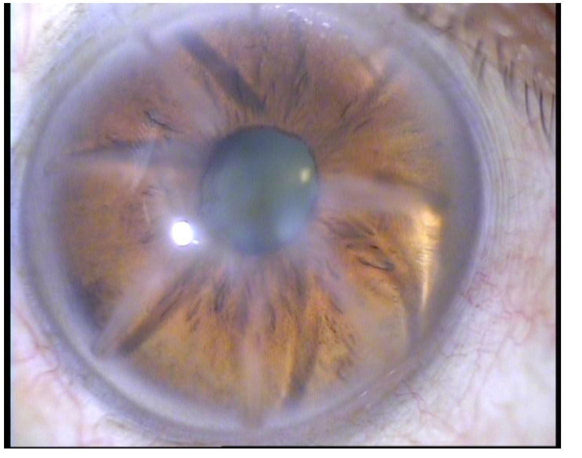
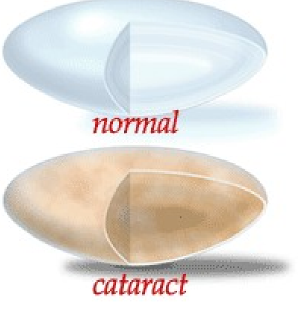
EFFECT OF LASER REFRACTIVE SURGERY ON BIOMETRY AND CATARACT SURGERY





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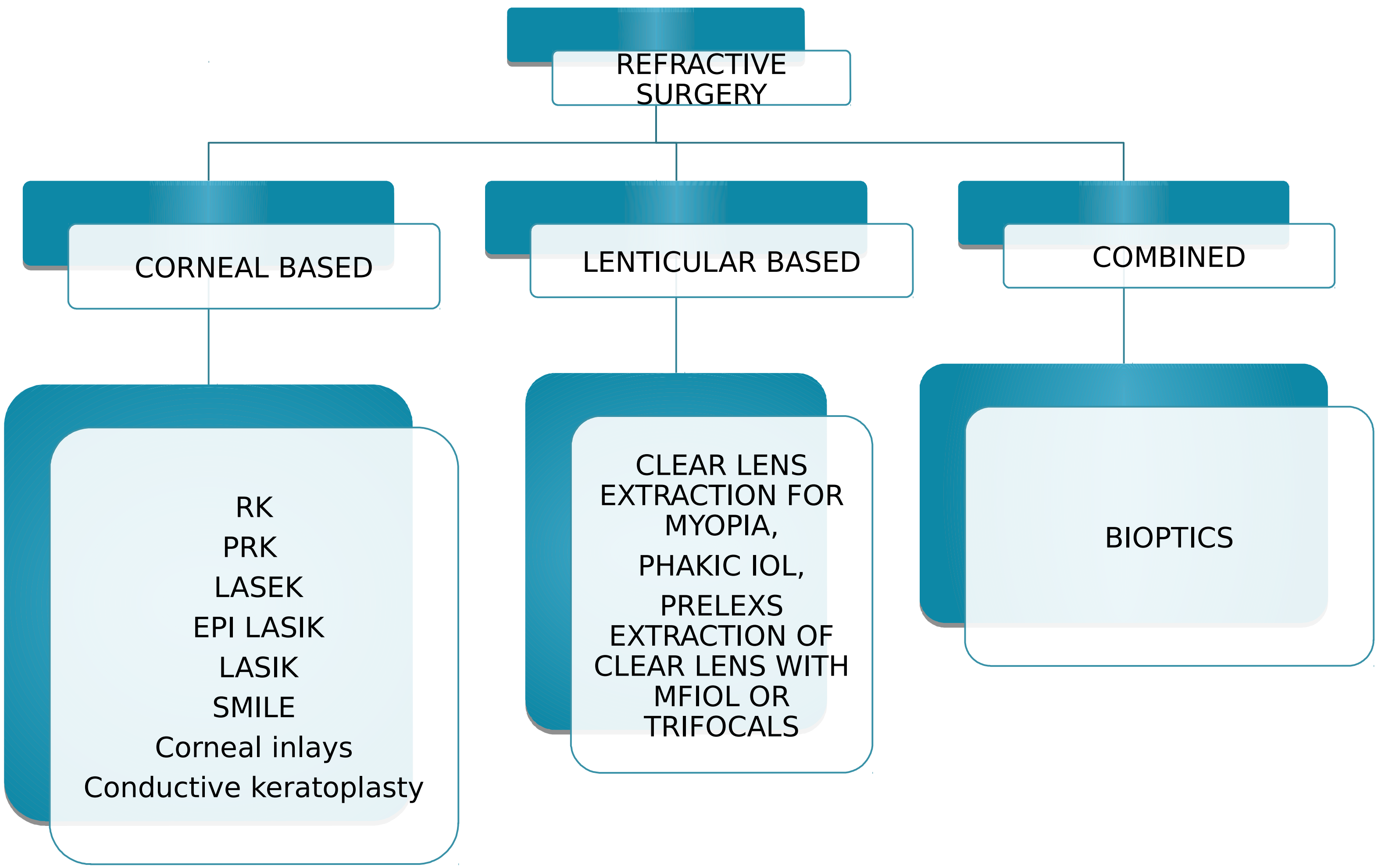
Fellowship in Cataract and Refractive Surgery

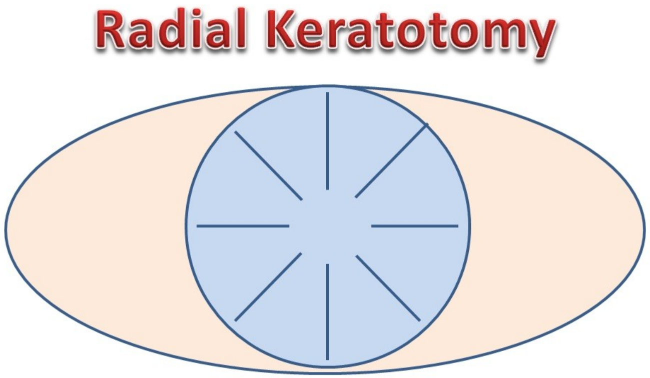
NO FINANCIAL DISCLOSURES

CLASSIFICATION OF REFRACTIVE SURGERY



RADIAL KERATOTOMY (RK)

- To correct myopia
- Developed in 1974 by Svyatoslav Fyodorov, a Russian Ophthalmologist
- Linear RK incisions made in a spoke-like pattern extending from a 3-4 mm central optical zone peripherally to within 1-2 mm of the limbus
- Incisions are made to 90-95% corneal stromal depth
- They can have 4, 8, 12, 16



