A COMPARISON AND EVALUATION OF ASPHERIC LENS DESIGNS

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ABSTRACT: Six aspheric, single vision lens designs, were subjectively and objectively compared by four non-presbyopic, hyperopic patients. The lenses chosen were Sola Optical's ASL Polycarbonate and Spectralite, Rodenstock's Cosmolit, American Optical's Aspherlite, Silor Optical's Hyperal, and Gentex Optic's Profile. The subjects were previously wearing spherical design single vision spectacles or contact lenses to correct their ametropia. Two of the four subjects preferred the Spectralite Aspherics overall, while the remaining two subjects preferred their habitual contact lenses.

INTRODUCTION: Hyperopic patients have long been subject to heavy, thick-centered, and magnified appearing prescription eyeglasses. Lens manufacturers are continually striving to design new materials free from distortions and other aberrations which become detrimental to image quality and a patients ability to function on both a visual and cosmetic basis. Studies have been conducted which have attempted to describe the aberrations produced by spherical as well as aspherical lenses (1). Similarly, studies describing measuring and/or comparing distortions produced by progressive addition lenses have been described (2,3,4). Single vision, aspheric lenses are an example of how lens designers have tried to meet the visual and cosmetic needs of the non-presbyopic, hyperopic patient, by utilizing the Cartesian Oval Theory with different lens materials (5). This study was conducted to assess the consequences of fitting non-presbyopic, hyperopic, spherical design spectacle or contact lens wearers with six different aspheric lens designs in order to determine which design(s) seems best based upon subjective and objective subject responses.

MATERIALS AND METHODS: Standard fitting techniques were applied for the fitting, adjusting and dispensing of each pair of lenses. Frames were chosen based on proximity of pupil to vertical center of frame (within 5mm of 180 line). Horizontal decentration was kept to a minimum, however, no specific horizontal parameters were established.

The goal of this study was to compare the performance and physical characteristics of a variety of aspheric lens designs. The lenses used were the Sola ASL PC (polycarbonate 1.586 index), Sola ASL+ PL (Spectralite 1.54 index), Rodenstock Cosmolit (1.499 index), AO Aspherlite (CR-39, 1.498 index), Silor Hyperal (1.523 index), and the Gentex Profile (Polycarbonate, 1.586 index). Two different optical laboratories were used for the surfacing of the study lenses. The first three lenses named above were surfaced at Twin Cities Optical in Traverse City Michigan. The remaining three lenses were surfaced at Optical Supply, Inc. of Grand Rapids, Michigan.

Various manufactures use different criteria to highlight the particular strong points of their lenses. For the purpose of this study the manufacturers criteria for lens superiority were disregarded and four physical parameters were recorded from each pair of lenses. These measurements consisted of center thickness, base curve, minimum edge thickness, and the weight of each lens. The center thickness and base curve was measured at the optical center of each lens. The base curve was measured by placing the center peg of the lens measure at the optical center of each lens. The instruments used for these measurements were a Vigor lens caliper G-302 to determine thickness, Vigor ball-tip lens measure Ga-760 to determine base curve, and a standard top-loading balance for weighing the lenses. A Humphrey's automated lensometer was used to verify the prescription of each lens. Random verification checks utilizing a standard Bausch and Lomb Vertometer was also performed. The data acquired from the physical measurements are listed in Table I. The prescription and patient's PDs are listed with each individual case as they were verified.

Subjects for the study were limited to pre-presbyopic hyperopes between ages 18 and 38. The spherical portion of the subjects refractive errors ranged from +3.00D to +8.25D. No limit was placed on the amount of cylinder correction. All participants were correctable to at least 20/20 and free from any ocular pathology.

