



## **Laser Vision Correction**

### Understanding your options

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## Understanding your vision

Vision is a result of the interaction between different parts of the eye and the brain. With a healthy vision, the light entering the eye is refracted by the cornea at the surface of the eye and by the natural eye lens (called crystalline lens) inside the eye. The light rays passing through the lens focus directly in one point on the back of the eye, called the retina. Here they produce a focused image with the help of photoreceptors and the brain.

Click for explanations of refractive disorders:

[Normal vision](#)

[Myopia](#)

[Hyperopia](#)

[Astigmatism](#)

[Presbyopia](#)



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### Normal vision:

If the shape of the cornea and the proportions of the eye are in balance, the light passing through the eye is focused directly on the retina forming a clear image.



Modern eye tests can accurately diagnose the exact curvature of your cornea, and Laser Vision Correction options are now available for almost every type of cornea shape.

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With normal vision (emmetropia) the objects at each distance can be seen sharp.



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### Myopia:

Myopia, or nearsightedness, can be caused by a disproportion between the curvature of the cornea and the length of the eye (the eye is too long) causing light rays to focus in front of the retina instead of on the retina. This causes distant objects, such as street signs to appear blurry. Near vision activities such as reading a book or writing text messages on your smartphone can be still performed without glasses or contact lenses.



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With nearsightedness the objects up close are sharp, whereas the objects at a distance appear blurry.

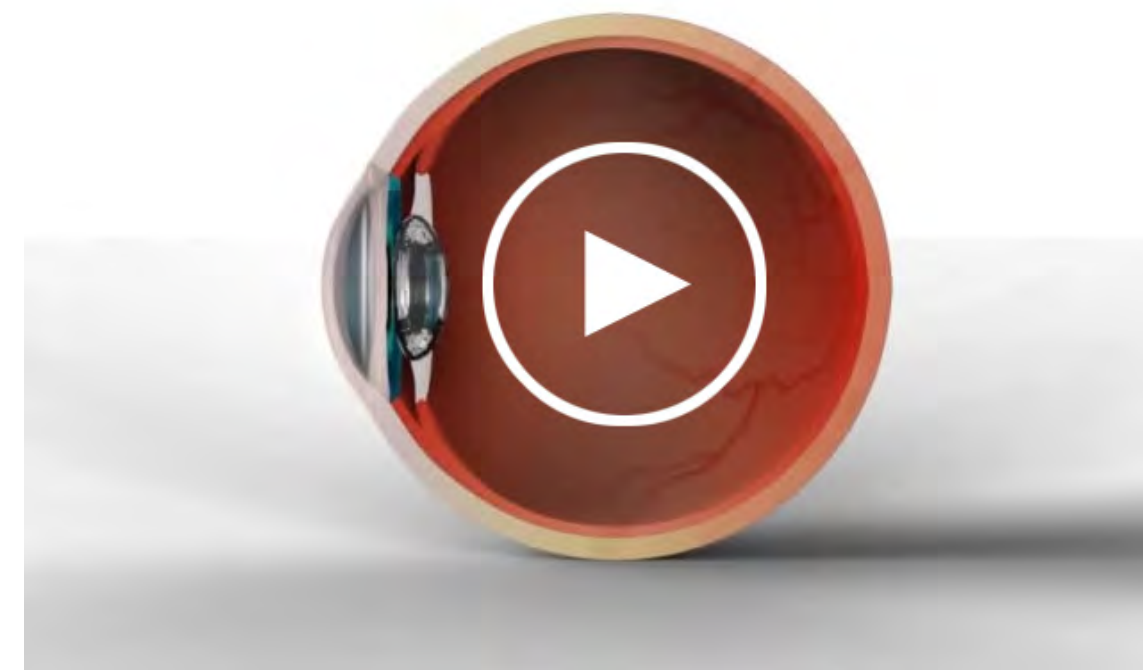


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### Hyperopia:

Hyperopia, or farsightedness, can be caused by a disproportion between the curvature of the cornea and the length of the eye (the eye is too short) causing light rays to focus behind the retina instead of on the retina. This causes near vision objects, such as package inserts or text messages, to appear blurry. Distant vision tasks can be still performed without glasses or contact lenses.



