Verifying and evaluating progressive addition lenses in clinical practice

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Background: Despite the fact that more than 50% of multifocal lenses dispensed in the United States are progressive addition lenses, adequate methods for clinical verification of these lenses have been lacking. Using automated lens meter techniques, the author describes a simplified method for verification of these complex lenses.

Methods: Thirty pairs of progressive lenses were measured in a modified method using a Humphrey 330 Lens Analyzer. Fifteen pairs were "premium-quality" progressive lenses: fifteen pairs were "non–premium-quality" progressives. Five criteria were assessed on each lens: Distance Zone Width (DZW), Intermediate Zone Width (IZW), Near Zone Width (NZW), Drop Distance (DD), and Maximum Astigmatic Distortion (MAD).

Results: "Premium-quality" progressive lenses failed to demonstrate clear-cut superiority over "non–premium-quality" progressive lenses in the five specified criteria. Individual measurements indicate considerable product inconsistency affected every brand tested.

Conclusions: Premium- and non–premium-quality progressive lenses demonstrated similar performance characteristics in this study. Zone size variation in these lenses was found to be considerable, a characteristic that seemed to cut across brand lines. The AO Compact lens seemed to demonstrate a shorter drop distance than other lenses, which does enhance its suitability for use with small frames. A comparison of the Essilor Natural PAL to the Younger Image lens showed little difference in the categories measured, although peripheral distortions seemed closer to the reading zone in the Image. A comparison of the MAD of lenses in this study to lenses tested in 1986 indicates a considerable improvement has been made in that important characteristic.

Key Words: Distance zone width, drop distance, intermediate zone width, maximum astigmatic distortion, near zone width, progressive addition lenses

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The sales of progressive addition lenses to optometric patients have been steadily increasing for the last three decades.[1] Maitenaz[2] was the pioneer who developed the optical properties and manufacturing techniques involved in the development of the first Varilux lens, marketed in 1959. Over the years, these lenses have increased in sophistication and are now made in many brands and variations, with extremely complex design formulations, to produce trifocal—like optics with no dividing lines. In many cases, these complex lenses are dispensed to patients without the dispenser having a thorough understanding of what characteristics the lenses may be expected to have. Dispensers often do not know whether or not the lenses they are dispensing are accurate and efficacious. When patients experience a problem, many times they are considered a "non-adapt" case and are refitted with conventional bifocals, whether the cause of a problem is understood or not.

Sheedy et al.[3] analyzed PAL lenses in 1986 as part of a project established by the American Optometric Association Commission on Ophthalmic Standards. This commission, in conjunction with several lens manufacturers, developed a format to "...provide information on the optical characteristics of these lenses that is meaningful and comparable from one lens to another." Unfortunately, the technique of that study was too time-consuming to have practical clinical application, and no other study of progressive lens optical characteristics has used that format. The authors of that study did identify important distinguishing characteristics of progressives, including: (1) the size and locations of the reading and distance viewing zones; (2) the width and length of the progressive corridor; (3) the rate of power change in the corridor; and (4) the location, magnitude, and axis of unwanted spherocylindrical power in the lenses.

