Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular
- Pseudophakic
- Phakic IOL
  - Iris-fixated
  - Sulcus-fixated

Corneal
- Incisional
  - RK
  - AK
  - LRI
- Laser
  - PRK
  - LASEK
  - Epi-LASIK
  - LASIK
  - SMILE
- Other
  - ?
  - ?
  - ?
  - ?
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular
- Pseudophakic
  - Refractive lens exchange (RLE)
- Phakic IOL
  - Iris-fixated
  - Sulcus-fixated

Corneal
- Incisional
  - RK
  - AK
  - LRI
- Laser
  - PRK
  - LASEK
  - Epi-LASIK
  - LASIK
  - SMILE

Other
- CK
- SAI
- CRI
- CXL
- ICRS
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

Pseudophakic
  - Refractive lens exchange (RLE)

Phakic IOL
  - Iris-fixated
  - Sulcus-fixated

Incisional
  - RK
  - AK
  - LRI

Corneal

Laser
  - PRK
  - LASEK
  - Epi-LASIK
  - LASIK
  - SMILE

Other
  - CK?
  - SAI
  - CRI
  - CXL
  - ICRS

What does CK stand for?
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

- Pseudophakic
  - Refractive lens exchange (RLE)
- Phakic IOL
  - Iris-fixated
  - Sulcus-fixated

Corneal

Incisional

- RK
- AK
- LRI

Laser

- PRK
- LASEK
- Epi-LASIK
- LASIK
- SMILE

Other

- CK
- SAI
- CRI
- CXL
- ICRS

What does CK stand for? Conductive Keratoplasty
What does **CK** stand for?  
Conductive Keratoplasty

What does **SAI** stand for?
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular
- Pseudophakic
  - Refractive lens exchange (RLE)
- Phakic IOL
  - Iris-fixated
  - Sulcus-fixated

Corneal
- Incisional
  - RK
  - AK
  - LRI
- Laser
  - PRK
  - LASEK
  - Epi-LASIK
  - LASIK
  - SMILE

Other
- CK
- SAI
- CRI
- CXL
- ICRS

What does CK stand for?
Conductive Keratoplasty

What does SAI stand for?
Small Aperture Inlay
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular
- Pseudophakic
  - Refractive lens exchange (RLE)
- Phakic IOL
  - Iris-fixated
  - Sulcus-fixated

Corneal
- Incisional
  - RK
  - AK
  - LRI
- Laser
  - PRK
  - LASEK
  - Epi-LASIK
  - LASIK
  - SMILE
- Other
  - CK
  - SAI
  - CRI
  - CXL
  - ICRS

What does **CK** stand for? Conductive Keratoplasty

What does **SAI** stand for? Small Aperture Inlay

What does **CRI** stand for?
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular
- Pseudophakic
  - Refractive lens exchange (RLE)
- Phakic IOL
  - Iris-fixated
  - Sulcus-fixated

Corneal
- Incisional
  - RK
  - AK
  - LRI
- Laser
  - PRK
  - LASEK
  - Epi-LASIK
  - LASIK
  - SMILE
- Other
  - CK
  - SAI
  - CRI
  - CXL
  - ICRS

What does CK stand for? Conductive Keratoplasty

What does SAI stand for? Small Aperture Inlay

What does CRI stand for? Corneal Reshaping Inlay
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

**Refractive Surgery**

- **Intraocular**
  - Pseudophakic
    - Refractive lens exchange (RLE)
  - Phakic IOL
    - Iris-fixated
    - Sulcus-fixated

- **Corneal**
  - Incisional
    - RK
    - AK
    - LRI
  - Laser
    - PRK
    - LASEK
    - Epi-LASIK
    - LASIK
    - SMILE
  - Other
    - CK
    - SAI
    - CRI
    - CXL
    - ICRS

**What does CK stand for?**
Conductive Keratoplasty

**What does CXL stand for?**
Corneal Reshaping Inlay

**What does SAI stand for?**
Small Aperture Inlay
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular
- Pseudophakic
  - Refractive lens exchange (RLE)
- Phakic IOL
  - Iris-fixated
  - Sulcus-fixated