Visual acuities were taken in a 20 foot examination lane with an AO Project-o-chart and are recorded in standard Snellen notation. Acuity was taken in the straight ahead position and also at 25 degrees to the right and left. The off center measurements were achieved by rotating the examination chair. When the chair was rotated to the patient's right, the eyes made a counter rotation to the left in order to view the chart. Thus, the right eye looks through the nasal aspect of the lens and left eye looks through the temporal portion of the lens. Similarly, with chair rotation to the left, eyes rotate to the right. Close observations monitoring patient head position were performed throughout visual acuity measurements to ensure the subject did not turn their head when reading the acuity chart. For completeness, binocular visual acuities at 40cm were also recorded. Near reading level was assumed to be 8mm (16 degrees) below the major reference point (MRP). The near acuity values are recorded in Snellen equivalents. Table IIIa and IIIb lists the acuities recorded.

The subjects involved were required to wear the various lenses for a 10 to 14 day period with the first test lens being used a second time as the last test lens. After the adaptation period, visual acuity was measured and questionnaires were completed. A sample questionnaire is provided (see Figure Ia and Ib). The subjective responses to the questions are compiled in Tables IIa, IIb, IIc, and IId.

Table I

LENS TYPE	CT O.D./O.S.	BC O.D./O.S.	MIN ET O.D./O.S	WT (GRAMS) O.D./O.S
SUBJECT #1	O.D. +8.00 -2.25 X 91 O.S. +8.25 -2.25 X 84		P.D. 30/30	
1. SOLA ASL PC	5.6/5.9	+ 7.25 O.U.	1.6/1.3	8.41/8.60
2. SOLA ASL PL	6.0/6.0	+ 8.50 O.U.	0.8/0.8	8.93/8.66
3. COSMOLIT	6.3/6.3	+ 8.00 O.U.	1.2/0.9	9.86/9.62
4. ASPHERLITE	7.5/7.6	+ 8.75 O.U.	1.7/1.5	12.34/12.30
5. HYPREOL	4.6/4.5	+ 10.0 O.U.	0.5/0.6	7.66/7.55
6. PROFILE	4.5/4.7	+ 8.50 O.U.	1.8/1.8	10.18/1048
SUBJECT #2	O.D. +3.00 -0.75 X 180 O.S. +3.00 -0.50 X 180		P.D. 30.5/30.5	
1. SOLA ASL PC	4.4/4.3	+ 7.25 O.U.	1.6/1.4	8.20/7.96
2. SOLA ASL PL	4.6/4.7	+ 7.00 O.U.	1.8/1.7	8.70/8.88
3. COSMOLIT	3.9/3.8	+ 5.00 O.U.	1.0/0.8	7.55/7.21
4. ASPHERLITE	3.6/3.6	+ 5.75 O.U.	O.9/0.8	6.91/6.86
5. HYPEROL	4.6/4.5	+ 5.75 O.U.	1.8/1.8	9.22/9.12
6. PROFILE	4.5/4.7	+ 6.25 O.U.	1.8/1.8	8.49/8.86
SUBJECT #3	O.D. +7.25 SPH O.S. +7.75 -0.75 X 25		P.D. 30/30	
1. SOLA ASL PC	7.9/8.4	+ 7.25 O.U.	1.5/1.8	12.80/13.64
2. SOLA ASL PL	7.7/8.4	+ 8.50 O.U.	1.0/1.1	12.13/13.47
3. COSMOLIT	7.6/9.2	+ 8.00 O.U.	0.5/1.4	12.27/16.00
4. ASPHERLITE	7.3/7.4	+ 8.75 O.U.	1.8/0.9	12.43/12.63
5. HYPEROL	N/A	N/A	N/A	N/A
6. PROFILE	7.3/7.0	+ 8.00 O.U.	1.4/1.3	12.04/11.61
SUBJECT #4	O.D. +3.75 -2.50 X 90 O.S. +4.25 -3.50 X 90		P.D. 30/30	
1. SOLA ASL PC	4.0/4.6	+ 7.50 O.U.	1.2/1.5	8.75/10.08
2. SOLA ASL PL	4.3/4.6	+ 7.00 O.U.	1.2/1.3	9.44/10.30
3. COSMOLIT	4.7/4.4	+ 7.00 O.U.	1.8/1.2	11.23/10.44
4. ASPHERLITE	4.3/4.5	+ 5.75 O.U.	2.0/2.1	10.22/10.89
5. HYPEROL	3.7/3.5	+ 5.00 O.U.	1.5/1.3	8.38/7.95
6. PROFILE	N/A	N/A	N/A	N/A
SUBJECT #5	O.D. +8.25 -0.75 x 170 O.S. +8.25 -2.00 X 165		P.D.29/29	
1. SOLA ASL PC	7.7/7.7	+ 7.25/7.50	1.8/1.8	11.70/11.84
2. SOLA ASL PL	8.2/8.4	+ 8.50 O.U.	1.8/2.0	12.42/13.14
3. COSMOLIT	8.2/8.3	+ 7.75/8.00	1.8/1.2	13.13/13.48
4. ASPHERLITE	N/A	N/A	N/A	N/A
5. HYPEROL	7.8/7.8	+ 8.50 O.U.	1.3/1.4	11.62/12.14
6. PROFILE	8.2/8.1	+ 8.00 O.U.	1.4/1.2	12.50/12.49

