Troubleshooting Soft Toric Contact Lenses

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ABSTRACT

Reasons to explain the reluctance of practitioners to fully embrace the toric soft lens alternative are explored. Possible solutions for common clinical problems in prescribing this lens type are then offered. These troubleshooting areas include orientation and misalignment, trial lenses with and without cylinder, orientation observation, and measurement. Also included are discussions related to fittings, prescribing, parameter verification, maintenance, and those cases least likely to be successful.

The need for an astigmatic correction in a significant portion of prospective contact lens wearers has been well documented.[1,2] Holden[2] reported that 34.8% of 179 patients requesting to be fit with soft lenses had 1.00D or more of refractive astigmatism. This 1.00D level is generally considered as an acceptable cut-off from leaving astigmatism uncorrected by using spherical soft lenses. Therefore, it is surprising to find that use of soft toric lenses in the United States accounts for less than 5% of the soft lenses prescribed.[3] The reluctance of practitioners to embrace this new vision correction alternative is largely related to problems associated with difficulty in prescribing for and maintaining soft toric patients.

By comparison, experience in some other countries has been at odds with the United States' result. Australia, for example, shows a soft toric proportion of approximately 25%.[2,3] This is closer to the theoretical 34.8% previously mentioned and can probably be attributed to the "custom-made" mode of contact lens practice in that country as opposed to the popular US "inventory" thinking. Lists of toric lenses currently available in the United States recently have been published[3,4] and will not be covered in this article.

Different rates of success with toric soft lenses worldwide have been documented in the literature. These rates range anywhere from 48% to 70% with the initial fitting and up to 90% after one reorder.[5,6,7] The success rate for this type of lens can potentially be very good.

As public awareness of "soft lenses for astigmatism" continues to increase, the prescribing efficacy also needs to improve. Mindful of this fact and its economic impact on our practices, we have sought to review some of the most frequently encountered hydrophilic toric lens problems and offer different means for resolving them.

1. Predicting the Degree of Lens Misalignment

Before any soft toric prescription can be finalized, a compensation must be made to the cylinder axis in order to allow the contact lens alignment on the patient's eye to still place the cylinder along the correct meridian.

This can be achieved by selecting an arbitrary allowance or by using trial lenses. The "arbitrary allowance method" usually compensates for approximately 10° rotation nasally (in the right eye counterclockwise, in the left eye clockwise). To illustrate the arbitrary nature of this technique, we conducted a prospective

Table 1. Stabilized Soft Toric Lens Orientation*

	Bausch & Lomb Toric	Ciba TORISOFT®	Hydrocurve 45% Toric	Hydron T	Salvatori Sofform T
n	15	15	15	15	15
$\bar{x}$	10.0 Nas	12.5 Nas	15.1 Nas	9.2 Nas	4.2 Nas
s	±14.3°	±12.3°	±14.9°	±11.6°	±15.1°

* Descriptive statistics for samples of patients fit with these alternative toric soft lenses.

study investigating stabilized soft toric lens orientation for five different manufacturers' lenses.

Fifteen patients were optimumly fit with each lens type. After one hour of wear, a video tape of lens performance was made. Orientation data was then measured by placing a protractor over the video monitor screen.

The clinical results of this study are listed in Table 1. Although the average lens orientation is indeed around 10° nasally, as a representation of average variation, the standard deviations are high.

The use of trial lenses to predict lens misalignment can be performed in at least two ways, with lenses used being either spherical or sphero-cylindrical. Spherical trial lenses which have all components of the toric design, except the cylinder, are useful. They are obviously advantageous for overrefractions where the resultant prescription becomes easy to calculate. No special calculations or vector analyses are necessary, as would be the case with sphero-cylindrical lenses.

