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Toric soft lens power calculation thesis

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Abstract

The basis of this project is to determine if the computer software program ToriTrack accurately predicts toric contact lens parameters that will neutralize a subject's refractive error. Calculations were compared to two different methods of cross cylinder calculations, the vector method and the lensometry method. The majority of the results from the ToriTrack method compared equally with our other methods used. However there were a small amount of trials done with ToriTrack that mildly differed from the other methods used. These results are unexplainable and would further need to be tested in ongoing research or thesis's.

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Subject Categories

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TORIC SOFT LENS POWER CALCULATION THESIS

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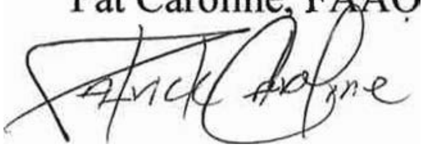


Biographies:

Brian Blanchard received a B.S. in Visual Science from Pacific University. Brian has attended Ricks College, Idaho State University, Utah State University, and Pacific University. He was awarded the WUE scholarship while attending Utah State University. Brian also received an Air Force Scholarship while attending optometry school and will serve in the Air Force for three years following graduation.

Daniel Nile Evans graduated from Idaho State University with a bachelor's of science. He is expected to receive his doctorate of optometry degree through Pacific University May of 2006. He has received the Western Interstate Commission for Higher Education award. This award is granted to one optometry student per year from the state of Idaho. Daniel plans on returning to the Idaho area to practice and expand his optometric experiences.

Shon Weaver received a B.S. in environmental engineering from Montana Tech. Shon has also attended Pacific University in Forest Grove, OR. Awards that he has received are: Montana Tech four-year honors scholarship, Plum Creek Timber Company honors scholarship, and WICHE scholarship from the state of Montana. Shon plans on joining a primary care practice in Whitefish, Montana following graduation.

Jon Zissman attended Vassar College and Northern Arizona University where he received his B.S. in microbiology. Jon was an Inaugural Hooper Grant recipient while attending Northern Arizona University. He currently attends Pacific University where he expects to receive his doctorate of optometry in May of 2006. Jon plans to settle down in a small ski town that will enable him to pursue both his professional interests and personal aspirations.

ABSTRACT

The basis of this project is to determine if the computer software program ToriTrack accurately predicts toric contact lens parameters that will neutralize a subject's refractive error. Calculations were compared to two different methods of cross cylinder calculations, the vector method and the lensometry method. The majority of the results from the ToriTrack method compared equally with our other methods used. However there were a small amount of trials done with ToriTrack that mildly differed from the other methods used. These results are unexplainable and would further need to be tested in ongoing research or thesis's.

Key Words:

ToriTrack
Cross-Cylinder
Lensometry
Vector Method
Toric Contact Lenses

INTRODUCTION

In determining the final parameters of a toric contact lens, ToriTrack requires three pieces of data, which include the following:

1. Refractive error vertexed to the plane of the cornea (sphere, cylinder, and axis),
2. Parameters of contact lens initially placed on subjects eye (sphere, cylinder, and axis), and
3. Value of sphero-cylinder over refraction performed on subject wearing the initial contact lens.

The ToriTrack software incorporates the mentioned data into cross-cylinder algorithms to predict the toric contact lens parameters that will neutralize the original refractive error.

For this project, the results from eight ToriTrack calculations will be compared directly to the results obtained from traditional lensometry techniques used to neutralize equivalent lab created optical systems. The optical systems created in the lab using the lensometer method will utilize the same parameters as the software program. When performed properly, the lensometry neutralization technique will provide accurate calculations of the cross-cylinder power effects of toric contact lenses.

CROSS-CYLINDER METHODS

Cross-cylinder effects of an optical system can be determined using three different methods. These three methods are the graphical/vector method, the mathematical method and the lensometry neutralization method. Each method will produce equal results for a specific data set. **A** step-by-step description is given below for each of the three methods that can be used to determine crossed cylinder effects.