Table 1. PAL Experiment

Rx no.	Rx	Add	Lens	DZW	IZW	NZW	DD	MAD
1	O.D. +0.25 = –0.25 × 80	1.00 D	Sola XL	31	7	7	23	1.00 D
	O.S. Plano	1.00 D	Sola XL	33	6.5	17	23	1.00 D
2	O.D. –0.75 = –0.75 × 105	1.75 D	Essilor Natural	25	7	10.5	22	1.75 D
	O.S. –0.25 = –0.50 × 127	1.75 D	Essilor Natural	19.5	4	7	22	1.75 D
3	O.D. Plano = –0.50 × 90	1.50 D	Sola VIP	29	5	13	21	1.75 D
	O.S. Plano	1.50 D	Sola VIP	30	4	9.5	18	2.00 D
4	O.D. –1.25 = –0.25 × 102	1.75 D	Essilor Natural	22	5.5	12	20	1.75 D
	O.S. –1.25 = –0.75 × 88	1.75 D	Essilor Natural	22.5	5.5	6	21.5	1.75 D
5	O.D. +0.50 = –1.00 × 100	1.50 D	Sola XL	21	6	10	23	1.00 D
	O.S. +0.75 = –1.25 × 75	1.50 D	Sola XL	16	8	13	23	1.00 D
6	O.D. –5.75 = –0.50 × 11	2.00 D	Essilor Natural 1.6	21	6.5	9.5	23	1.25 D
	O.S. –5.25 = –1.25 × 115	2.00 D	Essilor Natural 1.6	9.5	5	8.5	24	2.25 D
7	O.D. –5.75 = –0.50 × 15	2.00 D	Zeiss Top 1.67®	20.5	6	10.5	23	1.50 D
	O.S. –5.25 = –1.25 × 105	2.00 D	Zeiss Top 1.67®	11	6	8.5	23	2.00 D
8	O.D. +1.75 DS	1.75 D	Varilux Comfort®	20	3	8	22	2.00 D
	O.S. +2.75 DS	1.75 D	Varilux Comfort®	16	3	5.5	21	1.75 D
9	O.D. +1.00 = –0.50 × 116	1.00 D	AO Compact®	17	30	11.5	16	1.00 D
	O.S. +1.00 = –0.50 × 13	1.00 D	AO Compact®	20.5	28	7.5	16	1.25 D
10	O.D. +1.75 = –0.75 × 80	1.75 D	Sola XL®	19.5	6	9	18	1.50 D
	O.S. +1.75 = –0.50 × 84	1.75 D	Sola XL®	19	6	8.5	22	1.50 D
11	O.D. –0.50 DS	2.00 D	Sola XL®	18.5	4	6	18	1.75 D
	O.S. –0.50 DS	2.00 D	Sola XL®	13.5	4	7	18	1.75 D
12	O.D. +1.00 = –2.50 × 166	1.50 D	Younger Image®	29.5	6	10	18	1.75 D
	O.S. +1.25 = –3.00 × 4	1.50 D	Younger Image®	26.5	9	10.5	18	1.25 D
13	O.D. +1.00 = –0.50 × 115	1.00 D	Younger Image®	27	9	8.5	18	1.25 D
	O.S. +1.00 = –0.50 × 19	1.00 D	Younger Image®	24	4.5	8	18	1.25 D
14	O.D. +1.75 = –1.00 × 98	2.25 D	Essilor Natural®	24.5	4.5	10	22	2.25 D
	O.S. +1.50 = –0.75 × 101	2.25 D	Essilor Natural®	21.5	5.5	9.5	20	2.25 D
15	O.D. +0.75 = –0.50 × 73	2.25 D	Essilor Natural-glass®	12.5	6	9.5	18	2.50 D
	O.S +0.75 = –0.75 × 100	2.25 E	Essilor Natural-glass®	18	6	12.5	21	2.50 D
16	O.D. –3.00 = –1.25 × 24	2.00 D	Sola XL®	25.5	6	7.5	18	1.00 D
	O.S. –3.25 = –0.75 × 173		Sola XL®	32	7.5	8	20	1.00 D
17	O.D. –1.25 = –0.25 × 21	1.50 D	Essilor Natural-glass®	29	6.5	13	23	1.75 D
	O.S. –0.50 = –1.50 × 81	1.50 D	Essilor Natural-glass®	23.5	12	15	22	1.00 D
18	O.D. +0.50 = –1.50 × 88	2.25 D	Sola VIP®	15	6	12.5	18	3.50 D
	O.S. +0.25 = –1.25 × 84	2.25 D	Sola VIP®	16.5	4.5	7.5	19	3.50 D
19	O.D. +1.25 DS	2.25 D	Essilor Natural®	16.5	3	8.5	20	2.25 D
	O.S. +1.75 = –0.75 × 164		Essilor Natural®	20.5	6.5	8	18	1.50 D
20	O.D. +0.50 = –1.50 × 80	2.25 D	AO Compact®	15.5	4	7.5	16	1.75 D
	O.S. +0.75 = –1.00 × 90	2.25 D	AO Compact®	15.5	4	6.5	16	1.75 D
21	O.D. +2.00 = –0.75 × 90	2.00 D	Essilor Natural®	21	7	10.5	19	1.75 D
	O.S. +1.75 = –0.75 × 90	2.00 D	Essilor Natural®	19.5	6.5	9	19	1.75 D