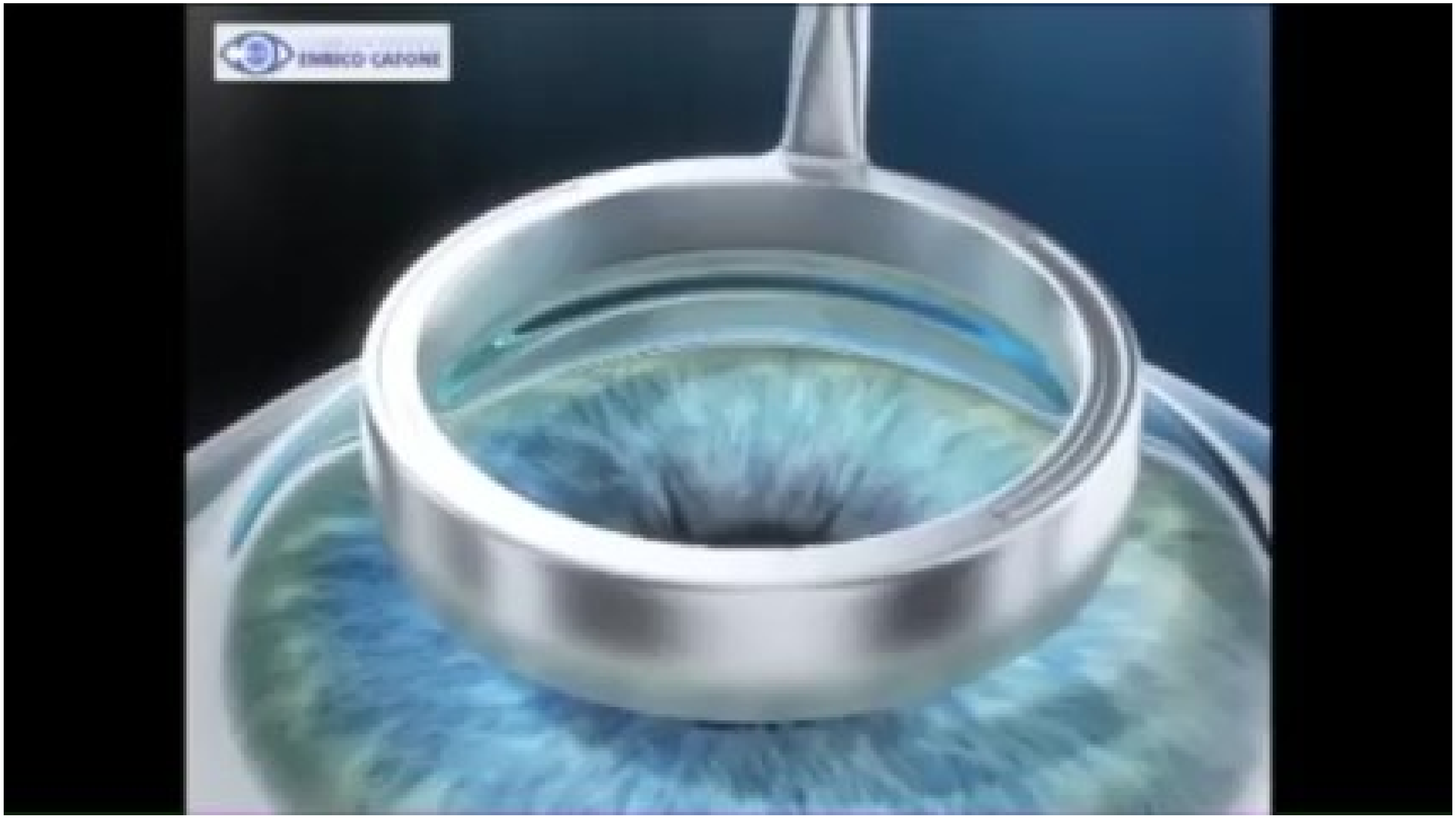
Source: https://www.eyeworld.org/

LASER VISION CORRECTION

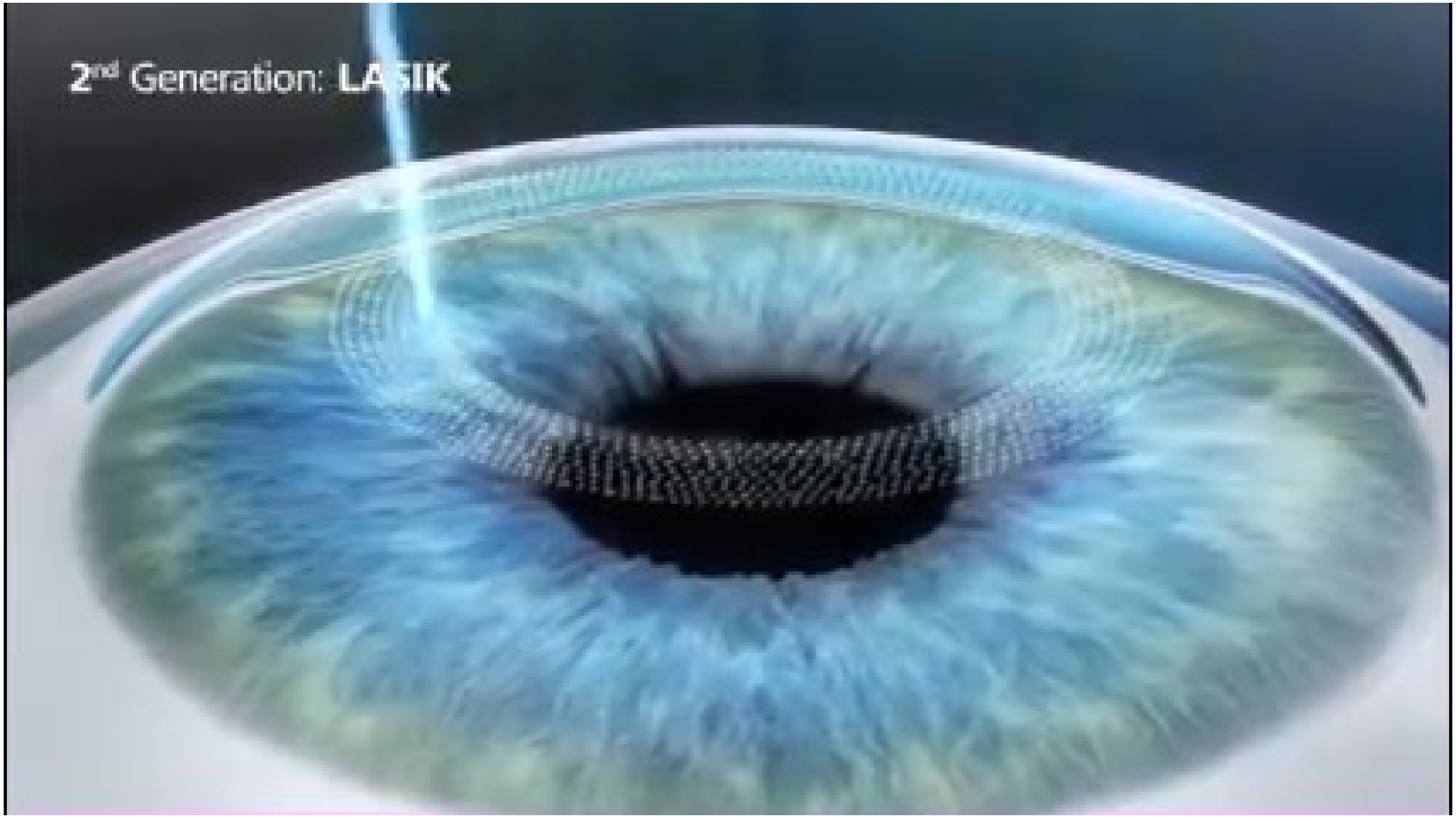
It includes

- PRK (Photorefractive keratectomy)
- Epi LASIK
- LASEK(Laser-Assisted Subepithelial Keratomileusis
- LASIK (laser in situ keratomileusis)
- SMILE (Small Incision Lenticule Extraction)

PRK (Photorefractive keratectomy)



LASIK (laser in situ keratomileusis)



SMILE (Small Incision Lenticule Extraction)

- Approximately 1 million refractive surgery procedures performed in the US per year in 2004 and 2005
- 7.1 million Americans had LASIK, since the FDA approved in 1995 (Research firm Market Scope LLC)
- The average age of the laser patient has consistently remained around 39 years old.
- This means that the average age of patients who had refractive surgery in 1996 is now 51, with many in their 60s.