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With farsightedness the distant objects are sharp, whereas the objects up close can appear blurry.



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### Astigmatism:

Astigmatism occurs when the cornea has an irregular shape and resembles more a rugby ball than a basketball. The light rays passing through the eye focus in multiple points on the retina, instead of in one single point. This causes different variations of distorted, hazy vision for near and far distance. Almost all people have some degree of astigmatism. The condition appears often in combination with myopia or hyperopia.



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With astigmatism, the irregular shape of the cornea causes a distorted and blurry vision at any distance.

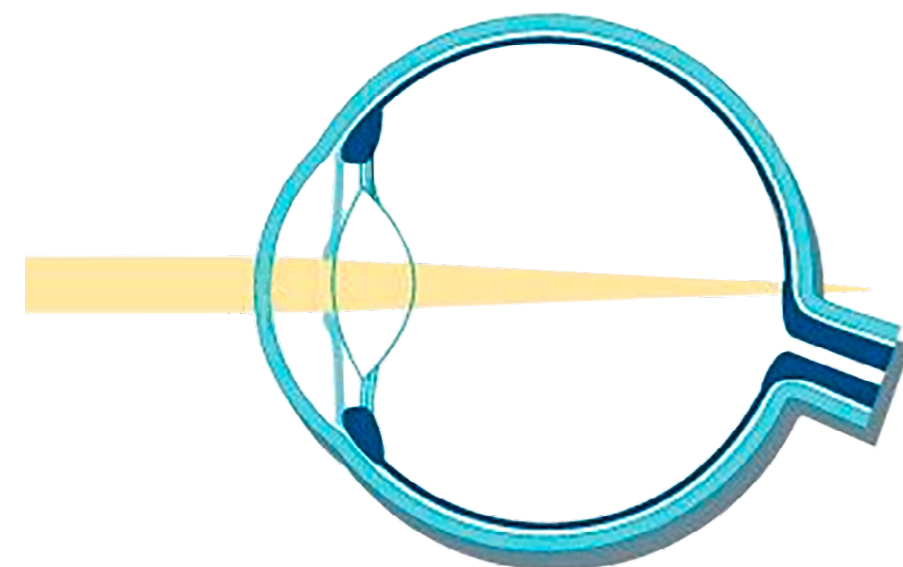


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### Presbyopia:

Through the increasing inflexibility of the lens and other biochemical changes within the eye, the light rays from close objects cannot be focused on the focal point of the retina. As a result, objects at a short distance appear out of focus.



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## What is Laser Vision Correction?

Laser Vision Correction refers to eye treatments using a laser to reshape the corneal curvature of an eye to correct refractive errors, such as myopia or astigmatism.

Click to compare:

PRK

LASIK

SMILE



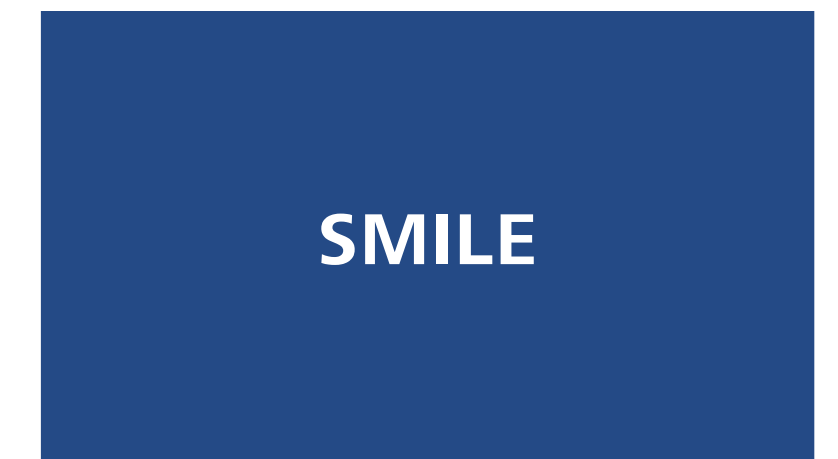




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Click to compare:



### Photorefractive keratectomy

In this procedure, the epithelium of the cornea is gently removed. Then, an excimer laser is used to reshape the underlying corneal area. The result is a cornea shape that more accurately focuses light on the retina.