Table 1. continued

Rx no.	Rx	Add	Lens	DZW	IZW	NZW	DD	MAD
22	O.D. +0.50 = −1.50 × 88	2.25 D	Younger Image®	25	7	11	19	2.25 D
	O.S. +0.25 = −1.25 × 84	2.25 D	Younger Image®	30	6.5	10	21	1.75 D
23	O.D. +1.50 = −1.25 × 172	2.50 D	AO Compact®	18.5	7	15	10	1.50 D
	O.S. +1.25 = −1.25 × 171	2.50 D	AO Compact®	17.5	5.5	15	9	1.50 D
24	O.D. −2.50 = −2.75 × 4	1.00 D	Essilor Natural-glass®	29	19	15	18	1.00 D
	O.S. −2.75 = −2.75 × 168	1.00 D	Essilor Natural-glass®	31	18	14	18	1.00 D
25	O.D. +1.00 = −0.50 × 102	2.00 D	Younger Image®	21	7	7.5	19	1.75 D
	O.S. +0.25 = −0.25 × 158	2.00 D	Younger Image®	25.5	4	6	19	2.00 D
26	O.D. −0.50 = −0.50 × 75	1.25 D	Younger Image®	28.5	7	8.5	17	1.25 D
	O.S. Plano = −0.75 × 90	1.25 D	Younger Image®	31	7.5	11	18	1.00 D
27	O.D. −2.50 = −0.25 × 111	1.25 D	Sola XL®	13	5.5	10	19	1.50 D
	O.S. −4.00 = −0.50 × 142	1.25 D	Sola XL®	28.5	5.5	10	19	1.25 D
28	O.D. −0.25 = −0.50 × 102	2.00 D	Younger Image®	17.5	5	11	18	2.00 D
	O.S. Plano = −0.75 × 81	2.00 D	Younger Image®	17	6	10.5	19	1.75 D
29	O.D. +0.75 = −0.75 × 110	1.75 D	Younger Image®	22	6	9.5	18	1.50 D
	O.S. +0.25 = −0.50 × 89	1.75 D	Younger Image®	23.5	4.5	11.5	18	1.75 D
30	O.D. −5.75 = −0.50 × 15	2.00 D	Sola Percepta® 1.6	19	6.5	16	20	1.25 D
	O.S. −5.25 = −1.25 × 105	2.00 D	Sola Percepta® 1.6	26.5	5.5	5.5	20	2.00 D

DZW, Distance Zone Width; ***IZW***, Intermediate Zone Width; ***NZW***, Near Zone Width; ***DD***, Drop Distance; ***MAD***, Maximum Astigmatic Distortion; and ***D***, diopters.

Other methods of evaluating progressive lenses include Moiré fringes,[4] grid patterns,[5] and 50% recognition acuity plots.[6] These techniques were even more far-removed from clinical practice than the methods used by Sheedy et al.,[3] and yielded little useful information as to whether or not a given patient will adapt to a lens.

This study proposes a method of measuring progressive lenses using an automated lens meter in such a way as to determine the "important distinguishing characteristics" of individual prescriptions. This simplified method allows evaluation of points 1, 2, and 4, but only an estimation of point 3—the rate of power change. This study included many "add" powers, which increases the difficulty of evaluating the rate of power change. Tunnacliffe[6] evaluated the rate of change on lenses and postulated that a power change of greater than 0.75 D per 5 mm of corridor would be disconcerting and impair the distance judgment of stairs. To exceed the critical rate of power change, for example, a +2.25 D reading addition would have to have a corridor length of 15 mm or less.