However, using spherical lenses to predict cylindrical lens orientation may have limitations for some soft toric designs. As discussed by Hanks,[8] the majority of these designs achieve lens orientation by thickness profile interactions with pressures from the upper lid. Holden[2,9] referred to this as the "watermelon seed principle" since it is analogous to squeezing a watermelon seed between the thumb and forefinger. Contrary to popular opinion, the effects of gravity are insignificant.

In addition to thickness changes seen in prism ballast or slab off designs, there will also be a change in the thickness profile contributed by the cylindrical component. This contribution will be greatest for larger cylinders but will always be a factor. Therefore, if lens orientation is predicted with a spherical diagnostic lens, it may be different when the subsequently or-

Table 2. Criteria of a Well-Fitted Toric Soft Contact Lens

- ☐ Full corneal coverage
- ☐ Good centration (concentric about the visible iris).
- ☐ Satisfactory movement (in up gaze 0.5mm movement with the blink is ideal).
- ☐ Satisfactory lens lag (in up gaze, lens lag of 0.5 – 1.0mm is ideal).
- ☐ Satisfactory comfort response by the patient.
- ☐ Stable lens orientation with consistent return if lens is mislocated.
- ☐ Satisfactory vision response by the patient (vision should be comparable to best spectacle acuity).

Table 3. Characteristics of a Tight (Steep) Toric Soft Contact Lens

- ☐ Good centration.
- ☐ Little or no up gaze movement with the blink.
- ☐ Little or no up gaze lag.
- ☐ Good comfort.
- ☐ Blurred vision which clears immediately following blink.
- ☐ Stable lens orientation but slow return if lens is mislocated.
- ☐ Bubble(s) under the lens.
- ☐ Conjunctival indentation and/or blanching of limbal vessels at the lens edge.
- ☐ Limbal-conjunctival hyperemia.

dered cylindrical lenses are tried at dispensing. To test this, Jurkus and Tomlinson[6] fit 15 patients with prism ballasted, truncated spherical diagnostic lenses and compared orientation to prescription toric lenses. Their analysis revealed that no significant statistical difference existed between the rotation of spherical trial lenses and the toric prescription lenses. However, when two stimuli are evaluated on the same subject, a t-test may be applied to the differences between the two. This mean difference may then be analyzed for statistical significance against the hypothesis of no difference. When we applied the calculation of mean difference of rotation between the two lenses for each subject, a significant difference in lens rotation was discovered with 99% confidence ($df = 14$, $t = 3.16$, $p < 0.01$). This fact would also agree with many practitioners who report better results being achieved when lens orientation is predicted using diagnostic lenses that include a cylinder correction.

In general, practitioners will have a "best chance" situation when orientation predictions are based on full prescription lenses as near as possible to all final lens parameters. The advantage of a toric inventory in this regard is obvious. Exceptions to this observation will be those designs in which the toric portion and subsequent thickness profile changes are confined only to the optic zone. For example, the Bausch & Lomb Toric and Ciba TORISOFT® lenses have a spherical periphery for both diagnostic and full cylinder prescription lenses. This approach is then intended to achieve better orientation agreement between lenses of different cylinder power and axis.

An accurate sphero-cylindrical overrefraction may be of help in determining the amount of lens misalignment if a sphero-cylindrical diagnostic lens is utilized. However, this becomes a problem of obliquely crossed cylinders and requires special calculations or vector analysis for its resolution. Reference tables [2,10,11,12] and computer programs[13] which deal with resolution of obliquely crossed cylinders have been described previously in the literature.