Figure Ia

Sample Questionnaire for Aspheric Lens Research

1) Before you were given your first set of study lenses, did you wear glasses or contact lenses?

2) Could you notice any visual differences between this pair of study lenses and the last pair of study lenses?

3) Did you experience any visual problems with this pair of study lenses that you did not experience with the previous pair of study lenses?

4) Was there any time or situation in which your could not wear the study lenses?

5) Was there any time while you were wearing the study lenses that you could not do your normal daily tasks?

6) a. When compared to your previous study lenses, did you notice any apparent increase or decrease in the size of your eyes while wearing this pair of study lenses?

If yes, did your eyes appear: (a)Larger (b)Smaller?

On a scale of One-to-ten, how would you rate the difference in eye size compared to your previous study lenses?

b. When compared to your contact lenses, did you notice any apparent increase or decrease in the size of your eyes while wearing this pair of study lenses?

If yes, did your eyes appear: (a)Larger, (b)Smaller?

On a scale of one-to-ten, how would you rate the difference in eye size compared to your previous contacts?

7) How many hours per day did you wear the study lenses?

8) How long did it take to adapt to the study lenses?

9) a. From a cosmetic standpoint, would you feel comfortable wearing these study lenses in public?

b. Was your vision clear and comfortable while wearing these study lenses?

Figure Ib

10) a. From a cosmetic standpoint, compared to your own pair of glasses or contacts, do you feel more or less comfortable wearing these study lenses in public?

b. On a scale of one-to-ten, by how much did you feel your comfort changed (with regards to your cosmetic appearance)?

11) a. Compared to your own pair of glasses or contacts, do you feel your vision, overall, is better or worse?

b. On a scale of one-to-ten, by how much did you feel your vision changed?

12) Overall, how would you rate this pair of study lenses compared to your own pair of glasses/contacts?

worse		same		better
1	2	3	4	5

13) Of <u>all the study lenses</u> tried so far, which did you like best?

My own pair of glasses/contacts			<u>study lenses</u>			
1	2	3	4	5	6	7

Aspheric Lens Study - Table IIa Questionnaire Tally

Subject	Question #	Cosmo 1	Spectra.	Aspherlite	Hyperal	ASL Poly	Gentex	Cosmo 2
One(1)	1)	CL	CL	CL	CL	CL	CL	CL
	2)	Yes, Clearer/ Periph.Better	Yes, Objects Pronounced	Yes, Objects Not as Clear	Yes, No Periph vision	Yes, I saw more clearly	Yes, Distance vision Blurry	Yes, Objects were clearer
	3)	No	No	Yes, HAs and Near Tasks	Yes, HAs	No	No	No
	4)	Yes, water sports	No	No	Yes, Couldn't Wear @ all	No	No	No
	5)	No	No	No	Yes, HAs and Couldn't Focus	No	No	No
	6)a.	Yes,small,3	Yes,small,2	Yes,large,2	No	No	No	Yes,small,3
	b.	No	No	Yes,large,4	Yes,large,2	Yes,large,3	yes,large,2	yes,large,4
	7)	12-14hrs	10-12hrs	8-10hrs	1-2hrs	8-10hrs	8-10hrs	10-12hrs
	8)	2-3hrs	1hr	1hr	Never Adapted	1-2hrs	1-2hrs	Under 1hr
	9)a.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	b.	Yes	Yes	No.Distance Objects Blurry	No. Couldn't Focus	Yes	Yes	Yes
	10)a.	More	More	More	Less	Less	Less	Less
	b.	6	7	2	3	2	4	3
	11)a.	Better	Better	Better	Worse	Better	Better	Better
	b.	3	5	3	5	2	3	3
	12)	5	5	4	2	4	4	4
	13)	1	2	2	2	2	2	2