GRAPHICAL or VECTOR METHOD

a. Transpose both cylinders to the same sign.

b. Choose A to be the cylinder with the smaller axis.

c. Plot A as a vector along a horizontal line (i.e., x-axis of a graph).

d. Plot B (the other cylinder) as a vector at an angle 2Φ with respect to A, where Φ is the difference between the two cylinder axes.

e. Complete the parallelogram and draw the long diagonal **C** connecting one end of the parallelogram to the other (see diagram below).

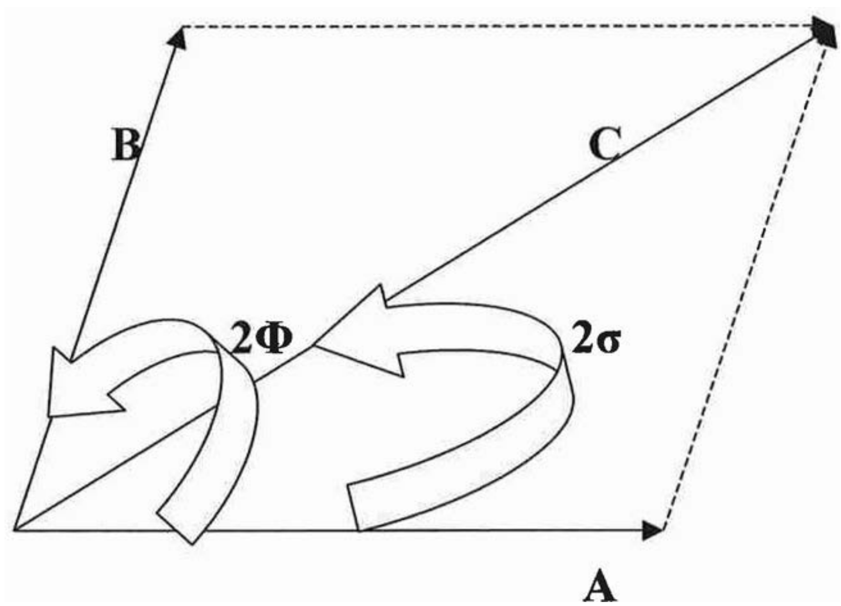
f. Measure the length of **C;** this is the resultant cylinder power.

g. Measure the angle 20 between **C** and A; half of this angle **(o)** plus the original axis of A is the resultant cylinder axis.

h. Calculate the resultant sphere power using the following equation:

$$D = (A+B-C)/2$$

and add this to the initial sphere powers, if any, of the original lenses.



MATHEMATICAL METHOD

a. Transpose both cylinders to the same sign.

b. Calculate the resultant cylinder power using the following equation:

$$C = (A^2 + B^2 + 2*A*B*\cos(2\Phi))^{1/2}$$

c. Calculate the cylinder axis of C with respect to A using the following equation:

$$\sin(20) = B/C*\sin(20)$$

d. Calculate the resultant cylinder axis by adding o to the cylinder axis of **A.**

e. Calculate the resultant sphere power using the following equation:

$$D = (A+B-C)/2$$

and add this to the initial sphere powers, if any, of the original lenses.

TRADITIONAL LENSOMETRY METHOD

Cylindrical Component

a. Place the cylindrical component of the contact lens in one lens well of trial fiame.

b. Place the cylindrical component of the over-refraction in one lens well of trial frame.

c. Neutralize the two lenses in the trial frame with lensometer.

d. The resultant power and axis represents the cylindrical portion of the contact lens that will properly correct the patient's refractive error.

Spherical Component

The spherical component is determined by simply combining the sphere power of the contact lens, the sphere power of the over refraction and the sphere power found in the above lensometry neutralization. It is not necessary to do this portion in the lensometer.