## What is Laser Vision Correction?

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Click to compare:



### Laser-assisted in situ keratomileusis

In the LASIK procedure a precise flap is created on the cornea. Then the flap is lifted and the excimer laser is used to reshape the underlying corneal area. The flap is then repositioned back. The result is a corneal shape that more accurately focuses light on the retina.

Today, doctors are able to create the LASIK flap in two ways. The first method uses a handheld surgical device called a microkeratome, the second a highly precise femtosecond laser.





## What is Laser Vision Correction?

Laser Vision Correction refers to eye treatments using a laser to reshape the corneal curvature of an eye to correct refractive errors, such as myopia or astigmatism.

Click to compare:

[PRK](#)[LASIK](#)[SMILE](#)

### Small incision lenticule extraction

SMILE supports the latest developments in Laser Vision Correction for myopia (nearsightedness) with or without astigmatism, providing well-proven visual outcomes in a minimally invasive procedure. In this procedure, the femtosecond laser is used to create a lenticule – a thin, contact lens-shaped layer just beneath the surface of the eye – and then a small opening through which that layer is removed, correcting your vision.



## Your treatment options

Every Laser Vision Correction treatment aims to create better vision by help of different methods. Each one also has a different impact on the eye, including possible dry eye symptoms, recovery time, structural integrity and risks of infection or inflammation. Seeing how each treatment works can help you understand the benefits and risks of each option.

**Click to compare:**

PRK

LASIK

SMILE





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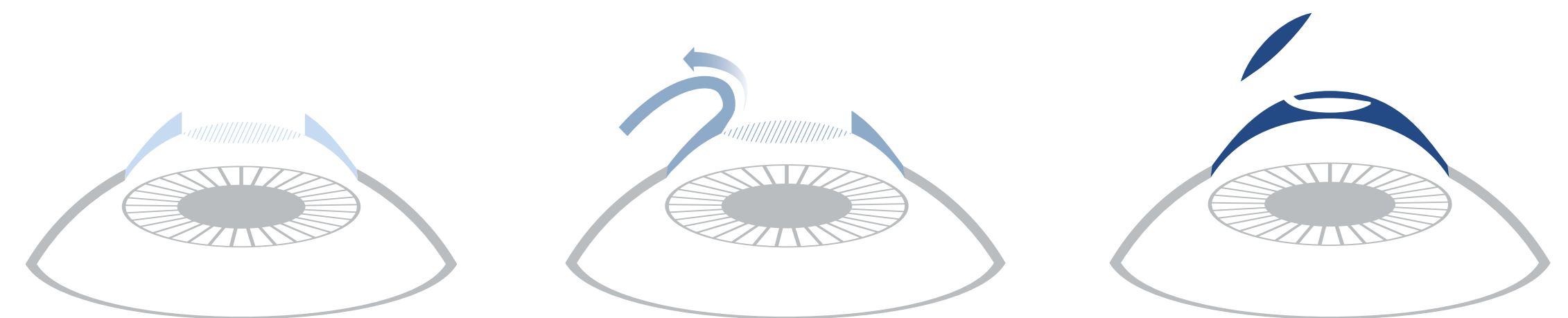
LASIK

SMILE

Because PRK gently removes the top surface of the cornea, a bandage contact lens is placed over the eye until the epithelium grows back. Patients often experience discomfort during their recovery period while the cornea heals. This is temporary and does not affect long-term visual results.

LASIK patients may experience transient dry eye syndrome after treatment due to the size, shape and location of the flap. However, LASIK patients often experience less discomfort than PRK patients during their recovery period.

