How to fit soft toric contact lenses

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Disclosure Statement of Financial Interests

• I have no conflict of interest to disclose
Objectives

- What is astigmatism?
- Incidence
- Classification of astigmatism
- Signs, symptoms and the impact on the visual acuity
- Astigmatism and contact lenses
Objectives

- Correction with Soft Toric contact lenses
- Fitting the astigmatic eye
- Case Studies and Troubleshooting
- Summary
Astigmatism

• Defined as a refractive condition: Refractive Ametropia

• The difference in refractive power of the 2 principles of the eye

• Derived from the Greek words: $a = \text{not, without}$

  $stigma = \text{spot, point}$

• In optics, **astigmatism** is when an optical system has different focal points for rays that propagate in two perpendicular planes
Astigmatism
Incidence

• Quite common

• 1 in 3 people have astigmatism > 0.5D Cyl
## Incidence

<table>
<thead>
<tr>
<th></th>
<th>Holden 1974</th>
<th>Cavara 1922</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.50 Dcyl</td>
<td>39%</td>
<td>23%</td>
</tr>
<tr>
<td>0.50 to 1.00 Dcyl</td>
<td>37%</td>
<td>42%</td>
</tr>
<tr>
<td>1.25 to 2.00 Dcyl</td>
<td>15%</td>
<td>25%</td>
</tr>
<tr>
<td>2.25 to 3.00 Dcyl</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>&gt;3.00 Dcyl</td>
<td>3%</td>
<td>3%</td>
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</tbody>
</table>
Incidence

• Nearly half of all patients requiring vision correction are significantly astigmatic in at least one eye, according to a study in *Eye & Contact Lens, 2011*.¹

• Data from the study also show that the prevalence of astigmatism is almost double in patients with myopia compared to those with hyperopia
# Incidence

<table>
<thead>
<tr>
<th></th>
<th>16 – 55</th>
<th>56+</th>
</tr>
</thead>
<tbody>
<tr>
<td>With the rule</td>
<td>60%</td>
<td>25%</td>
</tr>
<tr>
<td>Against the rule</td>
<td>17%</td>
<td>58%</td>
</tr>
<tr>
<td>Oblique</td>
<td>23%</td>
<td>17%</td>
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</tbody>
</table>
Incidence

Astigmatism is frequently associated with:

* **Local** & **Systemic pathology:**

  - Blepharoptosis
  - Keratoconus
  - Albinism
  - Arthritis
  - Bardet-Biedl Syndrome
  - Ehlers-Danlos Syndrome
Classification of the astigmatism

• According to:
  1. site of involvement:
     a) Corneal
     b) Lenticular
     c) Internal (Retinal)
  2. axis of astigmatism
  3. position of the image

• Clinical classification:
  – regular astigmatism
  – irregular astigmatism
Classification of the astigmatism

1. a) Corneal Astigmatism is the most common form of astigmatism (both regular and irregular)
2. According to the axis of astigmatism:
   a) regular astigmatism
      - the three types are with-the-rule, against-the-rule, and oblique astigmatism

- the two meridians are at right angle to each other:
  - one of them is horizontal, the other is vertical (the most common)
  - the oblique astigmatism
Classification of the astigmatism

2. According to the axis of image:
   b) irregular astigmatism - the astigmatism in the principal meridian vary; this might be cause by corneal irregularity like corneal scars, keratoconous, pterygium, post keratoplasty
Classification of the astigmatism

3. According to the position of image in relation to retina:

   a) simple: myopic, hyperopic
   b) compound: myopic, hyperopic
   c) mixt
Classification of the astigmatism

Simple hyperopic astigmatism

When refracted rays from one meridian takes focus on the retina and refracted rays from other meridian takes focus behind the retina.
Classification of the astigmatism

Simple myopic astigmatism

When refracted rays from one meridian takes focus on the retina and refracted rays from other meridian takes focus in front of retina.
Classification of the astigmatism

Compound hyperopic astigmatism

In this condition of astigmatism refracted rays from both meridians take focus behind the retina
Classification of the astigmatism

Compound myopic astigmatism

In this condition of astigmatism refracted rays from both meridians take focus in front of the retina
Classification of the astigmatism

Mixt astigmatism

When refracted rays from one meridian take focus in front of retina and refracted rays from other meridian take focus behind the retina.
Classification of astigmatism

Physiology

Pathological

regular

Irregular

simple

compound

mixed

myopic

Hypermetropic

With the rule

Against the rule

myopic

hypermetropic

With the rule

Against the rule

With the rule

Against the rule
Signs, symptoms and visual impact

• Depends on magnitude of astigmatism
• Astigmatism < 1D may be not noticed
• Higher amounts of astigmatism may cause:
  – blurry vision at distance and near,
  – distortion,
  – asthenopia,
  – fatigue,
  – headaches or even,
  – squinting.
How to Identify

• Eye charts
  – Missing some letters/numbers on each row
  – Certain orientation lines of letters/numbers

• Keratometry

• Topography

• Autorefractometry

• Jackson cross-cyl
ASTIGMATISM AND CONTACT LENSES
Astigmatism and Contact Lenses

- What would be the best option to correct astigmatism with contact lenses?
Astigmatism and Contact Lenses

- Spherical
- Toric
- Hard
- Soft
- Fitting and Optical considerations are different for RGP and SOFT toric contact lenses.
Soft Toric Contact Lenses

• The development of PHEMA (polyhydroxyethylmethacrylate) in the 1950s by Wichterle and Lim ultimately led to an increase in demand for contact lenses of all types.