		Cosmo 1	Spectral	ASL Poly	Aspherlite	Gentex	Hyperal	Cosmo 2
Two(2)	1)	CL	CL	CL	CL	CL	CL	CL
	2)	No	Yes, Small Print Blurry	Yes, Small Print Clearer	Yes, Small Print clear & vision Clear @ top of lens	Yes, a Glare seemed to exitst	No	Yes, Fine Print Clearer
	3)	No	Yes, Small Print Blur	Yes, blur @ Top & Bottom of Lens	No	No	No	No

Aspheric Lens Study - Table IIb

4)	Yes, Needed 2hrs to adjust to Lenses	Yes, HAs & Blur @ End Of Day	No	Yes,first Evening HAs, No Problems after	No	No	No
5)	No	Yes, Had to Squint for Fine print	No	No	No	No	No
6)a.	N/A	No, 5	No, 5	No,5	No,5	No	No
b.	Yes,Large,5	Yes,Large,8	Yes,Large,8	Yes,Large,8	Yes,Large,8	Yes,Large,7	Yes,Large,5
7)	18hrs	16-17hrs	17-18hrs	17-18hrs	17-18hrs	17hrs	17hrs
8)	2hrs	6hrs	Immediately	6hrs	Immediately	Immediately	Immediately
9)a.	Yes	No, prefer CLs	Yes	Yes	Yes	Yes	Yes
b.	Yes	No, Small Print Blur	Yes	Yes	Yes	No, Small Print Blur	Yes
10)a.	Less	Less	Less	Less	Less	Less	Less
b.	3	8	3	8	3	4	7
11)a.	Didn't Notice any Change	Worse	Worse	Worse	Worse	Worse	Worse
b.	5	9	3	3	4	3	4
12)	2	1	2	2	2	2	2
13)	CLs	CLs	CLs	CLs	CLs	CLs	CLs

		ASL Poly	Spetral	Cosmo 1	Gentex
Three(3)	1)	CL	CL	CL	CL
	2)	Yes, Changes with Perception and Dizziness	Yes	Yes, Brighter at first, then Blurry	Yes, Couldn't see as well
	3)	Yes, as 2)	No	Yes, Blur/Dizzy if Worn over time	No

Aspheric Lens Study - Table IIc

4)	Yes	No	No	Yes, Don't Feel Confident Driving
5)	---	No	Yes, Dizzy Espec. During the Day	No
6)a.	Yes,Small,5	Yes,Large,3	No	No
b.	Yes,Large,8	Yes,Large,7	Yes,Large,7	Yes,Large,8
7)	5-15min	3-5hrs	2-3days	5-8hrs
8)	Never Did	---	---	A long Time
9)a.	No	No	Yes	Received Bad Comments
b.	No	Not used to it	---	No, Couldn't see well
10)a.	Less	Less	Less	Less
b.	1	6	8	6
11)a.	Worse	Same	Better at First, then Bad	Worse
b.	1	---	6	7
12)	1	2	2	2
13)	CLs	2	CLs	CLs

		ASL Poly	Spectral	Cosmolit
Four(4)	1)	Glasses	Glasses	Glasses
	2)	Yes, Objects Seemed Closer	Yes, No HAs	Yes, Last Lenses were Clearer
	3)	Yes, HAs	No	No
	4)	Yes, During Episodes of HAs	No	No
	5)	No	No	No