Because SMILE does not involve removing the surface of the cornea or creating a flap, discomfort and dry eye symptoms may be reduced compared with LASIK and PRK.





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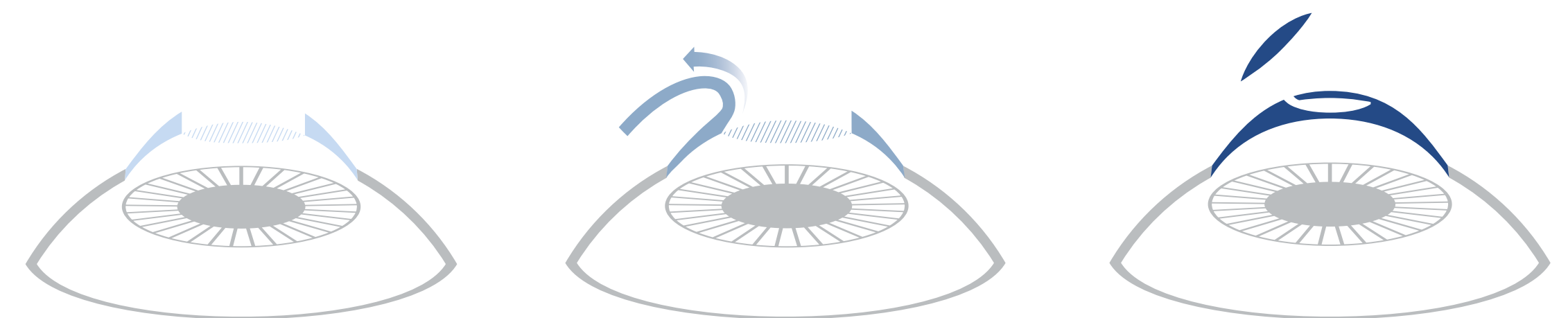
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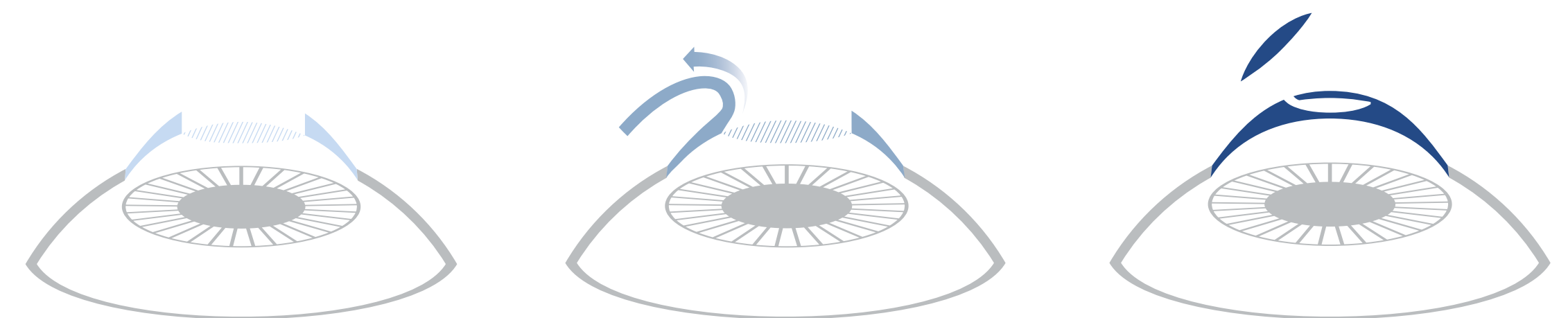
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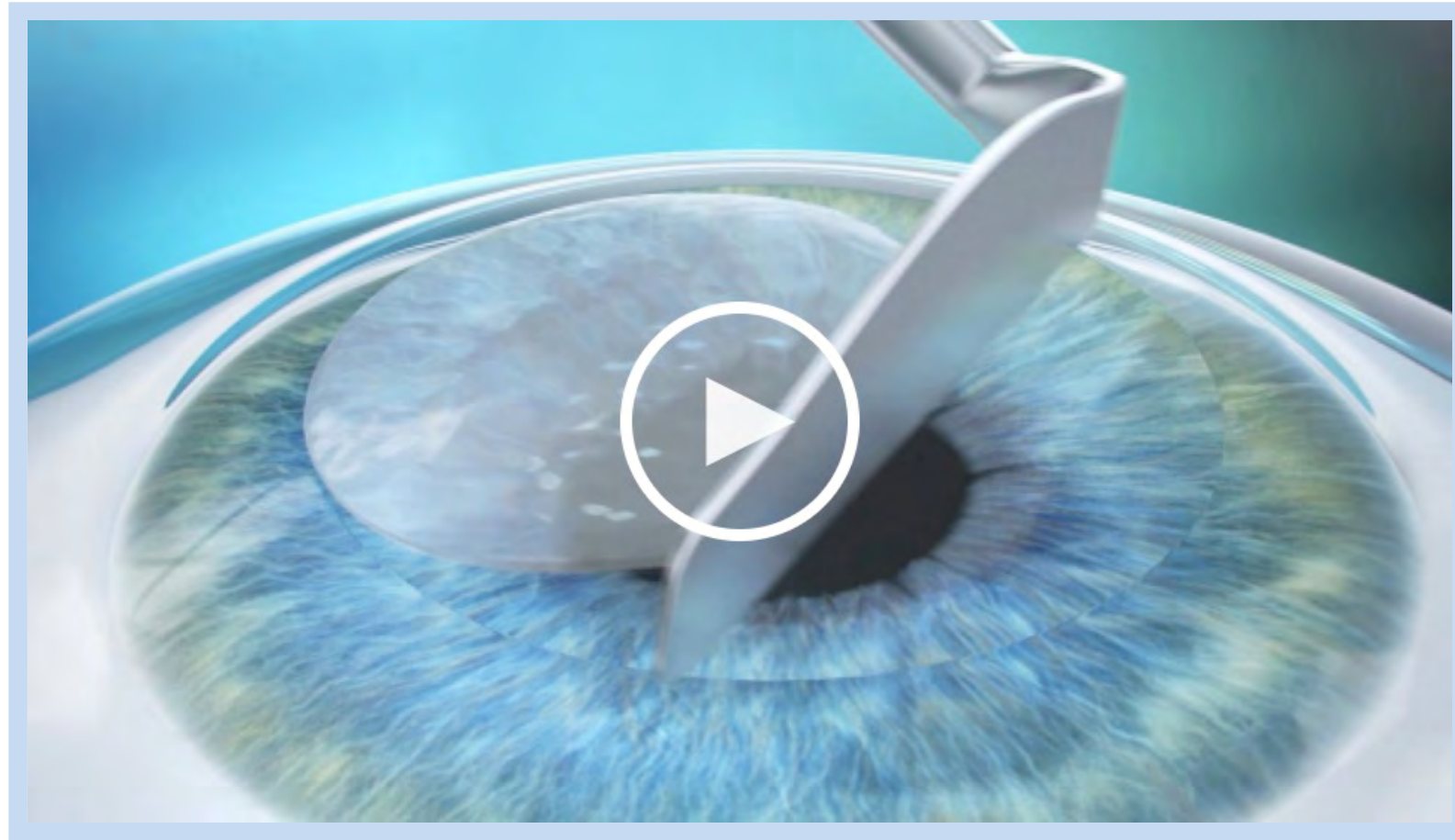