Another objective of this study was to determine whether a qualitative difference exists between premium-priced progressive lenses and more-moderately priced progressives. Major insurers often have tiered-fee remuneration systems that allow for more expensive progressives, showing that they feel there is a qualitative difference between premium and nonpremium lenses.

Methods

Thirty pairs of progressive lenses were measured as they were received from wholesale laboratories, allowing 0.50 D of blur (either spherical or astigmatic) to be the cut-off point in determination of the size of useful zones on the lenses. The author measured all lenses evaluated in this study. All lenses tested were nationally known brands with back surfaces generated by grinding equipment, not molds. A complete listing of all lenses tested is provided (*see* Table 1), with a limited statistical analysis. Every lens measured was the one considered the best match for the patient's needs, so it is hoped there would be a positive bias toward each of the lenses tested in this study. Fifteen pairs of lenses were of the "premium-quality" type, as defined by major insurance agencies, and 15 pairs were of "nonpremium" quality. All measurements were made with a Humphrey 330 Lens Analyzer

Table 2. Premium vs. nonpremium progressives

Premium PALs			Nonpremium PALs			Statistical
Characteristic	Mean	SD	Characteristic	Mean	SD	significance
DZW	20.12 mm	3.74 mm	DZW	23.63 mm	5.16 mm	N.P. Better z = 3.726 (0.0001 level)
IZW	7.85 mm	4.28 mm	IZW	6.02 mm	1.06 mm	N.P. Worse z = 9.8 (0.0001 level)
NZW	10.17 mm	2.55 mm	NZW	9.63 mm	1.78 mm	No difference z = –1.66
DD	18.78 mm	2.79 mm	DD	19.27 mm	1.46 mm	No difference z = 1.838
MAD	1.72 D	0.37 D	MAD	1.62 D	0.44 D	No difference z = 1.25

SD, Standard deviation; ***DZW***, Distance Zone Width; ***IZW***, Intermediate Zone Width; ***NZW***, Near Zone Width; ***DD***, Drop Distance; ***MAD***, Maximum Astigmatic Distortion; and ***D***, diopters.

Table 3. Lens characteristics by add power

	Add power (no. of lenses)						
	+1.00 D (8)	+1.25 D (4)	+1.50 D (8)	+1.75 D (10)	+2.00 D (16)	+2.25 D (12)	+2.50 D (2)
DZW (mean)	24.06	25.25	25.56	20.90	19.91	19.25	18.00
IZW (mean)	15.25	6.38	7.06	5.05	5.78	5.29	6.12
NZW (mean)	11.06	9.88	11.75	8.75	8.84	9.42	15.00
DD (mean)	18.75	18.25	20.75	20.45	20.00	19.00	*9.50
MAD (mean)	1.09	1.25	1.44	1.70	1.69	2.31	1.50

D, Diopters; ***DZW***, Distance Zone Width; ***IZW***, Intermediate Zone Width; ***NZW***, Near Zone Width; ***DD***, Drop Distance; and ***MAD***, Maximum Astigmatic Distortion.
* This pair of AO Compact® lenses had an unusually short drop distance, and represents a statistical anomaly.

with an AccuRx feature that compensates for high index materials. Calibration of the instrument was performed by use of high-powered, corrected-curve trial lenses The power reading of the instrument was set to round off powers to the nearest 0.25 D. The Lens Analyzer has a smaller exit stop (3.0 mm) than most manual lens meters, allowing more accuracy in the sliding measurements than a manual lens meter can provide.

The criteria for each pair of glasses included: Distance Zone Width (DZW), Intermediate Zone Width (IZW), Near Zone Width (NZW), Drop Distance (DD), and the Maximum Astigmatic Distortion (MAD). The DZW was taken 4 mm above the designated fitting height, which was determined by light reflex and a PD ruler. Some manufacturers recommend the 4 mm above-the-reflex position for measuring the distance power, and that was the criterion chosen for this evaluation. The limits of zone width were determined by sliding the lens slowly across the exit stop until 0.50 D deviation from the proper power was elicited by the lens meter, which was giving instantaneous readouts. At that point, the sliding was halted and the lens was dotted as an endpoint. The distance between the two dotted spots on the lens became the distance zone width.