Aspheric Lens Study - Table IId

6)	No		No		No
7)	3hrs		16hrs		15hrs
8)	2days		2hrs		1day
9)a.	Yes		Yes		Yes
b.	Yes		Yes		--
10)a.	More		More		Less
b.		5	---		5
11)a.	Better		Better		Better
b.		6	6		1
12)	3(same)		4		3
13)	Own Glasses		2		2

RESULTS: Of the five subjects initially enrolled in the study, only two successfully completed the study by wearing all six pairs of lenses for the prescribed time period. One patient gave birth during the study time-frame and was therefore able to wear only four pairs of the study lenses before her baby arrived. One subject was able to wear three pairs of lenses before the demands of his occupation would not permit him to complete the study. The last subject had recently gone back to school and moved farther away from home (and FSU) and was therefore unable to try any of the study lenses. Therefore, data were analyzed for only the remaining four subjects.

Questionnaire Results: See Fig. Ia and Ib - Questionnaire Tally

Subject 1 was a male, primarily a contact lens wearer before the study. Of the six study lens pairs tried, this subject preferred Spectralite overall, even over his own pair of contact lenses. The Hyperal lenses received the worst review by this subject, who claimed he could never adapt to the lenses because of blurred vision, headaches, and lack of peripheral vision. In fact, the Hyperal lenses were the only ones that the subject felt his vision, overall, was worse compared to his habitual pair of contact lenses. The remaining five study lens pairs were rated better, overall, than compared to his habitual correction, although there appeared to be some problems with blurred vision at distance with the Aspherlite and profile lenses. The Spectralite and Cosmolit lenses seemed to produce the only minification in apparent eye size when compared to other study lenses. In addition, these lenses seemed to have no effect on apparent eye size when compared to the subject's habitual contact lenses. It's interesting to note however, that after the subject tried the Cosmolit lenses for a second time, a noticeable increase in apparent eye size was recognized by him when compared to his habitual contact lenses.

Subject 2 was a female, primarily a contact lens wearer before the study. Of the six lens pairs tried, overall, this subject preferred her own habitual contact lenses. Visually, the study lenses performed inferiorly or at best, equal to her habitual contact lenses. The Spectralite and Hyperal lenses produced blurry vision with fine print at near, the Aspherlite lenses produced a blur at the top and bottom peripheral aspects and the ASL Polycarbonate lenses exhibited a noticeable "glare". Cosmetically, the subject reported no difference in apparent eye size between the study lenses but in every case the study lenses produced noticeable magnification when compared to her habitual contacts. The study lenses which seemed to produce the largest noticeable difference in eye size were the Spectralite, Aspherlite, Hyperol, and ASL Polycarbonate lenses each with a rating of eight on a one-to-ten scale when

compared to her contact lenses. This subject appeared to remark most negatively towards the Spectralite lenses. These lenses apparently produced headaches by the end of the day for the subject and as mentioned earlier, fine print at near point was blurred. Adaption time was longest for the Spectralite and aspherlite lenses, each requiring about six hours.

Subject 3 was a female primarily a contact lens wearer before this study. Of the four study lens pairs tried, overall, this subject preferred her habitual pair of contact lenses. As with subject 2, visually speaking, the study lenses performed inferiorly or at best equal to her habitual correction. Problems with perception, blurry vision, and dizzy spells were experienced by the subject during study lens wear (See Table II). Her vision with the Gentex Profile lens was compromised to the point that she felt unsafe driving with them. Cosmetically the lenses produced a noticeable increase in eye size compared to her contact lenses, with a value of 7 out-of-ten assigned to the Spectralite and Cosmolit lenses, and a value of 8 out-of-ten given to the Profile and ASL Polycarbonate lenses. The ASL Polycarbonate lenses seemed to produce a noticeable minification when compared to her own spectacle lenses. She noticed a slight increase in apparent eye size with the Spectralite lenses compared with the ASL Polycarbonate lenses, while the Cosmolit and Profile lenses produced about the same apparent eye size magnification as the Spectralites. In addition, the subject received numerous negative comments from her peers regarding the appearance of the Gentex Profile lenses, yet she assigned the greatest value of cosmetic non-comfort to the Cosmolit lenses with a value of 8 out-of-ten assigned. It is important to point out, however, that this subject wore her lenses the least amount of time on-average, compared to the other three subjects (See Table II). In addition, this subject failed to answer all the questions completely, making the subjective portion of this part of the study harder to analyze.