		PRK	LASIK	SMILE
<b>Correction</b>	Myopia (nearsightedness)	✓	✓	✓
	Astigmatism	✓	✓	✓
	Hyperopia (farsightedness)	✓	✓	✗
<b>Technology</b>	Lasers used	Excimer laser	Excimer and femtosecond laser	Femtosecond laser
<b>Safety</b>	Safety of the procedure	Very good	Very good	Very good
	Risk of traumatic corneal flap dislocation	None	Some	None
<b>Procedure comfort</b>	Odor during procedure	Some	Some	None
	Sound of laser	Loud	Loud	Almost none
	Impact on corneal surface	High	Relatively high (incision of 20 mm)	Low (small incision of 4 mm)
	Pain during procedure	Virtually painless	Virtually painless	Virtually painless
	Pain post procedure	Fair <sup>1</sup>	Almost none <sup>6</sup>	Almost none
<b>Recovery</b>	Speed of vision recovery	Relatively slow <sup>2, 3</sup>	Very fast <sup>7, 8</sup>	Fast <sup>11-14</sup>
	Risk of post-operative dry eye syndrom	Some <sup>4, 5</sup>	Some <sup>9, 10</sup>	Low <sup>15-17</sup>





## Treatment procedures



**PRK**  
Watch an animated walk-through of the PRK procedure.



**LASIK**  
Watch an animated walk-through of the LASIK procedure.



**SMILE**  
Watch an animated walk-through of the procedure with SMILE.

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## SMILE by the numbers

# No.1

In some countries, Lenticule Extraction with SMILE is on the way to become the most preferred Laser Vision Correction method

# 10

SMILE is successfully in the market for more than ten years

# Millions

Millions of treated eyes worldwide with SMILE

# 2,500

There are more than 2,500 practicing surgeons

# 80

SMILE is available in more than 80 countries

# 175

175 years of optic excellence from ZEISS, the creators of SMILE

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## Your questions about SMILE, answered

Click on the questions below for answers to the most frequently asked questions about SMILE.

Which one is better,  
SMILE or LASIK?

Does SMILE cost more  
than LASIK?

Will SMILE hurt?

How soon will I be able to  
return to work after SMILE?

Why haven't I heard of  
SMILE before?

Why don't more practices  
offer SMILE?

Is SMILE safe?

How many procedures have  
been performed?

Is it FDA-approved?

How long will my treatment  
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Can SMILE correct  
my astigmatism?

Will I require glasses  
after SMILE?



## Your questions about SMILE, answered

### Which one is better, SMILE or LASIK?

This is one of the most common questions we hear, and many patients want to know which treatment is “better.” The fact is that both LASIK and SMILE are proven and consistent, so most patients will be very happy with either option. Generally speaking, SMILE is the less invasive Laser Vision Correction option and has a small risk of post-surgical infection or transient dry eye syndrome. LASIK offers a slightly quicker post-procedure visual recovery time. Based on the refractive error, eye conditions and anatomy, your surgeon can recommend the right treatment for you!

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**Can SMILE correct  
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**Will I require glasses  
after SMILE?**



## Your questions about SMILE, answered

### Does SMILE cost more than LASIK?

SMILE and LASIK use different laser technologies to restore the clarity of your vision so the costs of the two options may differ and are handled by each clinic individually.

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## Your questions about SMILE, answered

### Will SMILE hurt?

SMILE is a gentle vision correction solution. Patients consistently tell us it was very comfortable. Some patients do say they feel a tiny amount of pressure but no pain around their eye for a few seconds during the treatment, but are quick to clarify that it generally didn't hurt.

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## Your questions about SMILE, answered

### How soon will I be able to return to work after SMILE?

Patients often return to most of their daily activities, including going back to work, the day after their treatment with SMILE. While LASIK patients are asked to avoid wearing makeup for one to two days after their LASIK procedure, SMILE patients can begin wearing makeup the next day. Patients can generally resume all daily activities four to seven days after their treatment.

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## Your questions about SMILE, answered

### Why haven't I heard of SMILE before?

Since SMILE was launched in 2011, it has been continuously growing with now more than 2,000 doctors performing the treatment with SMILE around the world. Furthermore, SMILE was officially approved by the FDA in 2016. Millions of eyes have benefited from this minimally invasive procedure with SMILE.

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## Your questions about SMILE, answered

### Why don't more practices offer SMILE?

To offer SMILE, clinics have to invest into expensive new laser technology. Not all clinics have the funds available immediately to make this investment. Currently, about 20% of all laser centers around the world have made this investment.