To measure the intermediate zone width, a similar sliding measurement was made 10 mm below the distance zone level. Once the IZW value was obtained, the lens being measured was slowly raised in relation to the exit stop of the lens meter, until the full power of the lens add was achieved. That point was dotted, and the distance between that dot and the plane of the distance zone width became the drop distance. This represents the distance at the spectacle plane the patient's eye must traverse when switching from seeing distant objects clearly to seeing clearly at a reading distance.

From the drop distance dot, a sliding measurement of near zone width was made, using the

Table 4. The Essilor Natural® (CR–39) vs. the Younger Image® (CR–39)

	Essilor Natural® (10 lenses)	SD		Younger Image® (14 lenses)	SD
DZW (mm)	21.15	1.92	DZW (mm)	24.79	3.46
IZW (mm)	5.50	1.00	IZW (mm)	6.36	1.21
NZW (mm)	9.10	1.40	NZW (mm)	9.54	1.17
DD (mm)	20.35	1.22	DD (mm)	18.43	0.69
MAD (in D)	1.90	0.23	MAD (in D)	1.82	0.33

SD, Standard deviation; ***DZW***, Distance Zone Width; ***IZW***, Intermediate Zone Width; ***NZW***, Near Zone Width; ***DD***, Drop Distance; ***MAD***, Maximum Astigmatic Distortion; and ***D***, diopters.

Table 5. Changes in MAD (by brand) since 1986

Sheedy et al. (1986)			Bell (2000)		
Company	Brand name	MAD	Company	Brand name	MAD
Sola	VIP®	3.00 D	Sola	VIP®	2.69 D
Essilor	Super No-Line®	3.50 D		XL®	1.32 D
	Varilux 2–glass®	2.50 D		Percepta®	1.62 D
	Varilux 2–CR-39®	2.00 D	Essilor	Varilux Comfort®	1.87 D
	Varilux 2–Hi-Index®	2.50 D		Natural-glass®	1.62 D
American Optical	Tru-vision®	2.50 D		Natural–CR-39®	1.90 D
Younger	CPS®	2.50 D		Natural–Hi-index®	1.75 D
	Ten/Thirty®	5.50 D	AO	Compact®	1.46 D
			Younger	Image®	1.82 D

same 0.50 D of blur criteria. Finally, the lens was moved until a spot of maximum astigmatic deviation could be found in the periphery. The amount of that maximum deviation became the MAD figure. One complication in many of the sliding measurements was astigmatic axis shifting in off center positions. This required some estimation as to when the shift was significant enough to create 0.50 D of blur. This introduced some potential inaccuracy, but I tried to apply my cut-off criteria in an even-handed fashion.

Results

Each lens tested is presented in Table 1. The author believes some important observations can be made in reviewing the raw data. For statistic analysis, the lenses were grouped into Premium and Nonpremium groups. The lenses included in the Premium group include the Essilor Natural®, the AO Compact®, and single pairs of the Sola Percepta®, the Varilux Comfort®, and the Zeiss Top® 1.67 index lens. The Nonpremium group included the Younger Image®, the Sola XL®, and VIP® lenses. In those groupings, computed average scores were tabulated for Distance Zone Width (DZW), Intermediate Zone Width (IZW), Near Zone Width (NZW), Drop Distance (DD), and Maximum Astigmatic Distortion (MAD). Standard Deviations were taken on each category, which may reflect on product consistency. These computations are presented in Table 2.

Also evaluated were the effects of add power on the various PAL characteristics measured, grouping all the lenses together for this computation. These results are shown on Table 3.

A comparison between two specific lens brands was derived from the data, with the Essilor Natural® and the Younger Image® lenses being chosen, representing my practice's standard and economy PALs. The results of this comparison are provided in Table 4.

Using the data published by Sheedy et al.[3] a comparison could be made with MAD values between lenses measured in 1986 and the 30 pairs measured in this study. These values are listed in Table 5. These values indicate that progressive lens MAD values have improved markedly since 1986.

