPHERICITY IS +0.27µ

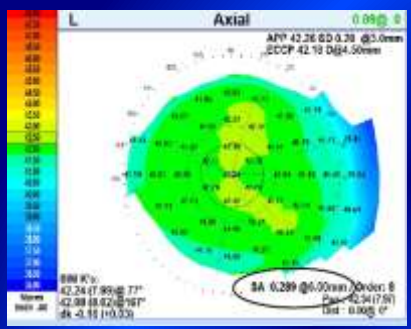
YET MEAN ASPHERICAL ABERRATION OF +0.10µ
MAY YEILD THE BEST CONTRAST SENSITIVITY

MEASURING THE SPERICAL ABERRATION OF THE CORNEA ALLOW US TO PREDICT THE SA THAT WILL NEED CORRECTION

MEASURING THE SPERICAL ABERRATION OF THE CORNEA ALLOW US TO PREDICT THE SA THAT WILL NEED CORRECTION

- AMO Tecnis® Z9000 - .27 µ
- Alcon AcrySof® SN60WF - .20 µ
- Hoya AF-1 iSpheric IOL - .18 µ
- Staar® Surgical (AQ2015) - .08 µ
- B&L Sofport® (Akreos™ AO) 0 µ
- Spherical (monofocal) +.15 µ

Average Cornea
No previous treatments



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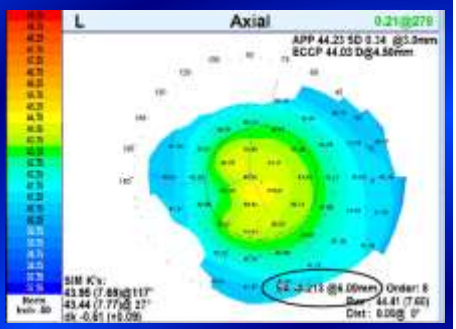
- Staar® Surgical (AQ2015) - .08 µ
- B&L Sofport® (Akreos™ AO) 0 µ
- Spherical (monofocal) +.15 µ

Post Hyperopic LASIK
Induces Negative SA



- AMO Tecnis® Z9000 - .27 µ
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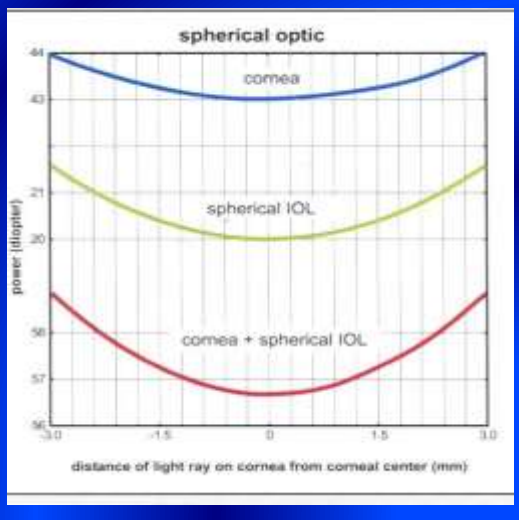
- Hoya AF-1 iSpheric IOL - .18 µ
- Staar® Surgical (AQ2015) - .08 µ
- B&L Sofport® (Akreos™ AO) 0 µ
- Spherical (monofocal) +.15 µ

SO THE IOL IS EITHER AN ASPHERICAL OPTICS OR TRUE OPTIMIZED ASPHERICAL OPTICS.

A)

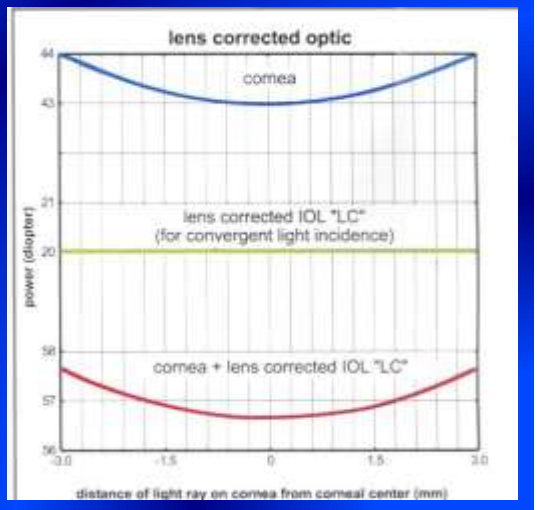
IOL WITH SPHERICAL OPTICS



SO THE IOL IS EITHER AN ASPHERICAL OPTICS OR TRUE OPTIMIZED ASPHERICAL OPTICS.

B)

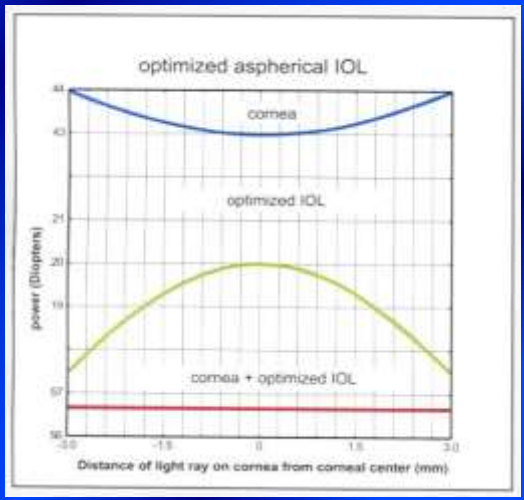
IOL WITH ASPHERICAL OPTICS



SO THE IOL IS EITHER AN ASPHERICAL OPTICS OR TRUE OPTIMIZED ASPHERICAL OPTICS.

C)

IOL WITH OPTIMIZED OPTICS



والصلاة والسلام
على رسول الله