American Academy of Ophthalmology. Online; 22 January 2008. http://www.aao.org/news/academy_express/20060405.cfm. [Accessed 15 March 2008]

CHALLENGES

- Pre opertive - IOL Power calculation
  IOL selection
- Intra operative
- Post operative

IOL POWER CALCULATION

- To determine optimal IOL power, several preoperative measurements are needed
- 1. Axial length
- 2. Corneal power
- 3. Anterior chamber depth
- 4. Horizontal corneal diameter

- In virgin corneas, traditional formulas such as the Holiday 1 and SRK/T do an excellent job in predicting postsurgical emmetropia

WHAT HAPPENS POST REFRACTIVE SURGERY

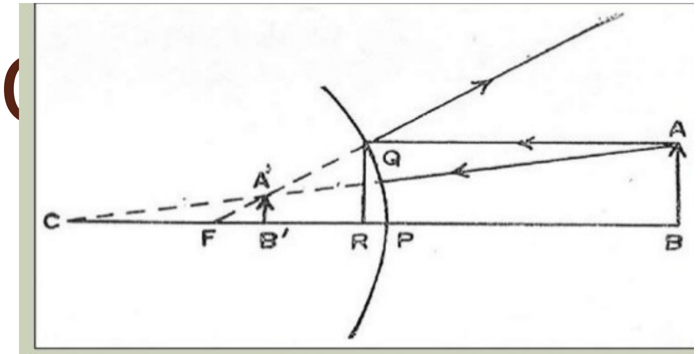
- In post refractive eyes these formulas are known to be inaccurate as both measurements of corneal curvature and regression formulas have sources that contribute to error
- They result in a hyperopic surprise when applied to patient's status post myopic correction and in a myopic surprise when applied to patient's status post hyperopic correction

- s**eitz** B, Langenbucher A. Intraocular lens power calculation in eyes after corneal refractive surgery. J Refract Surg. 2000;16:349–361.
- Wang L, Jackson DW, Koch DD. Methods of estimating corneal refractive power after hyperopic laser in situ keratomileusis. J Cataract Refract Surg. 2002;28:954–961.
- Awwad ST, Manasseh C, Bowman RW, et al. Intraocular lens power calculation after myopic laser in situ keratomileusis: estimating the corneal refractive power. J Cataract Refract Surg. 2008;34:1070–1076.
- Latkany RA, Chokoshi AR, Speaker MG, et al. Intraocular lens calculation after refractive surgery. J Cataract Refract Surg. 2005;31:562–770.

SOURCES OF ERROR

- 1. Corneal power calculation
- 2. Formula error

CORNEAL POWER C



Principles of Keratometry AB is the object and A' B' is the image. By measuring the size of the object and image, curvature of the convex surface can be calculated

- Principle of keratometry : Cornea acts as a convex mirror reflecting the light source off its surface producing a virtual image. The position and size of this image is measured and, as the light source size and distance to the cornea is known, the radius of the cornea can be calculated.
- Both manual and automated keratometers measure the intermediate areas around the central cornea and the central corneal power is then calculated.

These methods of corneal power estimation are less accurate in an eye with refractive surgery for several reasons.

- 1. Corneal measurements are taken at a 2.5mm {for manual keratometery} or a 3.0mm {for art keratometry} optical zone.
- However, after myopic ablation the power of the central cornea is flatter than the measured central power and steeper after hyperopic ablation

- Seitz B, Langenbucher A. Intraocular lens power calculation in eyes after corneal refractive surgery. J Refract Surg. 2000;16:349–361.
- Wang L, Jackson DW, Koch DD. Methods of estimating corneal refractive power after hyperopic laser in situ keratomileusis. J Cataract Refract Surg. 2002;28:954–961

2. The assumption of a spherocylindrical cornea leads to an overestimation of corneal power by 15% to 25% leading to a hyperopic outcome after myopic ablation and a myopic outcome after hyperopic ablation.

- Wang L, Jackson DW, Koch DD. Methods of estimating corneal refractive power after hyperopic laser in situ keratomileusis. J Cataract Refract Surg. 2002;28:954–961.
- 2 Awwad ST, Manasseh C, Bowman RW, et al. Intraocular lens power calculation after myopic laser in situ keratomileusis: estimating the corneal refractive power. J Cataract Refract Surg. 2008;34:1070–1076.
- 3 Latkany RA, Chokoshi AR, Speaker MG, et al. Intraocular lens calculation after refractive surgery. J Cataract Refract Surg. 2005;31:562–770.

- 3. The relationship between the anterior and posterior corneal curvature is changed after refractive surgery, thus the assumption of a refractive index of 1.3375 is no longer accurate.

POST LASIK

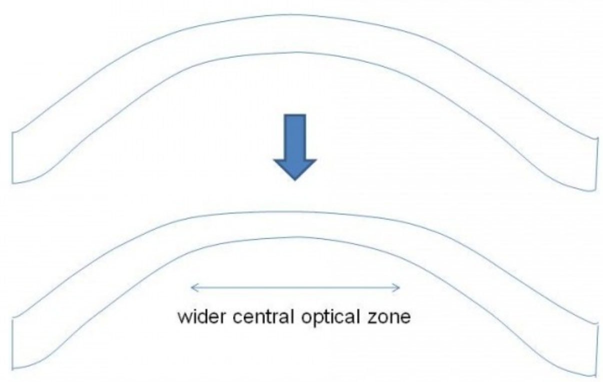
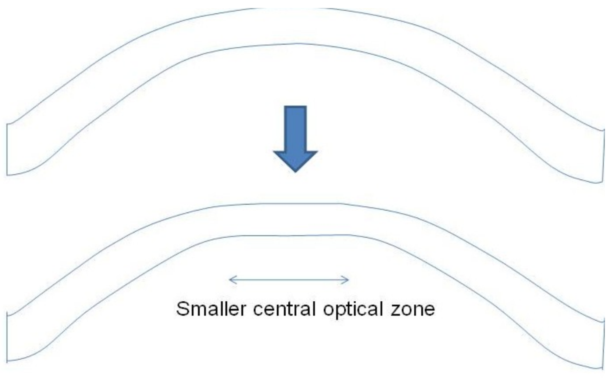


Figure 1. Laser vision correction alters the anterior corneal curvature but not the posterior curvature. This alters the normal anterior/posterior corneal curvature ratic

POST RK



igure 2. Radial keratotomy flattens both the anterior and posterior urvature, within a small central optical zone. This leads to an extrer ariation in corneal power between the center and periphery.