2. Observing and Measuring Orientation

If a measurement is to be used to predict lens misalignment, it will first be necessary to observe and then measure the trial lens orientation. Observing orientation is largely a problem addressed by manu-

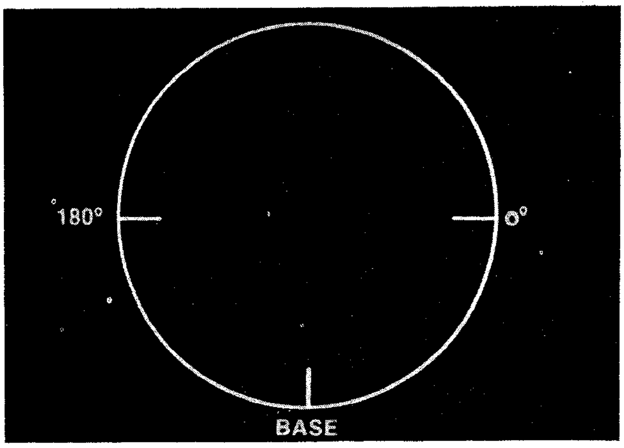


Figure 1. Reference markings on toric soft lenses

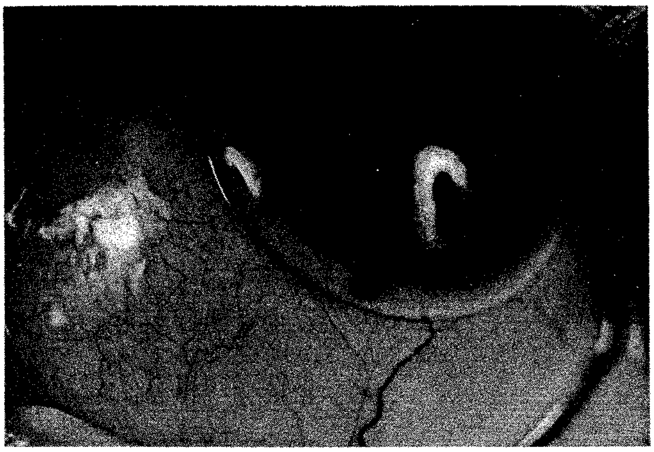


Figure 2. Noncytotoxic ink reference marks

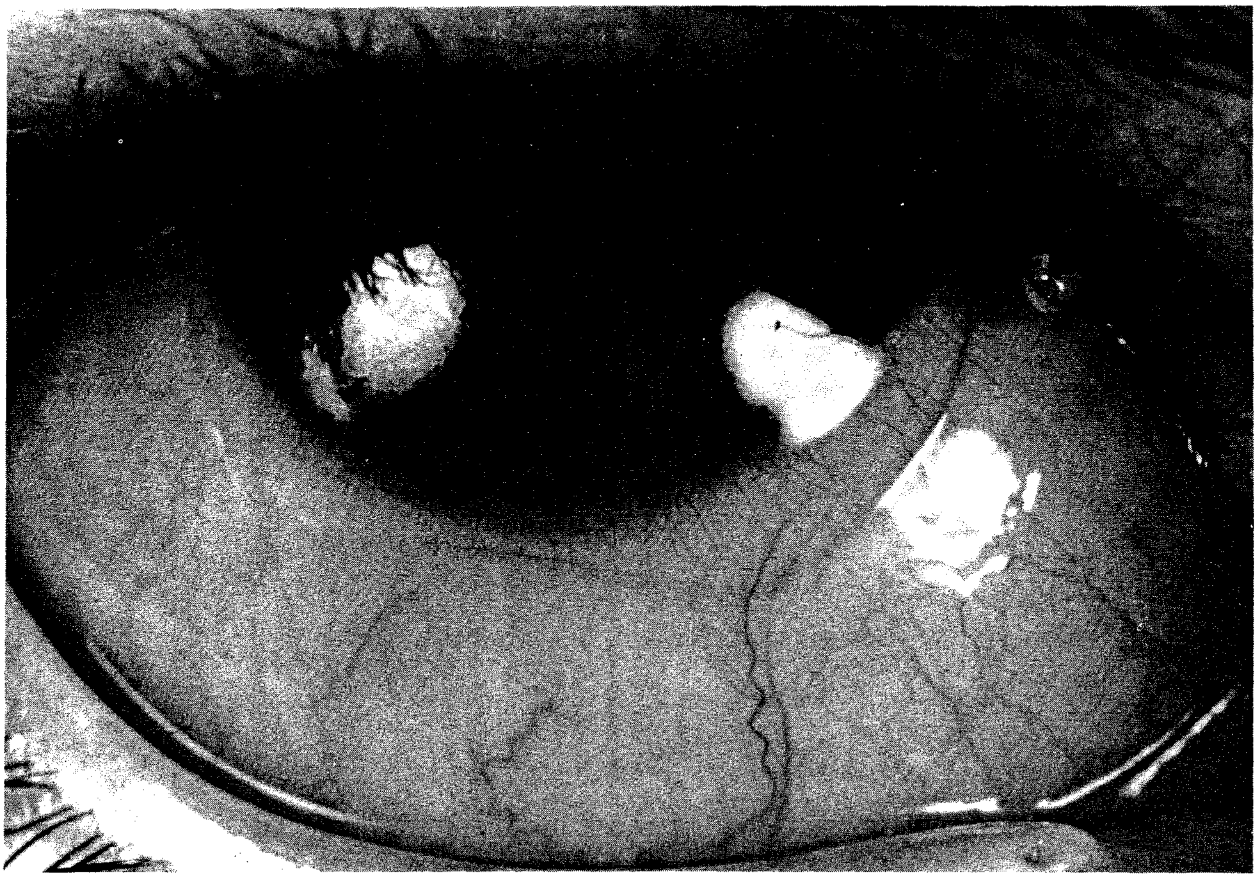


Figure 3. Visibility of truncation for use as an orientation reference