Subject 4 was a male, primarily a spectacle lens wearer before this study. This subject compared three study lenses: the ASL Polycarbonate, the Spectralite, and the Cosmolit lenses. Overall, this subject preferred the Spectralite lenses best while the ASL Polycarbonate and Cosmolit lenses were rated equal to his habitual spectacles (See Table II Questions 12 & 13). Visually all three lenses seemed to provide better vision than the subjects habitual spectacles. The ASL Polycarbonate and the Spectralite lenses were each assigned a value of 6 out-of-ten in regards to the visual improvement experienced, while the Cosmolit only showed a minimal improvement with a value of 1 out-of-ten reported (See Table II, Question 11). In addition, the subject experienced headaches while wearing the ASL Polycarbonate lenses. Cosmetically, the subject reported no difference in apparent eye size with any of the study lenses. Adaptation time was longest and the wearing time was shortest with the ASL Polycarbonate lenses, while the adaptation time was shortest with the Spectralite lenses (See Table II, Questions 7 & 8).

Visual Acuity Results: See Table III - Visual Acuities

Table III lists the visual acuities of the four subjects. Each number represents the denominator of the Snellen acuity fraction, with the numerator being a 20-foot test distance. Acuities were rounded up or down to the next Snellen line using +3/-3 as the rounding criterion. For instance, an acuity of 20/20-2 would be recorded as 20/20, yet an acuity of 20/20-3 would be recorded as 20/25, etc.. "Straight" are the acuities taken with the subjects facing the acuity chart. "Rt 25" are the acuities taken with the subject turned 25 degrees to the right of the straight ahead position. "Lt 25" are the acuities taken with the subject turned 25 degrees to the left of the straight ahead position. The "40cm" designations are the binocular near acuities recorded, and "AVG" are the column/row averages.

Subject 1 demonstrated an average visual acuity of slightly better than 20/20 with the Spectralite lenses in all measured directions which helps to explain his preference for these lenses. The Hyperal lenses seemed to provide adequate vision in the straight ahead position but poor acuities were evident when the subject was turned 25 degrees to the right or to the left. In particular, when the patient was turned 25 degrees to the right, average acuity plummeted to slightly better than 20/60. These results are consistent with the subject's subjective responses to the study questionnaire. It's interesting to note that the subject demonstrated poorest left-eye monocular acuity with the Hyperal lenses when turned 25 degrees to the right, and poorest right-eye monocular acuity when turned 25 degrees to the left. All other study lenses provided an average of 20/20 vision or better in all directions. The subject apparently had slightly reduced left-eye monocular acuity the first time he tried the cosmolit lenses, but his acuity improved with this lens upon a second trial.

Subject 2 expressed concern with the Spectralite and Hyperal lenses, noting they produced blurry vision with fine print at near point. Table II shows that the subject appears consistent with her subjective responses since the near acuities were slightly reduced at 40cm with the Spectralite and Hyperal lenses. The subject seemed somewhat inconsistent, however, with regards to the aspherlite lenses. She expressed concerns over peripheral "blur" at the top and bottom of these lenses, yet her distance acuities averaged better than 20/20 in all directions of gaze with these lenses and her near vision was 20/20. The subjects peripheral acuities were slightly reduced with the ASL Polycarbonate lenses (but still 20/20), which may be explained by the "glare" she was experiencing with these lenses. The remaining study lenses produced 20/20 or better acuities, yet were still judged inferior to the subjects contact lenses. As with subject 1, monocular acuity with the Cosmolit lenses was slightly reduced at distance peripherally, yet upon a second trial with the lenses the acuity improved (See Table III Subject 2, Rt 25 OD, Cosmo 1 & Cosmo 2).