- Laser vision correction modify only the anterior corneal curvature but leave the posterior curvature unchanged, thereby altering the normal anterior/posterior curvature ratio
- Because standard keratometry measures only the anterior corneal curvature, the posterior curvature is extrapolated based on the normal anterior/posterior curvature ratio.
- This extrapolation is no longer valid after LVC.
- Therefore, one potential strategy for determining post-LVC keratometry is to directly measure both anterior and posterior corneal curvature and thereby calculate the net corneal power.

2. FORMULA ERROR

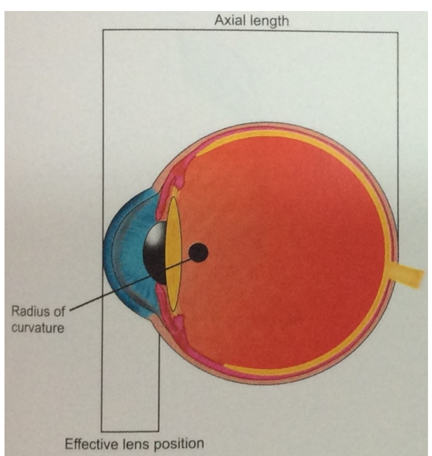
One of the most common regression formulas used for IOL power estimation is the SRK formula, which is:

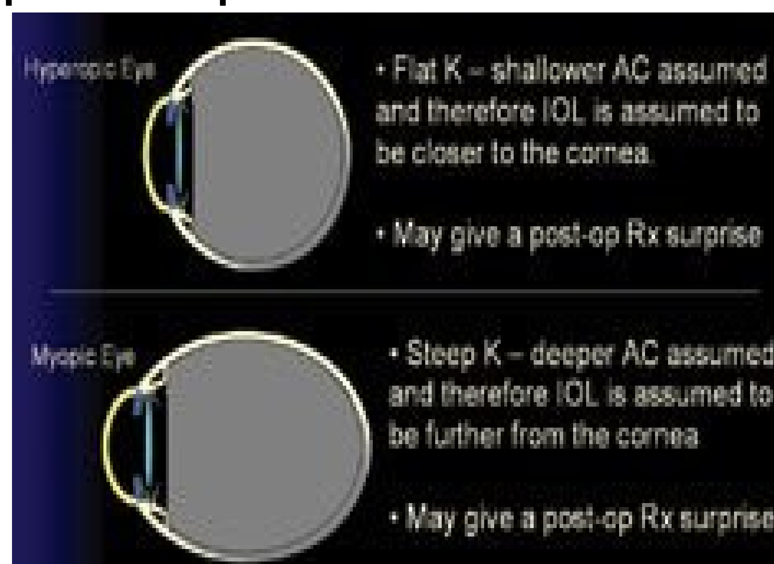
$$P = A - 2.5 (L) - 0.9 (K)$$

- where, P is the dioptric power of the IOL,
- L is the axial length of the eye (mm),
- K is the average corneal power (K)
- A represents a constant specified for the type of lens.

- Newer generation formulas (Holladay I, SRK/T, and Hoffer Q) also utilize the relationship between the steepness of the cornea and the anterior chamber depth to estimate the effective lens position (ELP).

- After a myopic ablation the formulas predict a falsely shallower anterior chamber depth and thus a more anterior ELP.
- This results in an underestimation of IOL power partially contributing to the hyperopic surprise.
- Conversely, after hyperopic ablation, these formulas predict a falsely deeper ELP resulting in an overestimated lens power with subsequent myopic surprise.





SOLUTIONS

- Newer techniques and formulas for post refractive eyes in attempts to improve outcomes after cataract surgery.

- 1.The historical method
- 2.Double-K Method
- 3.ASCRS calculator
- 4. Tomography
- 5.Intraopertaive aberrometry

1. The historical method

- The historical method of keratometry , first described by Holladay to determine corneal power in patients with a history of radial keratotomy.

- It relies on the patients' pre refractive surgery corneal power and spherical equivalent in combination with their post refractive surgery spherical equivalent.

$$\mathrm{K(pre)} + \mathrm{SE(pre)} - \mathrm{SE(post)} = K(\mathrm{post}).$$

Example- Clinical History Method

- Preoperative corneal power =43.5D
- Pre Op refractive error(SE) = -6.25 ,
- 1 year post operative refractive error = -2.00 without cataract
- $$K(\text{pre}) + SE(\text{pre}) - SE(\text{post}) = K(\text{post}).$$

43.5 + (-6.25) – (-2.00) = 39.25

Important to note

This method provides only an estimation of corneal power which can then be used in regression formulas for IOL power prediction.

- Holladay JT. Consultations in refractive surgery. J Refract Corneal Surg. 1989;5:203.
- Hoffer KJ. Intraocular lens power calculation for eyes after refractive keratotomy. J Refract Surg. 1995;11:490–493.

- Argento et al compared the predictability of various methods of IOL power calculation in 7 cases [6 post-laser-assisted in situ keratomileusis (LASIK) eyes and 1 postradial keratotomy eye] using the Holladay 2, Hoffer Q, and SRK/T formulas
- Conclusion - Clinical history method with the Hoffer Q formula provided the best results with a mean dioptric error of – 0.98±0.87.

- Argento C, Cosentino MJ, Badoza D. Intraocular lens power calculation after refractive surgery. Cataract Refract Surg. 2003;29:1346–1351

- Subsequent studies have shown that large variations of IOL power prediction and large refractive errors still occur with this method

- Holladay JT. Consultations in refractive surgery. J Refract Corneal Surg. 1989;5:203.
- Hoffer KJ. Intraocular lens power calculation for eyes after refractive keratotomy. J Refract Surg. 1995;11:490–493
- Gimbel HV, Sun R. Accuracy and predictability of intraocular lens power calculation after laser in situ keratomileusis. J Cataract Refract Surg. 2001;27:571–576.

2. Double-K Method

- Described by Aramberri
- Prerefractive surgery **K(Kpre) value is used to** calculate ELP and postrefractive surgery **K(Kpost) used to calculate IOL power** – hence called “Double K”
- Kpre - obtained before surgery using keratometry or topography
- Kpost – calculated from refractive history
- The Holladay 2 formula allows direct entry of 2 corneal power values for the double-K calculation
- Studies have shown greater accuracy of IOL power prediction in third-generation and fourth-generation formulas when utilizing the double- K method

- Aramberri J. Intraocular lens power calculation of corneal refractive surgery: double-K method. J Cataract Refract Surg. 2003;29:2063–2068.
- Koch DD, Wand L. Calculating IOL power in eyes that have had refractive surgery. J Cataract Refract Surg. 2003;29:2039–2042.

3. ASCRS Online

- Web-based ASCRS calculator generates IOL power for eyes with previous LASIK, PRK or radial keratotomy.
- Type of refractive surgery is selected and then all known preoperative and current data are entered.
- IOL power is calculated using the Aramberri double-K method modification of the Holladay 1 formula, which uses corneal power prior to LASIK or PRK to estimate effective lens position.
- A default value of 43.86 D is used when corneal power prior to LASIK or PRK is not available.
- IOL power is calculated by a variety of formulas, both those requiring historical data and those that do not.
- All predicted IOL powers are displayed

ASCRS ONLINE CALCULATOR

IOL power calculation in eyes that have undergone LASIK/PRK/RK

Prior Myopic LASIK/PRK | **Prior Hyperopic LASIK/PRK** | **Prior RK**

Warren Hill, M.D.
Li Wang, M.D., Ph.D.
Douglas D. Koch, M.D.