Corneal
- Incisional
  - RK
  - AK
  - LRI
- Laser
  - PRK
  - LASEK
  - Epi-LASIK
  - LASIK
  - SMILE
- Other
  - CK
  - SAI
  - CRI
  - CXL
  - ICRS

What does **CK** stand for?
Conductive Keratoplasty

What does **CXL** stand for?
Corneal CROSS Linking

What does **CRI** stand for?
Corneal Reshaping Inlay

What does **SAI** stand for?
Small Aperture Inlay
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

Pseudophakic

Refractive lens exchange (RLE)

Phakic IOL

Iris-fixated

Sulcus-fixated

Corneal

Incisional

RK

AK

LRI

Laser

PRK

LASEK

Epi-LASIK

LASIK

SMILE

Other

ICRS?

What does CK stand for?
Conductive Keratoplasty

What does CXL stand for?
Corneal CROSS Linking

What does CRI stand for?
Corneal Reshaping Inlay

What does SAI stand for?
Small Aperture Inlay

What does ICRS stand for?
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

- Pseudophakic
  - Refractive lens exchange (RLE)
- Phakic IOL
  - Iris-fixated
  - Sulcus-fixated

Corneal

Incisional

- RK
- AK
- LRI

Laser

- PRK
- LASEK
- Epi-LASIK
- LASIK
- SMILE

Other

- CK
- SAI
- CRI
- CXL
- ICRS

What does CK stand for? Conductive Keratoplasty

What does CXL stand for? Corneal CROSS Linking

What does CRI stand for? Corneal Reshaping Inlay

What does SAI stand for? Small Aperture Inlay

What does ICRS stand for? Intrastromal Corneal Ring Segments
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Corneal

RK

PPK

Other

CK

SAI

CRI

CXL

ICRS

CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

- Pseudophakic
- Phakic IOL
  - Refractive lens exchange (RK)

Corneal

- Incisional
- Laser
  - RK

Other

- CK
- SAI
- CRI
- CXL
- ICRS

CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?

CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are primarily used to treat keratoconus.
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

- Pseudophakic
  - Refractive lens exchange (RLE)

- Phakic IOL

Corneal

- Incisional
  - RK

- Laser
  - PRK
  - LASIK
  - SMILE

Other

- CK
- SAI
- CRI
- CXL
- ICRS

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Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Corneal

LRI

RK

PPK

Other

CK

SAI

CRI

CXL

CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities? CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are primarily used to treat keratoconus.

How is CK performed?

A thin probe is inserted into the corneal stroma, and energy (in the form of radiofrequency) is run through the probe's tip. This energy heats the adjacent stromal tissue, resulting in collagen shrinkage.

How does collagen shrinkage treat presbyopia? Each area of shrinkage causes localized flattening of the cornea. By placing a number of such spots in a ring (more than one ring may be needed) in the corneal periphery, the peripheral cornea flattens, which in turn produces central corneal steepening. The resulting myopic shift allows the pt to see at near without spectacles.
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CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?
CK, SAI and CRI are used to treat **presbyopia**, whereas CXL and ICRS are primarily used to treat **keratoconus**.
**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

**Refractive Surgery**

- Intraocular
  - Pseudophakic
  - Phakic IOL
  - Refractive lens exchange (RLE)

- Corneal
  - Incisional
    - RK
  - Laser
    - PRK
    - LASIK
    - LASEK
    - SMILE
    - Epi-LASIK
  - Other
    - CK
    - SAI
    - CRI
    - ICRS
    - CXL

How is CK performed?
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**CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?**

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**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

Refractive Surgery

- Intraocular
  - Pseudophakic
  - Phakic IOL

- Corneal
  - Incisional
    - RK
  - Laser
    - PRK
    - LASEK
    - LASIK
    - SMILE
    - Epi-LASIK
  - Other
    - Iris-fixated
    - ICRS
    - Collagen Shrinkage
    - Cross-linking
    - RK
    - AK
    - LRI

**CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?**

**CK, SAI and CRI are used to treat **presbyopia**, whereas CXL and ICRS are primarily used to treat keratoconus.**

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**Is CK typically performed unilaterally, or bilaterally?**
Unilaterally

**Is it usually performed on the dominant, or nondominant eye?**
Nondominant

**How much myopic shift are we talking about here?**
Usually 1-2D
**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

**Refractive Surgery**
- **Intraocular**
  - Pseudophakic
  - Phakic IOL
- **Corneal**
  - Incisional
  - Laser
- **Other**
  - CK, SAI, CRI
  - CXL, ICRS

**How is CK performed?**
A thin probe is inserted into the corneal stroma, and energy (in the form of radiofrequency) is run through the probe’s tip. This energy heats the adjacent stromal tissue, resulting in collagen shrinkage.

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Each area of shrinkage causes localized flattening of the cornea. By placing a number of such spots in a ring (more than one ring may be needed) in the corneal periphery, the peripheral cornea flattens, which in turn produces central corneal steepening. The resulting myopic shift allows the pt to see at near without spectacles.

**CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?**
**CK, SAI and CRI** are used to treat **presbyopia**, whereas **CXL** and **ICRS** are primarily used to treat **keratoconus**.

**Is CK typically performed unilaterally, or bilaterally?**
Unilaterally

**Is CK typically performed unilaterally, or bilaterally?**
Unilaterally
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Is it usually performed on the dominant, or nondominant eye?
Nondominant

CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?

CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are primarily used to treat keratoconus.

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Unilaterally

Is it usually performed on the dominant, or nondominant eye?
Nondominant

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CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?
CK, SAI and CRI are used to treat **presbyopia**, whereas CXL and ICRS are primarily used to treat keratoconus.

Is CK typically performed unilaterally, or bilaterally?
Unilaterally

Is it usually performed on the dominant, or nondominant eye?
Nondominant
**Refractive Surgery**

- **Intraocular**
  - Pseudophakic
  - Phakic IOL

- **Corneal**
  - Incisional
    - RK
  - Laser
    - PRK
    - LASEK
    - LASIK
    - SMILE
    - Epi-LASIK

- **Other**
  - Iris-fixated
  - Intraocular
  - Pseudophakic
  - Phakic IOL
  - Refractive lens exchange (RLE)
  - Sulcus-fixated
  - Refractive lens exchange (RLE)

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**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

- **CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?**
  - CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are primarily used to treat keratoconus.

- **Is CK typically performed unilaterally, or bilaterally?**
  - Unilaterally

- **Is it usually performed on the dominant, or nondominant eye?**
  - Nondominant

- **How much myopic shift are we talking about here?**
  - Usually 1-2D

---

**How is CK performed?**

A thin probe is inserted into the corneal stroma, and energy (in the form of radiofrequency) is run through the probe’s tip. This energy heats the adjacent stromal tissue, resulting in collagen shrinkage.

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Each area of shrinkage causes localized flattening of the cornea. By placing a number of such spots in a ring (more than one ring may be needed) in the corneal periphery, the peripheral cornea flattens, which in turn produces central corneal steepening. The resulting myopic shift allows the pt to see at near without spectacles.
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular
- Pseudophakic
- Phakic IOL

Corneal
- Incisional
- Laser
- Other
  - RK
  - PK

Other
- CK
- SAI
- CRI
- CXL

CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?

**CK, SAI and CRI are used to treat presbyopia**, whereas CXL and ICRS are primarily used to treat keratoconus.

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Unilaterally

Is it usually performed on the dominant, or nondominant eye?
Nondominant

How much myopic shift are we talking about here?
Usually 1-2D
**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

**Refractive Surgery**

- **Corneal Incisional Laser**
  - PRK
  - LASEK

**Iris-fixated**

- Intraocular Pseudophakic
- Phakic IOL

**Sulcus-fixated**

- Refractive lens exchange (RLE)
- LASIK
- SMILE
- Epi-LASIK

**Other**

- Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery
- CK
- SAI
- CRI
- CXL
- ICRS

**How is CK performed?**

A thin probe is inserted into the corneal stroma, and energy (in the form of radiofrequency) is run through the probe's tip. This energy heats the adjacent stromal tissue, resulting in collagen shrinkage.