Discussion

One can notice from Table 2 that the so-called "Premium" lenses failed to demonstrate clear-cut optical superiority over the "Nonpremium" lenses. The size of the usable zones for distance, intermediate, and near range in each category appear only slightly different. The same can be said for the Drop Distance and the Maximum Astigmatic Distortion. One lens, the AO Compact®, distorted the analysis of the premium lenses. This lens definitely had a shorter drop distance than other lenses tested. This skewed the drop distance results. With the AO Compact® excluded, the drop distance result was actually longer for the premium group (20.73 mm) than for the nonpremium group. The AO Compact® also tended to have a narrower DZW than other lenses. This may explain why the premium group may have scored lower than the nonpremium group. Additionally, one pair of AO Compact® lenses with a low add power had an exceptionally wide IZW, which skewed the premium IZW figure and the related standard deviation.

Concerning the standard deviations, the numbers are reflective of product consistency, and the amounts are inversely related. As found here, a premium lens might expect to have a near zone width of just greater than 10 mm. But with routine product variation—as it exists today—the NZW could be expected to vary from 7.5 mm to 13 mm, or have an even greater variance.

Studying the individual measurements of the lenses shows marked product inconsistency of key characteristics. The first pair measured was a low prescription pair of Sola XL® lenses with a low-powered add. The NZW for the right lens was 7 mm, whereas that of the left lens was 17 mm. Such differences may seem surprising, but still exist in many progressive lenses dispensed. Not singling out Sola, notice that pair number 4, an Essilor Natural®, had a right NZW of 12 mm and a left NZW of only 6 mm. Variations like this can explain why patients are sometimes unhappy with progressives, although they rarely verbalize accurately what the problem is. An actual example of this phenomenon occurred with PAL #18. The patient was prescribed the Sola VIP® because that was the lens the patient had previously worn. He returned reporting that his distance zone was not as wide as his previous VIP®. The measurements of DZW for his lenses were rather narrow, at 15 and 16.5 mm, respectively. We replaced the lenses with Younger Image® lenses (Case 21), which had DZW readings of 25 and 30, respectively, and the patient expressed complete satisfaction with the lenses. Thus, the information derived from this verification technique solved a clinical problem.

Table 3 demonstrates a trend toward narrowing of the effective use zones when increasing "add" was observed. A modest increase in Maximum Astigmatic Distortion was also seen as the add power increased. But even at 2.25 add power, which is the maximum add many patients need, the MAD was a manageable 2.31 D. Excluding one pair of Sola VIP® lenses with unusually high amount of MAD reduced the average to 2.07 D at the +2.25 add power. Little change in drop distance was seen with increasing add power.

Comments on lens brands

In discussing the characteristics of the lens brands, subjectivity will be kept to a minimum to be fair to the manufacturers. The AO Compact®—three pairs of which were included in this study—was specifically designed for the trendy, small frames that are prevalent today. An advertising claim that AO makes about the power channel of the PAL being shortened in the Compact seems to be true. Shortening of the channel was previously thought to be associated with large increases in astigmatic distortions. The Younger 10/30® progressive was an example of that type of design difficulty. Sheedy et al.[3] found that lens to have 5.50 D of MAD. AO cleverly avoided this problem by displacing the distortions low in the blank. The distortions are then edged off as the low fitting height—for which the lens is designed—is produced. Concerning the critical rate of power change (as stated by Tunnacliffe[5]), one pair of AO Compact lenses exceeded the critical rate (Case 23). The corridor of this lens seemed markedly shortened. The patient reported no adaptation problems to the lenses, but it is troubling that such a large deviation in lens uniformity was found. Because of its distinctive characteristics, the AO Compact® seems to be a good lens choice in cases in which the fitting height of the progressive is between 18 and 22 mm.