Version 4.9

Made possible by an unrestricted educational grant from Alcon Laboratorie
and The ASCRS Foundation

PRIOR MYOPIC LASIK / PRK

IOL Calculator for Eyes with Prior Myopic LASIK/PRK

(Your data will not be saved. Please print a copy for your record.)

Please enter all data available and press "Calculate"

Doctor Name | Patient Name | Patient ID

Eye | IOL Model | Target Ref (D)

Pre-LASIK/PRK Data:

Refraction* — Sph(D) — Cyl(D)* — Vertex (If empty, 12.5 mm is used)

Keratometry — K1(D) — K2(D)

Post-LASIK/PRK Data:

Refraction*§ — Sph(D) — Cyl(D)* — Vertex(If empty, 12.5 mm will be used)

Topography — EyeSys EffRP — Tomey ACCP / Nidek#ACP/APP — Galilei TCP — TCP2 / TCP1

Atlas Zone value — Atlas 9000 4mm zone — Pentacam TNP_Apex_4.0 mm Zone

Atlas Ring Values — 0mm — 1mm — 2mm — 3mm

OCT (RTVue or Avanti XR) — Net Corneal Power — Posterior Corneal Power — Central Corneal Thickness

Optical/Ultrasound Biometric Data:

Ks — K1(D) — K2(D) — Device Keratometric Index (n) — 1.3375 — 1.332 — Other

AL(mm) — ACD(mm) — Lens Thick (mm) — WTW (mm)

Lens Constants** — A-const(SRK/T) — SF(Holladay1)

Haigis a0 (If empty, converted value is used) — Haigis a1 (If empty, 0.4 is used) — Haigis a2 (If empty, 0.1 is used)

*If entering "Sph(D)", you must enter a value for "Cyl(D)", even if it is zero.

§Most recent stable refraction prior to development of a cataract.

Magellan ACP or OPD-Scan III APP 3-mm manual value (personal communication Stephen D. Klyce, PhD).

**Enter any constants available; others will be calculated from those entered. If ultrasonic AL is entered, be sure to use your ultrasound lens constants. It is

OCT (RTVue or Avanti XR)	Net Corneal Power		Posterior Corneal Power		Central Corneal Thickness	

Optical/Ultrasound Biometric Data:

Ks	K1(D)		K2(D)		Device Keratometric Index (n)	1.3375 1.332 Other
	AL(mm)		ACD(mm)		Lens Thick (mm)	WTW (mm)
Lens Constants**	A-const(SRK/T)		SF(Holladay1)			
	Haigis a0 (If empty, converted value is used)		Haigis a1 (If empty, 0.4 is used)		Haigis a2 (If empty, 0.1 is used)	

*If entering "Sph(D)", you must enter a value for "Cyl(D)", even if it is zero.
§Most recent stable refraction prior to development of a cataract.
Magellan ACP or OPD-Scan III APP 3-mm manual value (personal communication Stephen D. Klyce, PhD).
**Enter any constants available; others will be calculated from those entered. If ultrasonic AL is entered, be sure to use your ultrasound lens constants. It is preferable to use optimized a0, a1, and a2 Haigis constants.

Calculate Reset Form

IOL calculation formulas used: Double-K Holladay 1[1], Shammas-PL[2], Haigis-L[3], OCT-based[4], & Barrett True K[5]

Using ΔMR		Using no prior data	
[1]Adjusted EffRP	--	[2]Wang-Koch-Maloney	--
[2]Adjusted Atlas 9000 (4mm zone)	--	[2]Shammas	--
[1]Adjusted Atlas Ring Values	--	[3]Haigis-L	--
Masket Formula	--	[1]Galilei	--
Modified-Masket	--	[2]Potvin-Hill Pentacam	--
[1]Adjusted ACCP/ACP/APP	--	[4]OCT	--
[5]Barrett True K	--	[5]Barrett True K No History	--

Average IOL Power (All Available Formulas): --

Min: --

Max: --

PRIOR HYPEROPIC LASIK/ PRK

IOL Calculator for Eyes with Prior Hyperopic LASIK/PRK

(Your data will not be saved. Please print a copy for your record.)

Please enter all data available and press "Calculate"

Doctor Name | Patient Name | Patient ID

Eye | IOL Model | Target Ref(D)

Pre-LASIK/PRK Data:

Refraction* Sph(D) Cyl(D) Vertex (If empty, 12.5 mm will be used)

Keratometry K1(D) K2(D)

Post-LASIK/PRK Data:

Refraction* Sph(D) Cyl(D) Vertex(If empty, 12.5 mm will be used)

Topography EyeSys EffRP

Atlas 0mm 1mm 2mm 3mm

OCT (RTVue or Avanti XR) Net Corneal Power | Posterior Corneal Power | Central Corneal Thickness

Optical/Ultrasound Biometric Data:

Ks** K1(D) K2(D) Device Keratometric Index (n) 1.3375 1.332 Other

AL(mm) ACD(mm) Lens Thick (mm) WTW (mm)

Lens Constants*** A-const(SRK/T) SF(Holladay1)

Haigis a0 (If empty, converted value is used) | Haigis a1 (If empty, 0.4 is used) | Haigis a2 (If empty, 0.1 is used)

*If entering "Sph(D)", you must enter a value for "Cyl(D)", even if it is zero.
**Not manual/SimKs from other devices.
***Enter the constant available; the other will be calculated. If ultrasonic AL is entered, be sure to use your ultrasound lens constants. It is preferable to use optimized a0, a1, and a2 Haigis constants.

Calculate | Reset Form

OCT (RTVue or Avanti XR) | Net Corneal Power | Posterior Corneal Power | Central Corneal Thickness

Optical/Ultrasound Biometric Data:

Ks** | K1(D) | K2(D) | Device Keratometric Index (n) 1.3375 1.332 Other

AL(mm) | ACD(mm) | Lens Thick (mm) | WTW (mm)

Lens Constants*** | A-const(SRK/T) | SF(Holladay1)

Haigis a0 (If empty, converted value is used) | Haigis a1 (If empty, 0.4 is used) | Haigis a2 (If empty, 0.1 is used)

*If entering "Sph(D)", you must enter a value for "Cyl(D)", even if it is zero.
**Not manual/SimKs from other devices.
***Enter the constant available; the other will be calculated. If ultrasonic AL is entered, be sure to use your ultrasound lens constants. It is preferable to use optimized a0, a1, and a2 Haigis constants.

Calculate | Reset Form

IOL Powers Calculated Using Double-K Holladay 1[1], Shammas-PL[2], Haigis-L[3], OCT-based[4], & Barrett True K[5]

Using ΔMR		Using no prior data	
[1]Adjusted EffRP	--	[2]Shammas	--
[1]Adjusted Atlas 0-3	--	[3]Haigis-L	--
Masket Formula	--	[4]OCT	--
Modified-Masket	--	[5]Barrett True K No History	--
[5]Barrett True K	--		

Average IOL Power: --

Min: --

Max: --

PRIOR RK

IOL Calculator for Eyes with Prior RK

(Your data will not be saved. Please print a copy for your record.)