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Each area of shrinkage causes localized flattening of the cornea. By placing a number of such spots in a ring (more than one ring may be needed) in the corneal periphery, the peripheral cornea flattens, which in turn produces central corneal steepening. The resulting myopic shift allows the pt to see at near without spectacles.

**Is CK typically performed unilaterally, or bilaterally?**

Unilaterally

**Is it usually performed on the dominant, or nondominant eye?**

Nondominant

**How much myopic shift are we talking about here?**

Usually 1-2D

**Is CK a safe procedure?**

Yes. Serious complications are rare.

**What is the biggest drawback to CK?**

Regression. Long-term studies indicate that a significant proportion of eyes will lose much (if not all) of the treatment effect over time.
Refractive Surgery

Corneal

Is CK a safe procedure?
Yes. Serious complications are rare.

How is CK performed?
A thin probe is inserted into the corneal stroma, and energy (in the form of radiofrequency) is run through the probe's tip. This energy heats the adjacent stromal tissue, resulting in collagen shrinkage.

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CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are primarily used to treat keratoconus.

Is CK typically performed unilaterally, or bilaterally?
Unilaterally

Is it usually performed on the dominant, or nondominant eye?
Nondominant

How much myopic shift are we talking about here?
Usually 1-2D

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Yes. Serious complications are rare.

What are these respective commonalities?
CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are primarily used to treat keratoconus.

Other

Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery
Refractive Surgery

Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Is CK a safe procedure?
Yes. Serious complications are rare.

What is the biggest drawback to CK?
Regression

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Unilaterally

Is it usually performed on the dominant, or nondominant eye?
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Usually 1-2D

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Usually 1-2D

Is it usually performed on the dominant, or nondominant eye?
Nondominant

How much myopic shift are we talking about here?
Usually 1-2D
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

- PRK
- LASEK
- RK
- AK
- LRI
- LASIK
- SMILE
- Epi-LASIK
- Other

Is CK a safe procedure? Yes. Serious complications are rare.

What is the biggest drawback to CK? Regression. Long-term studies indicate that a significant proportion of eyes will lose much (if not all) of the treatment effect over time.

What are these respective commonalities? CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are primarily used to treat keratoconus.

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What are these respective commonalities? CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are primarily used to treat keratoconus.

Is CK typically performed unilaterally, or bilaterally? Unilaterally

Is it usually performed on the dominant, or nondominant eye? Nondominant

How much myopic shift are we talking about here? Usually 1-2D

Is CK a safe procedure? Yes. Serious complications are rare.

What is the biggest drawback to CK? Regression. Long-term studies indicate that a significant proportion of eyes will lose much (if not all) of the treatment effect over time.
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?

CK, **SAI** and CRI are used to treat **presbyopia**, whereas CXL and ICRS are primarily used to treat **keratoconus**.

**How is SAI performed?**

A femtosecond laser is used to create a pocket in the central cornea at a depth of about 200 μm. The SAI is then placed in the pocket, making sure that its aperture is centered on the line of sight.

**How does an SAI treat presbyopia?**

The central aperture of the inlay is only 1.6 mm; thus, it produces a 'pinhole effect.' This dramatically increases the depth-of-focus of the eye, thus allowing the eye to see at near with affecting distance vision.

As of this writing, only one SAI is FDA approved. What is the name of this device?

The KAMRA corneal inlay.
Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Corneal

Surgical

Other

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A femtosecond laser is used to create a flap or pocket in the central cornea at a depth of about 200 μm. The SAI is then placed under the flap/in the pocket, making sure that its aperture is centered on the line of sight.

What does the SAI look like?
Like an opaque ring with a central open aperture.
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Corneal

Incisional

Laser

Other

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Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

Corneal

Pseudophakic

Phakic IOL

Incisional

Laser

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The central aperture of the inlay is only 1.6 mm; thus, it produces a 'pinhole effect.' This dramatically increases the depth-of-focus of the eye, thus allowing the eye to see at near with affecting distance vision.