The Younger Image® was evaluated, with seven pairs included in this study. The identified characteristics of those lenses are presented in Table 4. It would appear that this lens performs at a level of that found in the premium lenses, although it is a nonpremium product. One pair (Case 25) had reduced near zone size, which seemed to have been due to an excessively low fitting height. Suppliers have said this lens can be fitted with a minimum fitting height of 18 mm, but published recommendations specify a minimum height of 22 mm.[7] In one way the Image might be somewhat inferior to the lens it was compared to, the Essilor Natural®. Although the amount of MAD was about the same in the Image® as that found in Natural®, the area of maximum distortion was closer to the viewing area in the Image®. This is likely to make it more bothersome, and slow patient adaptation. Because of that, the Natural® lens could be rated as slightly superior in adaptability to the Image®.

Table 5 shows the MAD values found on progressive lenses tested in this study and contrasts them with the values found by Sheedy et al.[3] in 1986. New designs have been introduced, but the purpose of this Table was to see how MAD in commonly prescribed brands has changed since 1986. In each case, MAD values have decreased since 1986, seeming to show significant advancement in design by each of the manufacturers in this important characteristic.

Efficacy of the methods

The Sheedy et al. study[3] used a rotating lens meter objective to allow for the effects of ocular rotation. They used degrees of ocular rotation as a benchmark for lens evaluation. Too many unwarranted assumptions were made in that approach to lens measurements to allow clinical application. That approach assumes size constancy of ocular globes, vertex distance, and globe position within the orbit. Wide variation in each of these factors exists in actual patient populations, introducing large errors into the angular measurements. Evaluation of the optical characteristics of progressive lenses at the plane of the lens appears to be the only practical way to assess whether a given lens is appropriate for a patient. Fringe or grid analysis may be effective at evaluation of lens optical performance at a manufacturing level, but no such clinical tool or method for making such information intelligible to the clinician exists. The lens meter is the main instrument available to the optical dispenser to evaluate the optical characteristics of a PAL. What I have provided is a "rough and ready" way to assess these lenses, which can provide information that can help the dispenser solve fitting problems. One potentially important shortcoming discovered during this experiment is that a way to evaluate the distance of the MAD from the reading zone was not included.

Conclusions

This study has presented a simplified method for the clinical verification and evaluation of progressive addition lenses. Thirty pairs of progressive lenses were measured in a clinical setting and some evaluative conclusions could be drawn from the results. A group of premium progressive lenses failed to demonstrate clear-cut superiority over the nonpremium progressives tested. The 30 pairs, taken as a whole, seemed to demonstrate product inconsistency, typified by varying usable zone size. The AO Compact® lens had a shorter drop distance than other lenses tested, and would appear to be a good choice of PAL when the fitting height was between 18 and 22 mm. The nonpremium Younger Image® progressive tested favorably when compared to the Essilor Natural® in five specified categories, although it was observed that the Image's areas of MAD were closer to the reading zone than was the case in the Natural® lenses. That "closer-in" distortion could inhibit adaptation to the Image® lens. A brand-based comparison of maximum astigmatic distortion was made using the values obtained in this study and the values obtained by Sheedy et al.[3] in 1986. These findings indicate that the lenses manufactured by four major suppliers have reduced MAD substantially since 1986. The improvements made in this important characteristic probably make today's lenses easier to adapt to than those dispensed in the 1980s.

A principal importance of the results presented here should be placed on the method described for the in-office verification and evaluation of progressive lenses. The product inconsistency found in the study would lead one to expect that practitioners will receive, in some instances, lenses that are substandard in optical performance. These substandard qualities could lead to patient adaptive difficulties. Using the techniques described here, practitioners may be able to find the source of a patient's dissatisfaction and make appropriate changes in lenses to bring about patient satisfaction. To make such an approach practical and equitable, lens suppliers would have to recognize the validity of such techniques, develop a suitable replacement policy, and work to improve gaps in product quality. More-advanced analysis could certainly be realized with the formation of a lens-testing institute, which could help pinpoint design defects and accelerate improvement of progressive addition lenses.

Disclaimer

The author of this article has no affiliation, association, or proprietary interest with any of the products mentioned within the artucle.

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