Please enter all data available and press "Calculate"

Doctor Name ____ Patient Name ____ Patient ID ____

Eye ____ IOL Model ____ Target Ref(D) ____

Pre-RK Data:

Refraction Sph(D) ____ Cyl(D) ____ Vertex (If empty, 12.5 mm will be used) ____

Post-RK Data:

Refraction Sph(D) ____ Cyl(D) ____ Vertex(mm) ____

Topography EyeSys EffRP ____ Average Central Power* ____

Atlas Ring Values 1mm ____ 2mm ____ 3mm ____ 4mm ____

Pentacam PWR_SF_Pupil_4.0 mm Zone** ____ CT_MIN** ____

OCT (RTVue or Avanti XR Net Corneal Power ____ Posterior Corneal Power ____ Central Corneal Thickness ____

Optical/Ultrasound Biometric Data:

Ks K1(D) ____ K2(D) ____ Device Keratometric Index (n)*** 1.3375 1.332 Other ____

AL(mm) ____ ACD(mm) ____ Lens Thick (mm) ____ WTW (mm) ____

Lens Constants*** A-cons (SRK/T) ____ SF (Holladay1) ____

*Not SimK values; average central corneal powers from other devices.
**PWR_SF_Pupil_4.0 mm Zone refers to the Pentacam Power Distribution display for the Sagittal Curvature (Front) Mean (Km) value at a 4.0 mm zone and centered on the pupil. Click on PWR_SF_Pupil_4.0 mm Zone to see this topographic display. CT_MIN is the minimum central corneal thickness in microns as displayed by the Pentacam.
***Enter the constant available; the other will be calculated. If ultrasonic AL is entered, be sure to use your ultrasound lens constants.

Calculate Reset Form

OCT (RTVue or Avanti XR | Net Corneal Power | Posterior Corneal Power | Central Corneal Thickness

Optical/Ultrasound Biometric Data:

Ks K1(D) K2(D) Device Keratometric Index (n)*** 1.3375 1.332 Other

AL(mm) ACD(mm) Lens Thick (mm) WTW (mm)

Lens Constants*** A-cons (SRK/T) SF (Holladay1)

*Not SimK values; average central corneal powers from other devices.
**PWR_SF_Pupil_4.0 mm Zone refers to the Pentacam Power Distribution display for the Sagittal Curvature (Front) Mean (Km) value at a 4.0 mm zone and centered on the pupil. Click on PWR_SF_Pupil_4.0 mm Zone to see this topographic display. CT_MIN is the minimum central corneal thickness in microns as displayed by the Pentacam.
***Enter the constant available; the other will be calculated. If ultrasonic AL is entered, be sure to use your ultrasound lens constants.

Calculate | Reset Form

IOL calculation formulas used: Double-K Holladay 1[1], OCT-based[2], & Barrett True K[3]

[1]EyeSys EffRP	--
[1]Average Central Power (other)	--
[1]Atlas 1-4	--
[1]Pentacam	--
[1]IOLMaster/Lenstar	--
[2]OCT	--
[3]Barrett True K	--

Average IOL Power:	--
Min:	--
Max:	--

4. Tomography

- With the advent of devices that can measure the tomography of the cornea with Scheimpflug images or Fourier-domain optical coherence tomography (OCT), the anterior and posterior surface powers can be more accurately calculated using Gaussian optics.

- A benefit of this methodology includes the possible elimination of regression formulas.

- Wang L, Booth MA, Koch DD. Comparison of intraocular lens power calculation methods in eyes that have undergone LASIK. Ophthalmology. 2004;111:1825–1831.
- Borasio E, Stevens J, Smith GT. Estimation of true corneal power after keratorefractive surgery in eyes requiring cataract surgery: BESSt formula. J Cataract Refract Surg. 2006;32:2004–2014.

- Fourier-domain OCT carries the advantage of higher resolution and speed of image acquisition to traditional Scheimpflug images

- However, no difference in predictive accuracy of Scheimpflug and OCT-based IOL calculations has been demonstrated.

- Tang M, Wang L, Koch DD, et al. Intraocular lens power calculation after previous myopic laser vision correction based on corneal power measured by Fourier-domain optical coherence tomography. J Cataract Refract Surg. 2012;38:589–594.

5. Intra operative aberrometry

- Intraoperative aberrometry is a relatively new technique for IOL power determination

Ianchulev T, Salz J, Hoffer K, et al. Intraoperative optical refractive biometry for intraocular lens power estimation without axial length and keratometry measurements. J Cataract Refract Surg. 2005;31:1530–1536.

- It uses Talbot-Moire wavefront aberrometry to measure the refraction of the entire optical system in an aphakic eye during surgery.
- The independence of historical or even preoperative data is an advantage to previously discussed methodologies.

- Recent studies found this to be statistically better at IOL power prediction to several techniques and can reach target refraction in similar percentages to virgin eyes undergoing cataract surgery.

- Canto AP, Chhadva P, Cabot F, et al. Comparison of IOL power calculation methods and intraoperative wavefront aberrometry in eyes after refractive surgery. J Refract Surg. 2013;29:484–489.
- Fram N, Masket S, Wang L. Comparison of intraoperative aberrometry, OCT-based IOL formula, Haigis-L, and Maskey formulae for IOL power calculation after laser vision correction. Ophthalmology. 2015;122:1096–1101.
- Ianchulev T, Hoffer K, Yoo S, et al. Intraoperative refractive biometry for predicting intraocular lens power calculation after prior myopic refractive surgery. Ophthalmology. 2014;121:56–60.

Even this technique has its limitations

- Aphakic measurements must be taken in the operating room, which can be altered depending on intraocular pressure, patient fixation, and external pressure from the speculum.
- In addition, determining the ELP still remains a source of error.