As of this writing, only one SAI is FDA approved. What is the name of this device? The KAMRA corneal inlay.
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

- Pseudophakic
- Phakic IOL

Corneal

- Incisional
  - RK
- Laser
  - PRK
  - LASEK
  - LASIK
  - RK
  - LRI

Other

- CK
- CRI
- CXL

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Refractive Surgery

Corneal

Intraocular

- Pseudophakic
- Phakic IOL

Corneal

- Incisional
- Laser
- Other

- RK
- PRK
- PK
- LASIK
- CXL
- SAI
- CRI
- ICRS

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**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

**Refractive Surgery**

- **Intraocular**
  - Pseudophakic
  - Phakic IOL
  - Incisional
    - RK
  - Laser
    - PRK
    - LASEK
    - LASIK
  - Other
    - CK
    - CRI
    - SAI
    - CXL

**Corneal**

- Refractive lens exchange (RLE)
- RK
- LRI
- LASIK

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**As of this writing, only one SAI is FDA approved. What is the name of this device?**
The KAMRA corneal inlay
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular
- Pseudophakic
- Phakic IOL
- Refractive lens exchange (CRS)

Corneal
- Incisional
- Laser
  - RK
  - PRK
  - LASEK
  - LASIK
  - RK
  - AK
  - LRI
- Other
  - LASIK
  - LASEK
  - RK
  - AK
  - LRI

Iris-fixated
- Intraocular
- Pseudophakic
- Phakic IOL
- Sulcus-fixated
- Refractive lens exchange (RLE)
- LASIK
- SMILE
- Epi-LASIK

SAI

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As of this writing, only one SAI is FDA approved. What is the name of this device?
The KAMRA corneal inlay
Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Corneal

RK

LASEK

PRK

Laser

Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

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The KAMRA corneal inlay
Refractive Surgery

Corneal

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Other

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Is SAI typically performed unilaterally, or bilaterally? Unilaterally

Is it usually performed on the dominant, or nondominant eye? Nondominant

How does an SAI treat presbyopia? The diameter of the central aperture is only 1.6 mm; thus, it produces a ‘pinhole effect.’ This dramatically increases the depth-of-focus of the eye, thus allowing the eye to see at near without affecting distance vision.

As of this writing, only one SAI is FDA approved. What is the name of this device? The KAMRA corneal inlay
**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

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**Refractive Surgery**

- Intraocular
  - Pseudophakic
  - Phakic IOL
  - Refractive lens exchange (CRK)
  - Incisional
    - RK
    - PK
  - Laser
    - PRK
    - LASIK
    - Epi-LASIK
  - Other
    - CK
    - CRI
    - CXL
    - ICRS

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**CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?**

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**Is SAI typically performed unilaterally, or bilaterally?**

Unilaterally

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**How does an SAI treat presbyopia?**

The diameter of the centrally aperture is only 1.6 mm; thus, it produces a ‘pinhole effect.’ This dramatically increases the depth-of-focus of the eye, thus allowing the eye to see at near without affecting distance vision.

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**As of this writing, only one SAI is FDA approved. What is the name of this device?**

The KAMRA corneal inlay
Refractive Surgery

Corneal

Incisional Laser

Iris-fixated

Intraocular

Pseudophakic

Phakic IOL

Incisional

RK

Laser

Sulcus-fixated

Refractive lens exchange (RLE)

LASIK

SMILE

Epi-LASIK

Other

CK

SAI

CRI

CXL

Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

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Is SAI typically performed unilaterally, or bilaterally? Unilaterally

Is it usually performed on the dominant, or nondominant eye? Nondominant

How much myopic shift are we talking about here? None.

As of this writing, only one SAI is FDA approved. What is the name of this device? The KAMRA corneal inlay
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Corneal

Other

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Refractive lens exchange (CK)

RK

CXL

SAI

CRI

LRI

Sulcus-fixated

Refractive lens exchange (RLE)

LASIK

PRK

LASEK

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How is SAI typically performed unilaterally, or bilaterally?
Unilaterally

Is it usually performed on the dominant, or nondominant eye?
Nondominant

How much myopic shift are we talking about here?
None. SAI do not change the refractive status of the eye!