Visual Acuity Results Continued:

Subject 3 experienced the lowest visual acuities with the ASL Polycarbonate lenses, with an average of 20/200 vision when turned 25 degrees to the right and slightly less than 20/40, on average, when turned 25 degrees to the left. The Spectralite lenses produced the second worst acuities with slightly reduced straight ahead distance acuity and significantly reduced peripheral acuities of about 20/60 when turned to the right, and about 20/40 when turned to the left. The acuities from the Spectralite lenses would seem to warrant a bad subjective rating, yet she rated these lenses as being about equal visually to her habitual contact lenses. The Profile and Cosmolit lenses performed about the same with regards to acuity, both showing the most notable drop in the peripheries. It's interesting that the subject made it a point to express her lack of confidence while driving with the Profile lenses and yet her worst acuities were recorded with the ASL Polycarbonate lenses (in the periphery) and all other study lenses produced worse (Spectralite), or only slightly better (Cosmolit) vision. The subjects near acuity appeared unchanged between the study lenses as 20/20 vision was achieved with all of them.

Subject 4 achieved 20/20 or better visual acuity with all three study lens pairs at distance and all other orientations (See Table III). The Spectralite lenses produced the most consistent 20/15 vision which may account for his overall preference for this lens, although the headaches experienced with the ASL Polycarbonate lenses probably contributed to their lower rating.

DISCUSSION: As the data shows (Table I) there is apparently no direct correlation between either base curve or the lens type used related to weight or thickness. There is, however, a direct correlation between lens thickness and overall weight of each lens which is to be expected. The main factor affecting the physical characteristics of the lenses used in this study was that minimum thickness requirements for each lens was not met. Manufacturers recommend a 1.0mm edge thickness on all six styles of aspheric lenses used. Table I shows these recommendations were not met. Minimum edge thickness for a plus power lens is a substantial factor for determining overall thickness and weight of a lens.

With the subject attrition experienced in this study, it is impossible to decide which aspheric lens design is truly best. If all five subjects were able to compare all six lenses, perhaps some concrete conclusions could be made. However, since at least three of the lens pairs were compared by four subjects, it is probably safe to make some generalizations regarding them. The three lenses were the Sola Spectralite, Sola ASL Polycarbonate, and the Rodenstock Cosmolit. Two of the four subjects, both males, preferred the Spectralite lenses even over their habitual prescription.

Table IIIa - Visual Acuities

Subject	ASL Poly	Cosmol 1	Cosmo 2	Aspherlite	Hyperal	Profile	Spectralite	AVG
One(1)								
Straight								
OD	15	15	15	15	15	15	15	15
OS	20	25	20	20	20	20	20	21
OU	15	15	15	15	15	15	15	15
AVG	17	18	17	17	17	17	17	17
Rt 25								
OD	15	15	15	15	40	15	15	19
OS	15	30	20	15	80	20	20	29
OU	20	15	15	15	50	20	15	21
AVG	17	20	17	15	57	18	17	23
Lt 25								
OD	15	15	15	15	30	20	15	18
OS	15	30	20	20	20	25	20	21
OU	20	15	15	15	30	15	15	18
AVG	17	20	17	17	27	20	17	19
40cm	20	20	20	20	20	20	20	20
Two(2)								
Straight								
OD	15	15	15	15	15	15	20	16
OS	15	15	15	15	15	15	20	16
OU	15	15	15	15	15	15	20	16
AVG	15	15	15	15	15	15	20	16
Rt 25								
OD	20	30	15	15	15	15	20	19
OS	20	15	15	15	15	15	20	16
OU	20	15	15	20	15	20	20	18
AVG	20	20	15	17	15	17	20	18
Lt 25								
OD	20	15	15	15	15	20	15	16
OS	20	15	15	15	15	20	20	17
OU	20	15	15	15	15	15	20	16
AVG	20	15	15	15	15	18	18	17
40cm	20	20	20	20	25	20	25	21