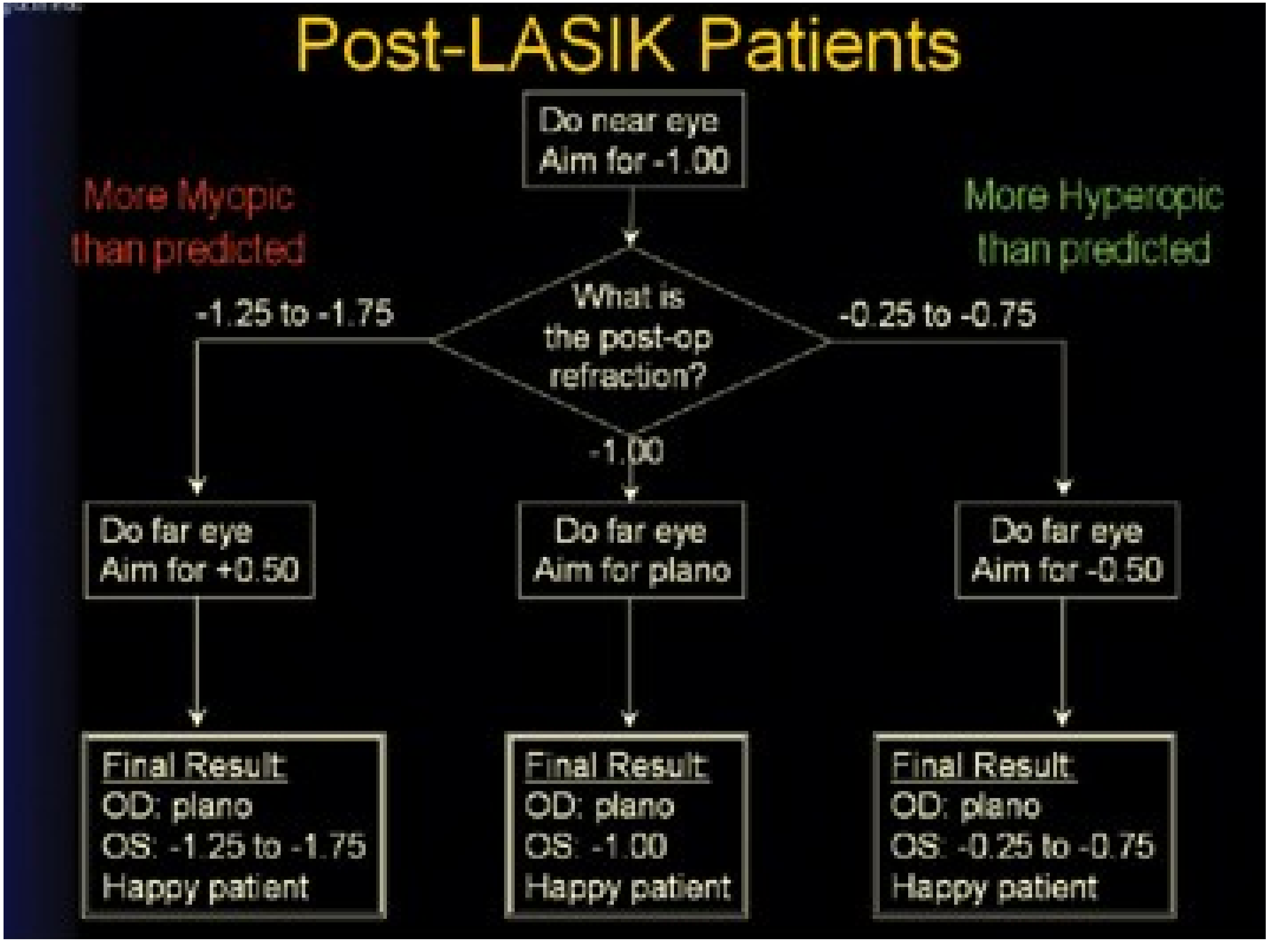
Aim for about -1 D postop

This is for two reasons:

- If the calculations are inaccurate, you'll have some leeway one way or the other, and the patient will have some useful vision somewhere.

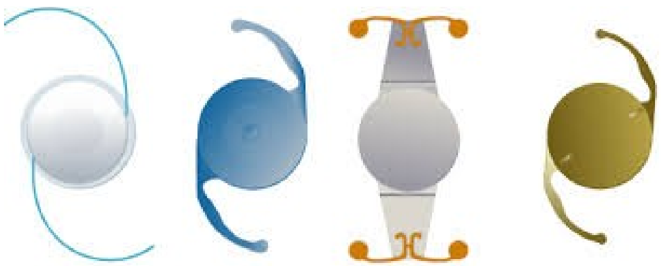
- Second, RK patients often have an ongoing hyperopic shift, and if you leave them -1 it will give them many years in which they can, we hope, see well without correction before they'll need some kind of excimer laser procedure

MONOVISON FOR POST LASIK



CHOICE OF INTRAOCULAR LENS

- No premium IOLs (MFIOL/ TRIFOCALS)
- A negative spherical aberration aspheric IOL can help to offset the large amount of positive spherical aberration often seen in RK corneas.
- Advanced Medical Optics Tecnis IOL - ability to offset large degrees of corneal positive spherical aberration.
- Bausch & Lomb SofPort Advanced Optics - zero spherical aberration (when the corneal aberration are not known and a degree of irregularity and HOA are suspected)
- Toric Intraocular lens can be very useful in cases with significant astigmatism



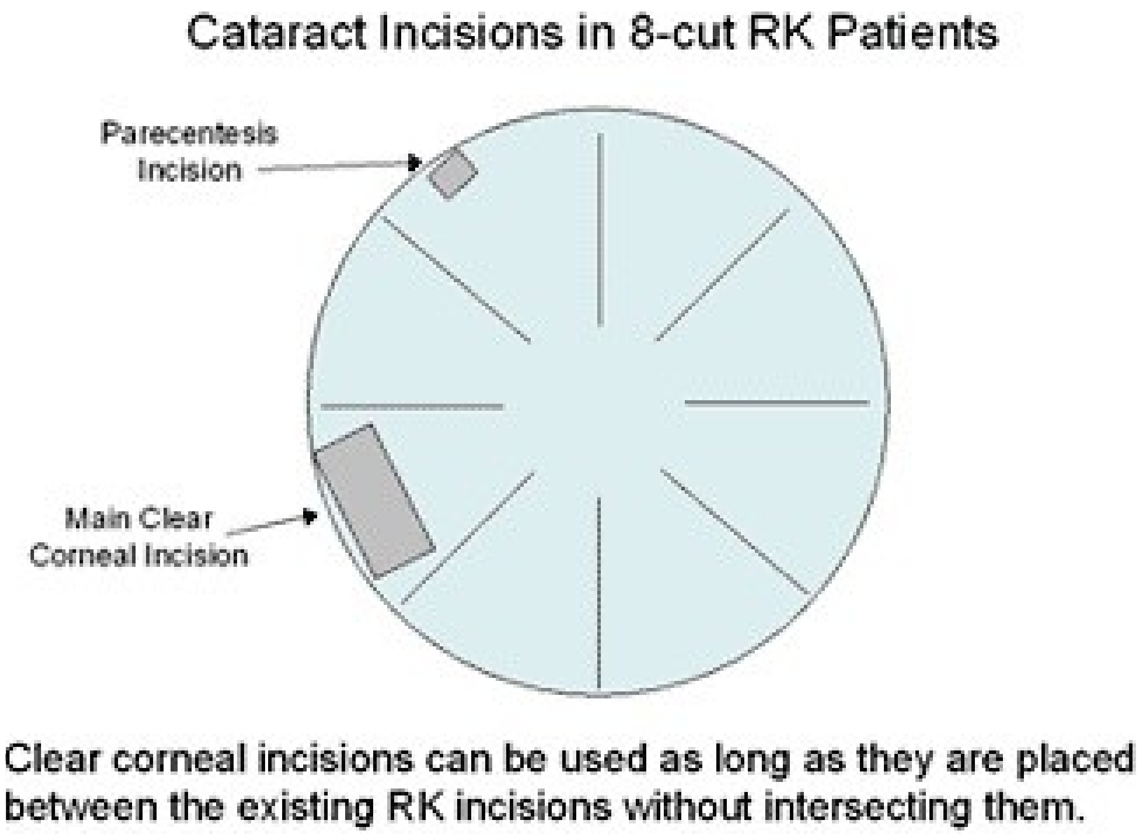
- Ocular Surgery News U.S. Edition, March 15, 2007 *Uday Devgan, MD, FACS*