Table 4. Characteristics of a Loose (Flat) Toric Soft Contact Lens

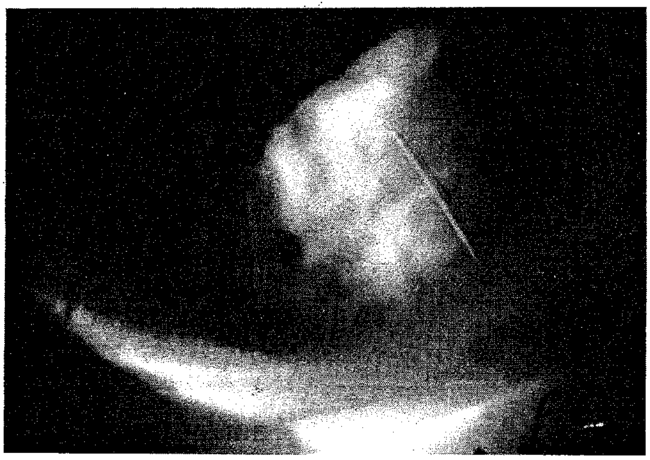
- ☐ Decentration (usually temporally and/or superiorly).
- ☐ Excessive up gaze movement with the blink.
- ☐ Excessive up gaze lag.
- ☐ Reduced comfort response—usually lower lid sensation.
- ☐ Lens orientation unstable and inconsistent.
- ☐ Lens edge standoff and buckling.
- ☐ Unstable vision.

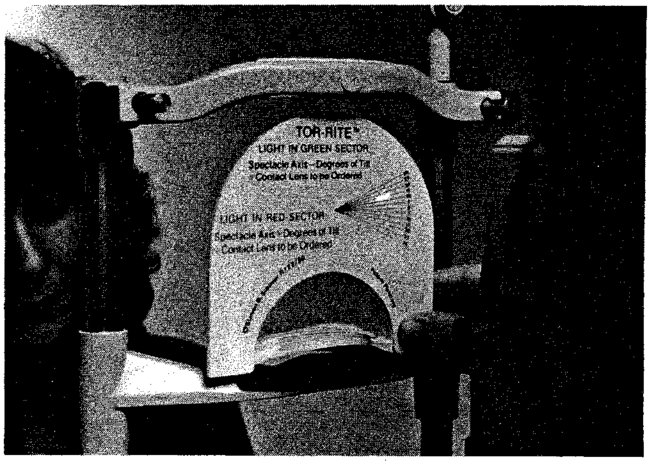
facturers and included in lens designs. It becomes a relevant consideration for practitioners in selecting a toric soft lens of first choice.