• By its very nature, a soft contact lens conforms to the shape of the anterior eye.
Soft Toric Contact Lenses

• Different powers in two mutually perpendicular meridians

• The underlying principle of all toric lens designs is to supply a full correction for each of the principal meridians

• In the interest of optimum visual performance, toric SCLs must maintain their correct meridional orientation under all reasonable circumstances and eye positions.

• In the interests of eye physiology the lens must move on the eye.
Soft Toric Contact Lenses

Compound Myopic Astigmatism
Rx: -1.00 D Sph - 2.00 D Cyl x 180

Orientation marks
Design Considerations

- Surface design (manufacture)
- Stabilization
- Reference marks (type and position)
Surface Designs

- Front surface toric
- Back surface toric
- Bitoric (uncommon)
Stabilization

- Good vision needs stable cylinder axis location
- Lid movement will attempt to move the lens in the *same* direction as itself
- Gravity and the inertia of lens and tear fluid, play relatively insignificant roles
Stabilization Techniques

- Prism ballast
- Truncation
- Peri-ballast
- Double slab-off
Prism Ballast

- 1 to 1.5 ΔD base down
- Stabilized by prism-induced thickness differences
- Reduced oxygen transmissibility where the prism is located
- Possible discomfort with lens-lid interaction
Truncation

- Alignment of truncation with lower lid margin is a stabilizing factor
- Truncation is a source of discomfort
- Truncation not always successful
- More patient visits required
Peri Ballast

- Minus carrier converted into a prism base down effect
- Uses thickness differences as the stabilizing component
- Discomfort with lens-lid interaction at the thicker inferior half
- Reduced oxygen transmissibility in thicker regions
Double Slab-Off

- Thin zone superiorly and inferiorly
- Lid forces maintain orientation
- Overall thinner lens; Lens is symmetrical
- Better comfort because of reduced lens thickness
Orientation Marks

• When fitting toric soft contact lenses it is essential to know where, and how reliably, the lens is orienting on the eye.
• Traditionally, manufacturers have provided special markings just for this purpose.
Orientation Marks

• Lens mislocation is measured as the deviation from the vertical (with markings nominally located at 6 o’clock) or from the horizontal (with markings nominally located at 3 & 9 o’clock).

• The magnitude and direction of any deviation must be determined and used to compensate the ocular astigmatic axis for any angular mislocation.
Fitting Soft Toric Contact Lenses

Indications for choosing a soft toric CL:

• Refractive astigmatism
• $>0.75$ cyl
• Unsatisfactory VA with best sphere
• Degree of astigmatism and ocular dominance are important to consider in some cases and visual needs.
Fitting Soft Toric Contact Lenses

- Degree of astigmatism and ocular dominance are important to consider in some cases and visual needs.

Ex:

- Dominant eye RE
  - +3.00 / -0.75 / 180

- Nondominant eye LE
  - +4.00 / -0.50 / 90

- BCV - correction in both eye with CL
  - RE soft toric CL
  - LE spherical equivalent
The Routine Preliminary Examination

• Slit-lamp examination of the anterior segment
• Measurement of ocular dimensions
• Assessment of the tears
• Spectacle refraction
Preliminary Examination of the Anterior Segment

- Eyelids
- Conjunctiva
- Tears
- Cornea
- Anterior chamber
- Iris and lens
Biomicroscopy

Performed:

• Before CL fitting or CL wear, to establish a ‘baseline’
• During trial lens fitting(s) and after-care visits to assess:
  - lens fit
  - any anterior eye changes
Measurement of Ocular Dimensions

- Corneal Curvature
  Consider:
  - Central and peripheral keratometry
  - Corneal topography
  - Sphere-to-cylinder ratio
Measurement of Ocular Dimensions

- **Cornea**
  - Corneal diameter related to horizontal and vertical iris diameter

- **Pupil:**
  - Standard room illumination
  - Low illumination
Palpebral aperture & lid positions

- Different sizes of the palpebral aperture are influencing the lens stability
Blink Types

- Partial
- Complete
- Forced
Assessment of the Tear Layer

- Invasive
- Non-invasive
Invasive Techniques

• Break-Up-Time (BUT)
• Schirmer test
• Phenol-red thread test
Non Invasive Techniques