Figure 1

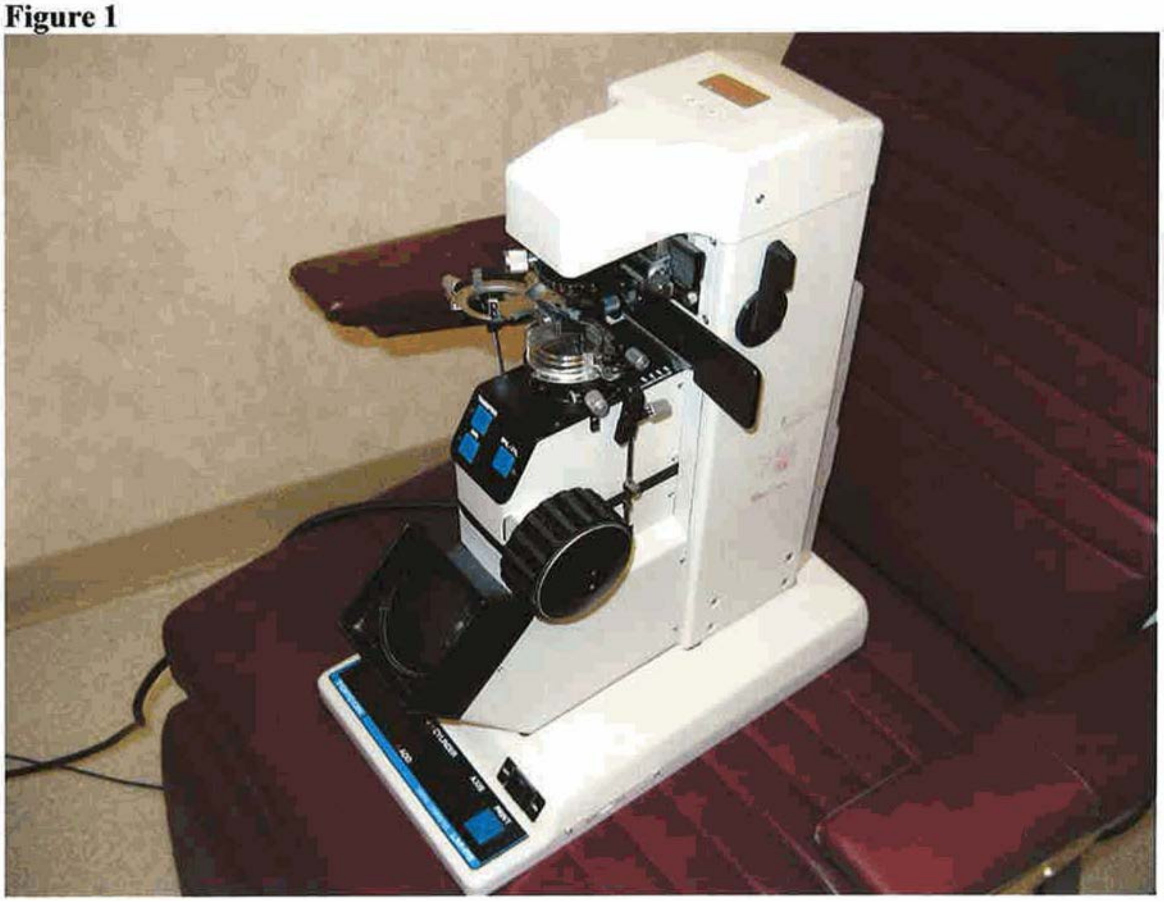


Figure 2

**Figure 1 and 2 are recreations showing the technique and manner in which the lensometry method was performed.*

SAMPLE PROBLEM
(Mathematical Method)

Spectacle Rx (OD): -0.25 - 1.75 x 110
Contact Lens: -0.50 – 1.25 x 160
Over Rx: +1.00 - 2.50 x 092

a. Both cylinders signs are negative
b. Resultant cylinder power is:

$C = (-1.25^2 + -2.50^2 + 2(-1.25)(-2.50)\text{Cos}(2*68))^{\wedge 1/2}$
$C = (3.317)^{\wedge 1/2}$
C = -1.821 approximately -1.75

c. Cylinder axis with respect the difference between original cylinder axes is:

$$\text{Sin } 2\sigma = -1.251 - 1.21 \text{ Sin } (2*68)$$
$$2\sigma = \text{Sin}^{-1} (.4761)$$
$$\sigma = 28.4812$$
$$\sigma = 14.24$$

d. Resultant cylinder axis is:

$$R = 14.24 + 92.0$$
R = 106.24 approximately 106

e. Resultant sphere power of the cylinder values is:

$$D = (-1.25 + -2.50 - -1.821)/2$$
D = -0.965 approximately 1.00

f. Final sphere power is the sum of all sphere powers:

Sphere = -0.50 + 1.00 – 1.00
Sphere = -0.50

g. Total of all sphere powers, resultant cylinder power and axis is final contact lens parameter.

-0.50 – 1.75 x 106

h. Different method comparison of final contact lens powers:

ToriTrack Method:	-0.25 – 1.75 x 106
Lensometer Method:	-0.50 – 2.00 x 109
Mathematical: Method:	-0.50 – 1.75 x 106

SUBJECT DATA AND FINAL LENS PARAMETER COMPARISON

Subject K.H. Data (OD, OS)

Spectacle Rx (OD):	-3.00 - 0.75 x 015
Contact Lens:	-0.75 - 2.00 x 178
Over Rx:	-0.75 - 2.25 x 090

Final Lens Rx

ToriTrack Method: ***-3.25 sph***
Lensometer Method: ***-3.50 sph***

Spectacle Rx (OS): -3.25 - 0.75 x 180
Contact Lens: -0.25 - 3.75 x 008
Over Rx: -1.25 - 2.75 x 087

Final Lens Rx

ToriTrack Method: -4.00 – 1.00 x 008
Lensometer Method: -4.25 – 1.25 x 032

Subject RP. Data (OD, OS)

Spectacle Rx (OD): -0.25 - 1.75 x 110
Contact Lens: -0.50 – 1.25 x 160
Over Rx: +1.00 - 2.50 x 092

Final Lens Rx

ToriTrack Method: -0.25 – 1.75 x 106
Lensometer Method: -0.50 – 2.00 x 109

Spectacle Rx (OS): -0.75 – 2.25 x 068
Contact Lens: -0.00 – 1.25 x 110
Over Rx: +0.50 - 2.75 x 056

Final Lens Rx

ToriTrack Method: -0.00 – 2.00 *x* 059
Lensometer Method: -0.25 – 2.50 *x* 066

Subject K.M. Data (OD, OS)

Spectacle Rx (OD); -6.00 – 1.00 x 180
Contact Lens: -2.00 – 1.25 x 160
Over Rx: -2.50 – 1.50 x 046

Final Lens Rx

ToriTrack Method: -5.25 – 0.75 x 025
Lensometer Method: -5.50 – 1.00 x 022

Spectacle Rx (OS): -5.50 - 0.75 x 180
Contact Lens: -1.75 – 2.25 x 010
Over Rx: -2.00- 1.75 x 118

Final Lens Rx

ToriTrack Method: ***-5.25 – 0.75 x 173***
Lensometer Method: ***-4.75 – 2.00 x 162***

Subject *S.C.* Data (OD, OS)

Spectacle Rx (OD): -3.50 – 3.50 x 005
Contact Lens: -4.00 – 3.75 x 010
Over Rx: +0.50 – 0.50 x 155

Final Lens Rx

ToriTrack Method: ***-3.75 – 4.00 x 006***
Lensometer Method: ***-3.50 – 4.00 x 005***

Spectacle Rx (OS): -3.25 – 4.00 x 178
Contact Lens: -4.00 – 1.75 x 130
Over Rx: +1.25 – 4.50 x 007

Final Lens Rx

ToriTrack Method: ***-4.00 – 3.25 x 009***
Lensometer Method: ***-4.00 – 3.75 x 176***

Subject P.M. Data (OD, OS)