Methods of observing toric lens orientation currently or previously available include the following: ink, scribe lines, engraved dots, laser trace, and truncation.

These markings are generally applied at the prism base or in the horizontal lens meridian (Figure 1). Ink markings and lens truncation are the easiest to observe, however, both have limitations. The use of ink raises questions of physiological compatability and eventual fading.[14] Ink reference points typically are easy to use at the dispensing visit and then nonexistent at after care follow-ups (Figure 2). Truncations are also easy to observe and can then be aligned with a measuring device (Figure 3). The limitation is that this method requires the use of truncated lenses. Many practitioners who would be willing to accept the easily observed truncation marking may not want to accept the possibility of reduced patient comfort or additional processing for a truncation.

Scribe lines have been the most commonly used axis reference guide. These are similar to engraved dots but have the advantage of providing more information. A line by itself can be aligned with the measurement device to measure angle.[15] This is not as simple with dots which, at best, require two opposite dots to be sighted together with the measuring method.[16] The disadvantage with scribe lines has been that for some materials or manufacturers, the result has been a potential mechanical weak point. Scribed soft toric lenses which split are often found to have done so along the scribe line marking. This can be overcome when manufacturers choose to place scribe marks away from the thinnest lens portions.





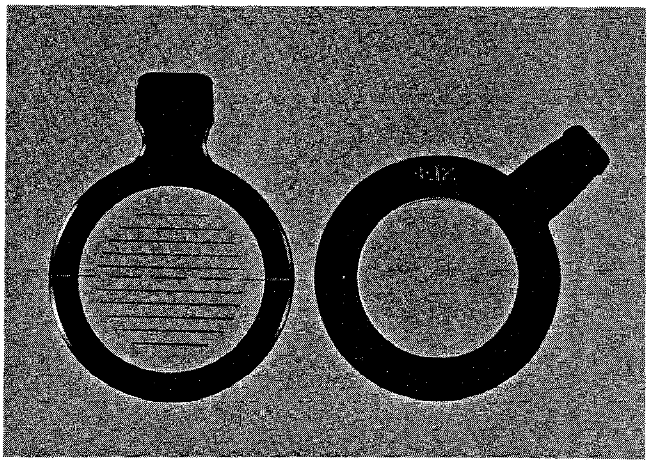


Figure 4. Laser trace® reference marks (Bausch & Lomb Toric)
Figure 5. The Tor-Rite™ device in use for measurement of lens orientation
Figure 6. Marked plano lenses suitable for use in trial frames when measuring orientation

Laser trace® was introduced in 1978 by Milton Roy and the result is now available from more than one manufacturer.[17,18] This process leaves a permanent mark with a claimed absence of lens weakening (Figure 4).

Once a lens choice has been made, it will then become necessary to make measurements of lens orientation. Numerous techniques exist from a considered guess through to videotapes and screen protractor overlays. With economical considerations in mind, the serious soft toric practitioner can be well prepared by using a slit lamp eyepiece with an axis reticule. Unfortunately, many fitters will feel that this $200 investment is not warranted. In these situations, less expensive slit lamp adaptations may be used. These include rotating slit and axis scales, marked plano lens in trial frame, etc. (Figure 5 and 6). At worst, if a simple guess of lens axis is used as a last resort, the simple remembrance of one hour on the clockface being 30° will aid in improving accuracy.

Once mislocation has been observed, then measured, a compensation must be made to the spectacle cylinder axis. This then enables determination of the soft toric axis so that after lens orientation, the cylinder will align appropriately on the cornea. Although this appears to be a straightforward calculation, it is also the most common area for mistakes and subsequent difficulties in fitting soft toric contact lenses.