As of this writing, only one SAI is FDA approved. What is the name of this device?
The KAMRA corneal inlay

CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?
CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are

Is SAI typically performed unilaterally, or bilaterally?
Unilaterally

Is it usually performed on the dominant, or nondominant eye?
Nondominant

How much myopic shift are we talking about here?
None. SAI do not change the refractive status of the eye!
How is SAI performed?

A femtosecond laser is used to create a flap or pocket in the central cornea at a depth of about 200 \( \mu \text{m} \). The SAI is then placed under the flap/in the pocket, making sure that its aperture is centered on the line of sight.

How thick is the KAMRA?

The KAMRA corneal inlay is about 6 microns thick.

How does an SAI treat presbyopia?

The diameter of the central aperture is only 1.6 mm; thus, it produces a ‘pinhole effect.’ This dramatically increases the depth-of-focus of the eye, allowing the eye to see at near with affecting distance vision.

As of this writing, only one SAI is FDA approved. What is the name of this device?

The KAMRA corneal inlay
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Corneal

Sulcus-fixated

Refractive lens exchange (RLE)

Other

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How thick is the KAMRA?

About 6 microns

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The KAMRA corneal inlay
How is SAI performed?

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How thick is the KAMRA?

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For comparison purposes: What is the diameter of a red blood cell?

About 6 microns

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As of this writing, only one SAI is FDA approved. What is the name of this device?
The KAMRA corneal inlay
Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Corneal

Laser

Other

LRI

RK

LASK

PPK

Refraction Surgery

Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?

CK, SAI and CRI are used to treat presbyopia, whereas CXL and ICRS are primarily used to treat keratoconus.

How is CRI performed?

A femtosecond laser is used to create a flap or pocket in the central cornea at a depth of about 150 μm. The CRI is then placed under the flap/in the pocket.

How does a CRI treat presbyopia?

The CRI is shaped like a tiny ‘flying saucer’—thin at the edges, thicker centrally. This shape causes the central cornea to bulge slightly, making it more prolate (and thereby causing a myopic shift centrally).

As of this writing, only one CRI is FDA approved. What is the name of this device?

The Raindrop Near Vision Inlay.
**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

**Refractive Surgery**

- **Corneal**
  - Pseudophakic
  - Phakic IOL
  - Incisional
  - Laser
  - Other
  - **CRI**

**Intraocular**

- Refractive lens exchange (RLE)

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**CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?**

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**How is CRI performed?**

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**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

Refractive Surgery

- Intraocular
  - Pseudophakic
  - Phakic IOL
- Corneal
  - Incisional
    - RK
  - Laser
    - RK
    - PRK
    - LASEK
    - LASIK
  - Other
    - CK
    - SAI
    - CRI
    - CXL

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**How does a CRI treat presbyopia?**
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular
- Pseudophakic
- Phakic IOL
- Refractive lens exchange (RLE)

Corneal
- Incisional
- Laser
- Other
  - CK
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  - CRI
  - CXL

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Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

RefRACTive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Corneal

CRI

CK

SAI

CXL

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Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

- Pseudophakic
- Phakic IOL

Corneal

- Incisional
  - RK
- Laser
  - PRK
  - LASEK
  - LASIK
  - SMILE
  - Epi-LASIK

Other

- CK
- SAI
- CRI
- CXL

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The Raindrop Near Vision Inlay (although as of this writing, the parent company has stopped production)
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

- Pseudophakic
- Phakic IOL

Corneal

- Incisional
- Laser
- Other

Laser

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Is CRI typically performed unilaterally, or bilaterally?

Unilaterally

Is it usually performed on the dominant, or nondominant eye?

Nondominant

As of this writing, only one CRI is FDA approved. What is the name of this device?

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As of this writing, only one CRI is FDA approved. **What is the name of this device?**

The Raindrop Near Vision Inlay (although as of this writing, the parent company has stopped production)

**Is CRI typically performed unilaterally, or bilaterally?**

Unilaterally
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Corneal

Other

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Is CRI typically performed unilaterally, or bilaterally? Unilaterally.