INTRA OPERATIVE CONSIDERATIONS FOR RK

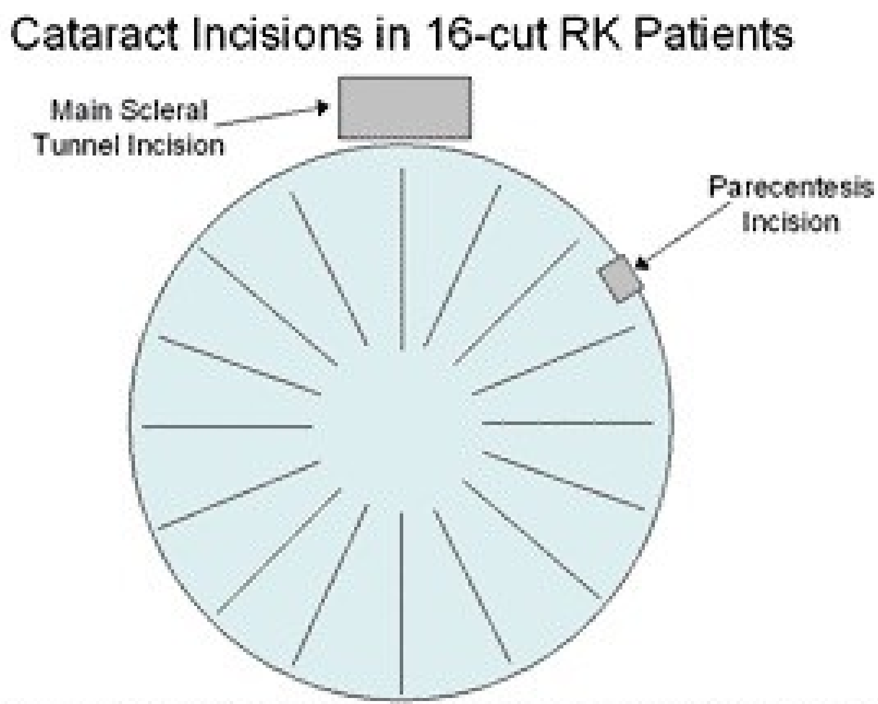
INCISION :

All incisions should be made in between the RK incisions to avoid wound dehiscence or leaks and to prevent irregular astigmatism post-operatively.

- In patients with previous 8-cut RK, clear corneal incisions can be made between the existing RK incisions



- In patients with 16-cut or more RK, it becomes difficult to avoid the existing RK incisions unless a scleral tunnel cataract incision is used



A scleral tunnel incision should be used for the cataract surgery since it will not intersect any of the many existing RK incisions.

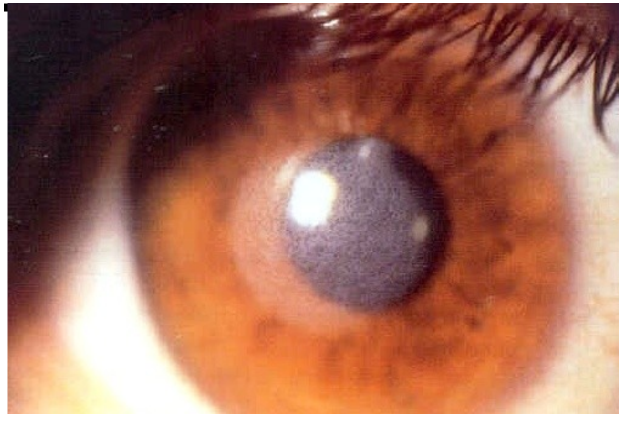
- Consider lowering phacoemulsification parameters to minimize operative complications, use lower flow and a lower bottle height with a smaller phaco needle to ensure that the fluid inflow still stays greater than the fluid outflow.
- If the RK incisions open during surgery there could be sudden instability and shallowing of the anterior segment, and the chance for capsule rupture is increased.
- Be prepared to suture incisions
- Coat the endothelium with Viscoelastic to minimize any endothelial cell loss, since RK may have caused some prior loss

- These patients may have had a microperforation during their initial RK procedure, which one may not be aware of now.
- Be prepared for some zonular laxity due to past shallowing of the chamber during their RK.
- Have some capsular tension rings
- The RK incisions can confuse while making capsulorhexis
- Use capsular stain to highlight the capsule
- At the end of the surgery , paint the entire cornea with fluorescein dye to check for any leaks, which can easily be sutured while the patient is in the operating room

INTRA OPERATIVE CONSIDERATION FOR PRK

- It is important to note the degree of haze, if any, preoperatively.

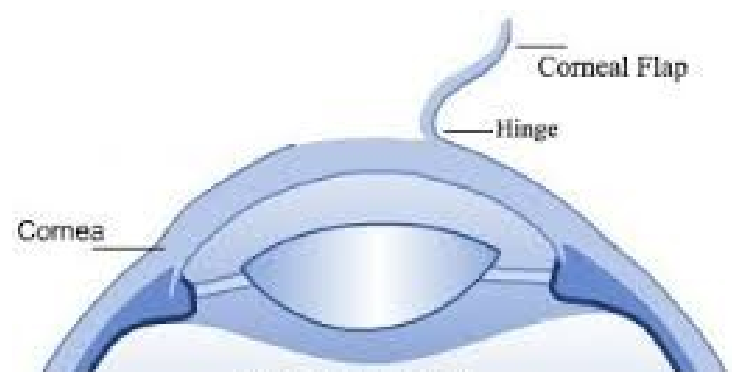
- Given a potential for limited view during cataract surgery , Trypan blue could be used to aid in visualization of the anterior capsule to make a capsulorrhexis.



INTRA OPERATIVE CONSIDERATION FOR LASIK

- Flap and hinge position should be determined for when planning surgical incisions.

- Do not disrupt the flap during surgery as to keep the risk of epithelial ingrowth at a minimum.



POST OP RECOVERY FOR RK

- The RK incisions swell during even the gentlest cataract surgery, and this swelling can induce central corneal flattening, which results in excessive hyperopia immediately postop.

- Patient my experience fluctuations in their refractive state for many weeks after their cataract surgery

POST OP RECOVERY FOR LASIK

- Flap incision doesn't change much after surgery

- stable refraction soon after surgery
- Post op dry eye

Manage Expectations

- Many patients will recall the speed of recovery and the freedom of corrective lenses after their refractive surgery and may expect the same results if not counseled appropriately.
- Over time, the progressive hyperopic shift may continue, and we have to counsel patients that, no matter what we do today, these incisions could continue to change, as will their vision.

Managing Postoperative Refractive Error

- Despite the new advances in technology for IOL selection, patients may still have postoperative refractive errors.
- Small refractive errors can be managed with contact lenses or glasses
- For small amounts of spherocylindrical error, PRK or LASIK can be offered.
- For larger amounts of error, or in eyes where further corneal surgery would be contraindicated, piggyback IOL or even IOL exchange can be performed.

Summary

- Counseling of patient with regards to refractive surprises
- Unrealistic expectations should be carefully addressed.
- Preoperative, intraoperative and post opertaive evaluation are more demanding than required for standard cataract surgery
- Cataract surgery in eyes with prior refractive surgery can be challenging, but with careful planning and patient education, we can achieve great results and patient satisfaction.