- Non-invasive Tear Break-Up-Time (NIBUT)
- Tear prism height
- Lipid layer evaluation
Spectacle Refraction

• Baseline refraction:
  - Vertex distance
  - Accommodation
  - Convergence

• Subjective vs objective refraction

• Over-refraction
Special considerations

- Refractive condition (type and degree of astigmatism; astigmatism and presbyopia)
- General health
- Ocular conditions
- Medications/therapeutics
- Previous prescription/s
- Occupational, recreational and environmental factors
General Health

- Diabetes (moderate to severe; managed with daily insulin)
- Allergies
- Arthritis
- Pregnancy
- Sinus problems
Ocular Conditions

- Allergies
- Active eye disease
- Susceptibility to infections
- Dryness of eyes
- Conjunctival swelling and redness
- Photophobia
Medications

• Ocular
• Systemic
• Topical
Previous prescription/s

- Current contact lens wearer
- Previous contact lens wearer
Other Factors

• Sports
• Hobbies
• Environmental exposure
Final Evaluation

• Decision is made on specific lens type to trial fit
• Consult with patient to determine specific needs
Wear Modality & Lens Replacement

Wear Modality Classification:
• Daily wear
• Flexible wear
• Extended wear
• Continuous wear

Lens Replacement Classification:
• Conventional
• Frequent replacement
• Disposable
• Daily disposable
Fitting Soft Toric Contact Lenses

- Measure refractive error & vertex distance
- Select toric lens design
- Select trial lens power to match corneal-plane refraction
- Select BC and/or TD
- Measure meridional orientation (axis mislocation)
- Compute final prescription including axis compensation
Assessment

Alignment fit: Full corneal coverage, good centration and movement, quick return to axis if dislocated

Tight fit: Good centration, initially comfortable, little or no movement. Slow return to axis if dislocated

Loose fit: Excessive movement, poor centration, uncomfortable. Lens orientation unstable and inconsistent
Assessment

- Full corneal coverage, 0.2-0.5 mm movement on primary gaze
Lens Rotation

• Marks: ink, photochemical dots, laser marks, scribe lines, engraved dots
• The marks are reference points. They DO NOT represent the cylinder axis
• Rotation is measured with:
  - narrow slit-lamp beam
  - spectacle cylinder in trial frame
  - use of an analogue clock
Rotation Prediction

- Average lens rotation is 5-10 nasal, however large individual variations exist:
  - anticlockwise for RE
  - clockwise for LE
- Lens affected by lens/eye relationship and lid anatomy
- Lens location affected by the lens thickness profile
Rotation Prediction

- Interactions with lids moves thinnest meridian towards vertical
- Upper lid is the dominant stabilizing component
- Rotational stability is influenced by the type of astigmatism: Oblique is $>$ WTR $>$ ATR
Rotation Correction

• LARS rule:
  – Reference point 6 o’clock:
    Left Add, Right Subtract
  OR
  – Clockwise Add, Anti-clockwise Subtract
Rotation Correction

20° Clockwise Rotation Left according to LARS

PLN -1.25x180

Trial Lens

Lens Rotation

PLN -1.25x20

Lens to Order
The compensation of the axis.
Rotation Correction

• **Example**

• **Spectacle refraction:**
  
  – -5.00 -2.00 x 100°

• **Trial lens used:** 8.60 -4.00 / -1.75 x 100°

• **Rotation of trial lens:** 10° clockwise (left)

• **Correct for vertex distance (power is over -4.00D):**
  
  -4.75 / -1.75 x 100°

• **Compensate for any axis rotation as determined in the trial fitting:**

  \[100° + 10° = 110°\]

• **Final lens:** -4.75 -1.75 x 110°
  
  **8.6 B.C.**
Patients who are less likely to be successful with toric soft lenses include those with:

- **Low spherical components** e.g. +0.50 / -2.75 x 180

Axis alignment is very critical to these patients because the astigmatism is the most significant component of their refractive error.
Case Studies and Troubleshooting

Patients who are less likely to be successful with toric soft lenses include those with:

• **Oblique cylinders** *e.g.* -2.00 / -2.25 x 50
  Will possibly have poor stability due to complex lid-lens interactions.
Case Studies and Troubleshooting

• **High cylinders** e.g. +4.00 / -5.50 x 80
  Lens rotation becomes more significant optically as the degree of cylinder is increased

• In general avoid compensations for axis mislocation > 15° even if lens mislocation is stable
Case Studies and Troubleshooting

Problem solving:

• Check baseline data
  – (spectacle refraction, CL power, K readings)
• Lens fit
• Lens rotation
• Lens quality
Summary

• Fitting toric soft lenses is in most cases well predictable and easy
• Low astigmatic patients should also be corrected with toric lenses
• Assessing the rotational stability is the key
• New materials offer a healthier option

2. Lang, Ophthalmology, 2000 Thieme