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As of this writing, only one CRI is FDA approved. What is the name of this device? The Raindrop Near Vision Inlay (although as of this writing, the parent company has stopped production).
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The Raindrop Near Vision Inlay (although as of this writing, the parent company has stopped production)
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Corneal

Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

How tiny is the Raindrop? What is its diameter?

How is CRI performed?
A femtosecond laser is used to create a flap or pocket in the central cornea at a depth of about 150 μm. The CRI is then placed under the flap/in the pocket.

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Refractive Surgery

Intraocular

Pseudophakic

Phakic IOL

Incisional

Laser

Corneal

Corneal Incisional Lasers

PRK

LASEK

RK

AK

LRI

Refractive lens exchange (RLE)

LASIK

SMILE

Epi-LASIK

Other

CK

SAI

CRI

CXL

ICRS

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2 mm

What is its thickness:

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10 microns

Centrally?

32 microns

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Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

Refractive Surgery

Intraocular

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Incisional

Laser

Corneal

Other

Sulcus-fixated

Refractive lens exchange (RLE)

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**Intraocular**
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  - Refractive lens exchange (CLE)

**Corneal**
- Phakic IOL
- Incisional
  - RK
- Laser
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**Other**
- CRI
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What is the dioptic power of the Raindrop inlay?

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Does the gradual peripheral-to-central thickening of the Raindrop inlay play a role in how it affects vision?
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Raindrop Corneal Inlay

- Refractive Power: None
- Optically clear hydrogel
- 77% water content
- Similar refractive index as the cornea (1.37)
- Glucose concentration: -2.5% in tissue anterior to the inlay to +0.6% in tissue just posterior to the inlay
- Oxygen concentration: +3.3% in tissue anterior to the inlay to -3.5% posterior to the inlay

32 μm center thickness

2 mm
Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

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How is it implanted?

In essence, like a multifocal CL/IOL. It is ring-shaped (ie, has a central aperture). This allows rays from distant objects to pass through unrefracted (by the device). The doughnut-shaped device itself consists of rings of increasing plus power, and these rings of added plus power produce the presbyopia-correcting effect.
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Flexivue Microlens®

- Thickness: 15 μm
- Diameter: 3.2 mm

- Peripheral zone with refractive power: +1.5 D to +3.5 D
- Central zone without refractive power

Flexivue Microlens
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Is it usually performed on the dominant, or nondominant eye?

Nondominant

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How much plus power are we talking about here? The rings range in power from 1.5 to 3.5D
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The fact that rays from distance are unaffected implies what about the refractive status of the eye?

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The fact that rays from distance are unaffected implies what about the refractive status of the eye? That it is emmetropic. Because of this, most surgeons will implant the Flexivue only if the pt is emmetropic in both eyes.
Corneal Inlay, Collagen Shrinkage, and Cross-Linking Surgery

In one word, what sort of condition is keratoconus (KCN)?

CK, SAI and CRI have something in common. Likewise, CXL and ICRS do too. What are these respective commonalities?
CK, SAI and CRI are used to treat **presbyopia**, whereas CXL and ICRS are primarily used to treat **keratoconus**.
In one word, what sort of condition is keratoconus (KCN)?
An ectasia

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What does corneal topography reveal about the typical dz course in KCN?

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The central and/or paracentral cornea thins progressively, producing a cone-like bulge. Extreme irregular astigmatism eventually results.

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Adolescence

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In addition to KCN, what are the two other main ectatic conditions for which CXL is used?
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In one word, what sort of condition is keratoconus (KCN)?
An ectasia

In addition to KCN, what are the two other main ectatic conditions for which CXL is used?
--Pellucid marginal degeneration
--Ectasia after keratorefractive surgery

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Refractive Surgery

Corneal Incisional Laser

PRK
LASEK

Iris-fixated Intraocular Pseudophakic Phakic IOL

RK
AK
LRI

Sulcus-fixated Refractive lens exchange (RLE)