Spectacle Rx (OD): -0.00 – 1.00 x 087
Contact Lens: -0.50 – 1.25 x 080
Over Rx: +0.50 – 0.50 x 150

Final Lens Rx

ToriTrack Method: ***-0.25 – 1.00 x 089***
Lensometer Method: ***-0.50 – 1.00 x 083***

Spectacle Rx (OS): -0.00 – 1.00 x 082
Contact Lens: -0.00 – 1.25 x 080
Over Rx: +0.50 – 0.25 x 065

Final Lens Rx

ToriTrack Method: ***+0.50 – 1.25 x 076***
Lensometer Method: ***+0.50 – 1.50 x 077***

Subject D.C. Data (OD, OS)

Spectacle Rx (OD): -0.75 – 0.75 x 150
Contact Lens: -3.50 – 1.25 x 140
Over Rx: +4.00 – 1.00 x 030

Final Lens Rx

ToriTrack Method: -0.00 – 0.50 x 164
Lensometer Method: -0.00 – 1.00 x 168

Spectacle Rx (OS): -1.00 – 0.50 x 025
Contact Lens: -5.00 – 1.25 x 010
Over Rx: +3.75 – 0.50 x 156

Final Lens Rx

ToriTrack Method: -1.75 – 1.00 x 180
Lensometer Method: -1.25 – 1.50 x 004

Subject C.D. Data (OD, OS)

Spectacle Rx (OD): -4.00 – 0.50 x 150
Contact Lens: -1.00 – 0.75 x 180
Over Rx: -2.00 – 1.00 x 027

Final Lens Rx

ToriTrack Method: -3.75 – 0.25 x 060
Lensometer Method: -3.00 – 1.50 x 016

Spectacle Rx (OS): -2.00 – 1.25 x 030
Contact Lens: -1.00 – 1.25 x 180
Over Rx: -0.50 – 0.75 x 064

Final Lens Rx

ToriTrack Method: -1.75 – 1.00 x 017
Lensometer Method: -2.00 – 1.00 x 026

Subject *H.I.* Data (OD, OS)

Spectacle Rx (OD): -1.25 – 0.75 x 085
Contact Lens: -3.00 – 0.75 x 070
Over Rx: +2.25 – 0.75 x 051

Final Lens Rx

ToriTrack Method: ***-1.00 – 0.75 x 040***
Lensometer Method: ***-0.75 – 1.50 x 058***

Spectacle Rx (OS):	-1.25 – 1.00 x 088
Contact Lens:	-2.25 – 0.75 x 160
Over Rx:	+1.75 – 1.75 x 082

Final Lens Rx

ToriTrack Method: ***-1.00 – 1.00 x 083***
Lensometer Method: ***-1.25 – 1.00 x 097***

DISCUSSION OF RESULTS

In comparison, some values between the ToriTrack method and the lensometry method are more or less the same, whereas other values are not similar at all. One explanation in the differences is the element of human error introduced into the optical system setup and lensometry neutralization. However, when comparing the values that were extremely different, the lensometry method compared almost exactly with the mathematical and graphical/vector method results. The consistency between the lensometry, mathematical, and graphical/vector methods suggests that ToriTrack is determining its results in a different manner than the other methods. Another factor which might contribute to the difference in results is the over refraction values due to the subjectivity involved.

CONCLUSION

The different results produced by the ToriTrack and the lensometry methods, demonstrates the two methods are not identical. This fact actually creates the need for a second or spin-off thesis to determine which method produces the best visual results. The next thesis should involve the actual wearing of the contact lens predicted by both methods and the patient subjectively assesses which lens creates the best visual acuity. If neither lens produces a satisfactory result there is no problem because the LARS (Left Add Right Subtract) method has a proven track record. The conclusion of this thesis is the lensometer method provides similar results to the mathematical and vector methods and can be used as another tool in formulation cross cylinder calculations of toric contact lenses. There were a small amount of trials done with ToriTrack that mildly differed from the other methods used. These results are unexplainable and would further need to be tested in ongoing research or thesis's.

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