Several wheels and calculating devices are available for determining the resultant soft toric axis to order.* Other guides refer to nasal or temporal, right or left, etc. Probably the easiest to use and remember is the clockface approach:

Clockwise ....Add
Counterclockwise ....Subtract

If the diagnostic lens rotates and then orients in the clockwise direction, note the degree and add this amount to the overrefraction axis. For counterclockwise, subtract the amount.

3. Expected Orientation

Another frequent mistake is the expectation that, after a prescription has been compensated for mis-

* Calculating devices are available from Hydrocurve, B&L and Ciba.

location, the ordered lens will orient with the base or base marking in the vertical meridian. This is not the case. After axis compensation, the final lens must continue to orient in the same position which was allowed. For example, a lens ordered at axis 170 and expected to sit 10° clockwise must always sit 10° clockwise. Otherwise, the axis 170 will no longer be correct.

Thus, the final lens orientation expected, if the lens orients correctly, should really be recorded as part of the prescription. Reference to this information will frequently simplify problem solving during future visits.

4. But, What Next?

Another common problem is the soft toric lens supplied by the laboratory which no longer works as it was intended. For example, a lens expected to sit 10° clockwise and ordered axis 170, may in fact sit 10° counterclockwise when the ordered lens is about to be dispensed. So, what next?

Two solutions are possible. First, the problem may be due to a defective product or it may have occurred when the original orientation was estimated based on a lens which was not sufficiently matched in parameters.

Second, where we are now viewing a lens more closely matching required parameters, an adjusted axis will be necessary for reorder. At the dispensing visit, the ordered lens is placed on the eye. Check the orientation observed with this lens and compare it to that expected if it had located correctly. If the lens orientation observed matches the expected, then it is positioning correctly for the compensation allowed in the axis ordered. This lens can be dispensed after vision and fitting criteria are confirmed.

If, however, the lens orients in another position, then the cylinder will no longer be placed along the correct axis. To reorder the lens, follow these steps:

a) Compare the actual orientation observed with that expected.
b) Calculate the relative difference between the two.

Example:	expected	10 CW
	actual	10 CCW
	relative difference	20 CCW
Example:	expected	10 CW
	actual	20 CW
	relative difference	10 CW

c) If relative difference is clockwise, add it to the current axis to determine the new axis to be ordered.
d) If relative difference is counterclockwise, subtract.

Example: Contact lens Rx ordered:
$-3.00 \ -1.00 \times 180$

Expected orientation:	10 CW
Instead orients at:	10 CCW
Relative difference:	20 CCW
CCW, so subtract from current axis:	$180 - 20 = 160$
Lens to reorder	$-3.00 \ -1.00 \times 160$