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## Your questions about SMILE, answered

### Is SMILE safe?

SMILE enables the proven and minimally invasive Laser Vision Correction procedure that has created better vision for millions of patients. As with any surgical treatment, there are possible risks and side effects. After a thorough eye exam and consultation, your surgeon will discuss your options with you and help you make the right decision for your vision.

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## Your questions about SMILE, answered

### How many procedures have been performed?

SMILE is the fastest-growing Laser Vision Correction option in the world. Worldwide, millions of eyes have been treated with SMILE by more than 2,500 surgeons.

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## Your questions about SMILE, answered

### Is it FDA-approved?

Yes. The FDA approved SMILE for the United States in September 2016 after trials and testing showed it to be a consistent, effective way to improve vision and to reduce dependence on glasses and contact lenses.

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## Your questions about SMILE, answered

### [How long will my treatment with SMILE last?](#)

Your treatment with SMILE is permanent, but as with every part of your body, your eyes will continue to age and your vision will be affected as you get older. SMILE cannot prevent cataracts and presbyopia, but most SMILE patients enjoy years of spectacle independence.

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### Can SMILE correct my astigmatism?

It is approved for astigmatism correction of up (or down) to -5 dpt.

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## Your questions about SMILE, answered

### [Will I require glasses after SMILE?](#)

Most patients who receive SMILE tell us that they use their glasses and contact lenses very little, or not at all! The goal of SMILE is to reduce or eliminate your dependence on glasses. Based on the anatomy of your eye, your surgeon will be able to tell you more about the results you can expect from SMILE.

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## Financing

Consider the yearly and long-term costs of your glasses and contact lenses when thinking about investing in Laser Vision Correction. Long-term Laser Vision Correction may actually save you money, as well as provide you with many other lifestyle benefits with little to no need for glasses and contact lenses.

Ask your doctor to help you understand all your vision correction options and if Laser Vision Correction could be right for you.

### Glasses, contact lenses and Laser Vision Correction at a glance:

	Glasses	Contact lenses	Laser Vision Correction
<b>Initial costs</b>	Moderate	Low	High, but varies
<b>Recurring costs</b>	\$\$\$\$	\$\$\$\$	\$
<b>Extra costs</b>	<ul style="list-style-type: none"> <li>■ Eye exams (prescription change is the same)</li> <li>■ Change of frame</li> <li>■ Broken frame</li> <li>■ Broken lens</li> </ul>	<ul style="list-style-type: none"> <li>■ Eye exams</li> <li>■ Replacement of contact lens</li> <li>■ Lost lenses</li> <li>■ Eye infection</li> <li>■ Contact lens solution</li> </ul>	<ul style="list-style-type: none"> <li>■ LVC eye exam</li> <li>■ Eyedrops</li> </ul>





## PRK clinical evidence

### Comparatively painful

#### <sup>1</sup> Management of Post-PRK Pain

*Survey of Ophthalmology 2013 Nov. Woreta FA1, Gupta A, Hochstetler B, Bower KS.*

### Delayed visual recovery

#### <sup>2</sup> Randomized Bilateral Comparison of LASIK and PRK for 2.50 to 8.00 diopters of Myopia

*Ophthalmology 1999 Mar. El-Maghraby A, Salah T, Waring GO 3rd, Klyce S, Ibrahim O.*

#### <sup>3</sup> Myopia Correction with Trans-PRK versus Fs-LASIK: One-Year Case-Matched Analysis

*Journal of Cataract Refractive Surgery 2016 Nov. Luger MH, Ewering T, Arba-Mosquera S.*

### Risk of dry eyes

#### <sup>4</sup> Comparison of Tear Secretion and Tear Film Instability after Photorefractive Keratectomy and Laser in situ Keratomileusis

*Journal of Cataract Refractive Surgery 2004 Sep. Lee JB, Ryu CH, Kim J, Kim EK, Kim HB.*