LASIK
SMILE
Epi-LASIK

Other

Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery

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It is inflammatory, or noninflammatory?
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Briefly, how is CXL performed?
After removal of the corneal epithelium, the stroma is suffused with riboflavin, then subjected to UV radiation. The riboflavin acts as a photosensitizer, absorbing the radiation and producing reactive oxygen species. The reactive oxygen species cause cross-linking to occur among fibrils, stiffening the cornea.
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CXL concept

BEFORE CXL: LESS CROSSLINKING = WEAKER CORNEA

AFTER CXL: MORE CROSSLINKING = STRONGER CORNEA
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1. We remove the Epithelium

2. Riboflavin (Vitamin B2) eye drops are applied onto the cornea

3. 1 minute later, the solution is irrigated or washed away by the surgeon

4. An ultra-violet light (UVA) illuminates the Riboflavin solution for the corneal cross-linking procedure

CXL: Process
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Refractive Surgery

Intraocular

- Pseudophakic
- Phakic IOL

Phakic IOL

Corneal

- Incisional
- Laser
- Other


cross-linking surgery

Other

- CK
- SAI
- CRI
- CXL
- ICRS

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    - RK
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    - LASIK
    - SMILE
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- **Other**
  - CK
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Intrastromal ring segments
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Which produces more corneal flattening--a thicker Intacs, or a thinner one?

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The hallmark of KCN is corneal steepening that is greater inferiorly than superiorly. How might this affect Intacs selection in the surgical correction of KCN? 
Typically, the surgeon will opt to place a thicker segment inferiorly, and a thinner one superiorly.

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In some cases of KCN, the area of inferior steepening is more peripheral and is accompanied by an area of abnormal flattening of the superior cornea, 180° away. In such a situation, what approach might the surgeon take?
To place a single, unpaired Intacs in the inferior cornea, the effect of which will be to flatten the inferior cornea and steepen the superior cornea

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What is the name for this phenomenon wherein ICRS flattening of the inferior cornea produces desired steepening of the too-flat superior cornea?
The beanbag effect, so-called because it is reminiscent of what happens to the other end of a beanbag chair when one plops down on one end of it.

So this is the same as the ‘coupling effect’ that occurs during arcuate keratotomy (AK) and the creation of limbal relaxing incisions (LRIs), yes?
No! The coupling effect refers to steepening that occurs 90° away from AK incisions and LRIs, whereas the beanbag effect occurs 180° away, and in response to the placement of an ICRS. Don’t get the two confused!

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So this is the same as the ‘coupling effect’ that occurs during arcuate keratotomy (AK) and the creation of limbal relaxing incisions (LRIs), yes?
No! The coupling effect refers to steepening that occurs 90° away from AK incisions and LRIs, whereas the beanbag effect occurs 180° away, and in response to the placement of an ICRS. Don’t get the two confused!
**Corneal Inlay, Collagen Shrinkage, and Cross-linking Surgery**

*Refractive Surgery*

**How is the flattening effect titrated?**
By selecting segments that differ in thickness. That is, the inner and outer radius-of-curvature of Intacs segments do not vary among the different 'powers.' What **does** vary is the thickness of the segments. (As of this writing, Intacs come in eight thicknesses.)

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**ICRS have three main advantages over other forms of keratorefractive surgery. What are they?**
- No corneal tissue is removed
- It is reversible (i.e., the ICRSs can be removed)
- It is performed on the corneal periphery, so the central cornea is not disturbed

That said, the procedure **what** is the main downside to the procedure?
It is unlikely to result in good UCVA by itself.

**What is the current main indication for ICRS surgery?**
Correction of the astigmatism and myopia induced by KCN

**What exactly are ICRS, and how do they reduce astigmatism and myopia?**
They are semicircular segments of PMMA that are slipped into channels created within the mid-peripheral cornea. By displacing some of the stroma, they cause local flattening the cornea.

As of this writing, only one brand of ICRS is FDA-approved. **What is that brand?**
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In fairness, good UCVA is not the goal of ICRS placement; rather, what is the goal?
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In fairness, good UCVA is not the goal of ICRS placement; rather, what is the goal?
By flattening the cornea and reducing astigmatism (especially irregular astigmatism), the hope is that the pt can once again have his/her refractive error adequately corrected by RGPs, or even spectacles

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