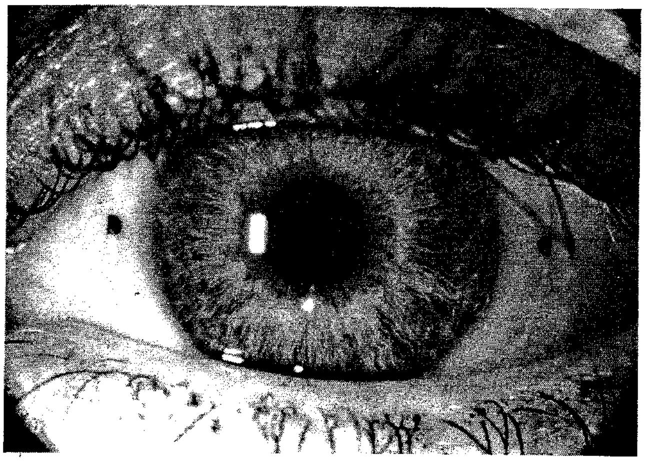


Figure 7. A well-fitted toric soft lens with stable orientation

5. Toric Fitting Effects

In addition to the traditional evaluations of soft lens fitting performance, toric lenses require additional evaluations. These are related to lens orientation and stability. Ideally, a well-fitted soft toric lens will have stable lens orientation. If mislocated, the lens will also return consistently (Figure 7). Lenses which are stable in their orientation, but which return slowly when mislocated, are usually tight or steep in their lens/eye relationship. Those which rotate quickly but show unstable and inconsistent orientation are typically loose or flat. Of course, inconsistent orientation may also occur in patient and soft toric design combinations in which the orientation component fails to work successfully with lid dynamics for that particular patient. The fitting characteristics for well-fitted, tight, and loose toric soft lenses are summarized in Tables 2, 3, and 4, respectively.

6. Accuracy of Baseline Data

The accuracy of the baseline refraction is also of importance. A potential for error exists if old refractive findings, a patient's outdated spectacle prescription, or another practitioner's refractive results are used. In addition to sphere and cylinder power, the exact cylinder axis is one of the most necessary items since all calculations of rotation and cylinder axis to be ordered rely on this piece of data. The few minutes needed to update or recheck a refraction may save the practitioner many hours of future grief. Also, the use of the spectacle refraction compared with trial lens power plus overrefraction is a good check of final lens power to be ordered.

7. Verification of Lenses

Manufacturing accuracy is another potential pitfall when prescribing hydrophilic toric lenses. Measuring the lens power of soft lenses is more difficult than measuring the lens power for hard lenses due to the dehydration that occurs. As a consequence, practitioners oftentimes feel unable to verify the power of toric soft lenses. This may, in turn, result in frustration and disappointment if the lens ordered does not perform as expected when placed on the patient's eye. Appropriate techniques for in-office verification of lens parameters are described by Janoff.[19]

8. Cases to Avoid

A) Low Spherical Components:

Patients with corrections that are mostly cylinder combined with low or no spherical components are very difficult to correct with toric soft lenses. This is because these patients, along with those of high cylinder requirements, are very critical of axis alignment and will not accept axis instability which often occurs when reading, with dryness, etc. In addition, the thickness differentials which are possible to achieve are reduced with small spherical components.

Remba recommends the "4 to 1 Rule" in cases of this nature. That is, if the refractive astigmatism is no more than one quarter of the spherical component, try a spherical lens of spherical equivalent power as the first lens to evaluate.[20]

B) Oblique Cylinders:

It is unwise to fit patients who exhibit oblique refractive cylinders unless a trial lens approximating the needed cylinder axis location can be utilized. The stability of lenses of this nature is usually poor due to the lid effects on the differential edge thickness of the lens.[9,16]

9. Importance of Hygiene

Oftentimes practitioners are faced with a patient who, for a period of time, has done well in toric hydrophilic lenses and then appears suddenly to have developed problems with lens stability. This may be caused by an often overlooked factor—lens cleanliness. If a lens stabilizes well, it may do so only as long as it is clean.[21] A dirty or protein-coated lens can certainly interfere with meridional alignment in the lens/eye relationship. Therefore, patients must be informed of the importance of cleaning, enzyming, and avoiding hairsprays and other causes of surface deposits.

CONCLUSION

Contavue Laboratories in Australia recently conducted a survey to determine the frequency of the most commonly encountered problems with toric soft lenses.[22] Results of their study indicate that when lenses are reordered, 41% are for fitting alterations (diameter, base curve), 33% for sphere and cylinder power changes, 26% for different cylinder axes.

Remba's data[7] do not concur with these figures. He found that the most frequent reason for initial lens failure was due to poor axis location and/or poor meridional stability (54%). Lens changes for base curve or diameter were infrequent and ineffective. And, as he points out, this is probably because "few parameter options were available at the time of the study."

Recent improvements in lens designs, new designs, new materials, quality control and increased parameter ranges will drastically improve the chances for successful soft toric contact lens fittings.

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