#### <sup>5</sup> Symptoms of Dry Eye and Recurrent Erosion Syndrome after Refractive Surgery

*Journal of Cataract Refractive Surgery 2001 Apr. Hovanesian JA, Shah SS, Maloney RK.*



## LASIK clinical evidence

### Almost no pain

- <sup>6</sup> **Comparison of Photorefractive Keratectomy with Excimer Laser in situ Keratomileusis in Correcting Low Myopia (from -2.00 to -5.50 diopters). A Randomized Study**

*Ophthalmology* 1999 Feb. el Danasoury MA, el Maghraby A, Klyce SD, Mehrez K.

### Faster visual recovery

- <sup>7</sup> **Myopia Correction with Transepithelial Photorefractive Keratectomy versus Femtosecond-Assisted Laser in situ Keratomileusis: One-Year Case-Matched Analysis**

*JCRS* 2016 Nov. Luger MHA, Arba-Mosquera S.

- <sup>8</sup> **Comparison of Photorefractive Keratectomy with Excimer Laser in situ Keratomileusis in Correcting Low Myopia (from -2.00 to -5.50 diopters). A Randomized Study.**

*Ophthalmology* 1999 Feb. el Danasoury MA, el Maghraby A, Klyce SD, Mehrez K.

### Risk of dry eyes

- <sup>9</sup> **Dry Eye after Lasik for Myopia: Incidence and Risk Factors**

*European Journal of Ophthalmology* 2007 Jan-Feb. Shoja MR, Besharati MR.

- <sup>10</sup> **The Incidence and Risk Factors for Developing Dry Eye after Myopic LASIK**

*American Journal of Ophthalmology* 2006 Mar. De Paiva CS, Chen Z, Koch DD, Hamill MB, Manuel FK, Hassan SS, Wilhelmus KR, Pflugfelder SC.



## SMILE clinical evidence

### Faster overall recovery

**<sup>11</sup> Comparison of the Optical Quality between Small Incision Lenticule Extraction and Femtosecond Laser LASIK**

*Journal of Ophthalmology* 2016 Nov. Ying Jin, Yan Wang, Lulu Xu, Tong Zuo, Hua Li, Rui Dou, Jiamei Zhang.

**<sup>12</sup> Efficacy, Predictability, and Safety of Small Incision Lenticule Extraction (SMILE)**

*Eye and Vision* 2015. Chansue E, Tanehsakdi M, Swasdibutra S, McAlinden C.

**<sup>13</sup> Comparison of Visual and Refractive Outcomes Following Femtosecond Laser-Assisted LASIK with SMILE in Patients with Myopia or Myopic Astigmatism**

*Journal of Refractive Surgery* 2014 Sep. Ganesh S, Gupta R.

**<sup>14</sup> Dry Eye and Corneal Sensitivity after Small Incision Lenticule Extraction and Femtosecond Laser-Assisted in situ Keratomileusis: a Meta-Analysis**

*International Journal of Ophthalmology* 2017. Wen-Ting Cai, Qing-Yu Liu, Cheng-Da Ren, Qing-Quan Wei, Jun-Ling Liu, Qian-Yi Wang.

### Lesser dry eyes incidence

**<sup>15</sup> Corneal Sensitivity after Small-Incision Lenticule Extraction and Laser in situ Keratomileusis.**

*Journal of Cataract Refract Surgery* 2015 Aug. Reinstein DZ, Archer TJ, Gobbe M, Bartoli E.

**<sup>16</sup> Dry Eye Disease after Refractive Surgery: Comparative Outcomes of Small Incision Lenticule Extraction versus LASIK.**

*Ophthalmology* 2015 Apr. Denoyer A, Landman E, Trinh L, Faure JF, Auclin F, Baudouin C.

**<sup>17</sup> Dry Eye After Small Incision Lenticule Extraction and Femtosecond Laser-Assisted LASIK: Meta-Analysis.**

*Cornea* 2017 Jan. Kobashi H, Kamiya K, Shimizu K.



Seeing beyond