Table IIIb - Visual Acuities Continued

Subject	ASL Poly	Cosmo 1	Profile	Spectralite	AVG
Three(3)					
straight					
OD	20	20	25	25	23
OS	20	20	25	25	23
OU	20	20	20	20	20
AVG	20	20	23	23	22
Rt 25					
OD	200	30	40	50	80
OS	200	40	50	70	90
OU	200	25	40	70	84
AVG	200	32	43	63	85
Lt 25					
OD	60	30	25	40	39
OS	40	30	25	70	41
OU	30	20	25	20	24
AVG	43	27	25	43	35
40cm	20	20	20	20	20
Four(4)					
Straight					
OD	15	15		15	15
OS	15	15		15	15
OU	15	15		15	15
AVG	15	15		15	15
Rt 25					
OD	20	20		15	18
OS	15	15		15	15
OU	15	15		15	15
AVG	17	17		15	16
Lt 25					
OD	15	15		15	15
OS	15	15		15	15
OU	15	15		15	15
AVG	15	15		15	15
40cm	20	20		20	20

One of the male subjects was primarily a contact lens wearer and the other was primarily a spectacle lens wearer. Therefore, the Spectralite preference here seems to be independent of the habitual prescription among the males in this study. However, if the subjects were under corrected with their habitual prescriptions, then their preference for at least one of the study lens pairs would be understandable.

Subjects 2 and 3 had a different view of the Spectralite lenses. Subject 2 experienced blurred vision at near point and headaches by the end of the day with the Spectralite lenses. This subject might have been slightly under corrected with these lenses since her distance visual acuity averaged 20/20 and it is evident from Table III that she was able to achieve 20/15. If she was under corrected, the blurred vision at near point and the headaches would be understandable. Subject 3 rated the spectralite lenses, overall, inferior to her habitual contacts. However, as mentioned earlier, these lenses were rated about equal, visually, to her contacts. This could be explained if her contact lenses were not fully correcting her ametropia and/or because of her pregnancy, her visual acuity was fluctuating.

The Cosmolit and ASL Polycarbonate lenses were rated inferior by all four subjects. The females preferred their habitual contact lenses to all the study lenses tried, while the males preferred the Spectralite lenses even over their habitual prescription.

CONCLUSION: This study showed a wide variation in acceptance by any subject of all the aspheric lens designs. This makes duplication of a specific manufacturers lens design all the more important. Physical parameters data for this study point to two major considerations which should be kept in mind no matter what aspheric lens design is used. These considerations are: (1) The practitioner should verify that with a hyperopic prescription the manufactures minimum thickness parameters have been met. (2) When the need to duplicate an aspheric lens arises and there are no previous records of the patient's lens type, duplication at best is difficult. The only lens in this study that could be physically identified was the Sola ASL+ Spectralite which can be identified by a small oval shaped "S" which is etched 17mm from the lens optical center. No other indications such as base curve can be used as an indicator.

Since each of the four subjects had a full visual exam within a year of the beginning of this study, it is assumed that each of the subjects were fully corrected with their habitual prescriptions. If this assumption is correct, then it is impossible to safely predict the most desirable aspheric lens because no one design was desired by the majority of the subjects. Although the males of this study preferred the Spectralite lenses, it cannot be said that most males would feel the same. Likewise, just

because the two females disliked the lenses, no conclusions can be made regarding female preferences for aspheric lenses. More studies in this area need to be conducted before any conclusions can be drawn. Studies with greater numbers of subjects and fewer lens pairs to compare should help control attrition rates which greatly plagued this study.

The following changes and/or additions should be considered for implementation into any further research in this area:
(1) The study population should be a minimum of 30 subjects for valid statistical analysis. (2) Spherical CR-39 and Polycarbonate lenses should be incorporated into the lens pool. (3) Group and compare lenses with similar prescriptions. (4) Eliminate habitual corrections, including contact lenses from the study. (5) Assess initial reactions immediately after dispensing new test lenses. (6) Make the 10 day adaptation period mandatory. (7) Emphasize the time commitment to potential test subjects. (8) Eliminate subjects with systemic conditions which may affect refractive error (eg. pregnancy, diabetes, etc.).

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