Single vision lenses - now it's personal

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Competencies covered:	Optical appliances
Target groups:	Dispensing opticians, optometrists

Progressive power lenses (PPLs) that incorporate freeform surfacing techniques are now commonplace in optical practices. Such lenses often require additional measurements and lifestyle information in order to provide a personalised lens for the patient. However, it is often forgotten that the same technology can be applied to single vision lenses. This article will look at the range of single vision lenses which are now available that can be customised. We will look at some of the extra measurements required as well as addressing why we take them.

What is available?

Table 1 shows a selection of personalised single vision lenses which are available in the UK; although not an exhaustive list, it demonstrates that all the major manufacturers now offer these lenses.

Monocular pupil distance and vertical fitting heights

With the use of appropriate horizontal and/or vertical centration the practitioner aims to ensure that the patient does not experience unwanted prismatic effects. However the oblique power experienced by the patient as the eye rotates to view through off axis points on the lens may vary significantly from the prescribed back vertex power when spherical surfaces are used. **Figure 1** shows that as the eye rotates and its gaze moves across the lens, the power in oblique gaze (+4.25DS/+1.00DC) is significantly different from the prescribed back vertex power of +4.00DS. By altering the lens geometry of the lens surfaces we can improve the off-axis performance of the lens, as both spherical and aspherical surfaces can be used to give different effects **(Figure 2)**[1]. If an aspherical surface is employed surface power changes as the eye rotates away from the vertex of the aspheric surface. Aspherical surfaces are said to incorporate

Lens Brand	Lens Name
BBGR	Asphro PdM
Essilor	SV-360
Hoya	Nulux EP
Kodak	Digital SV
Nikon	Seemax SV
	SeeStyle
	DAS
Norville	Nortor SV
Rodenstock	Impressions Mono
Rupp + Hubrach	Ysis Single Vision
Seiko	SPGAZ
Shamir	Smart SV As Worn
Sola	Sola HD SV
Zeiss	Clarlet Individual

Table 1: Some examples of free form single vision lenses available

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General Optical Council Approved CET For Dispensing Optician Optometrist

C-19503

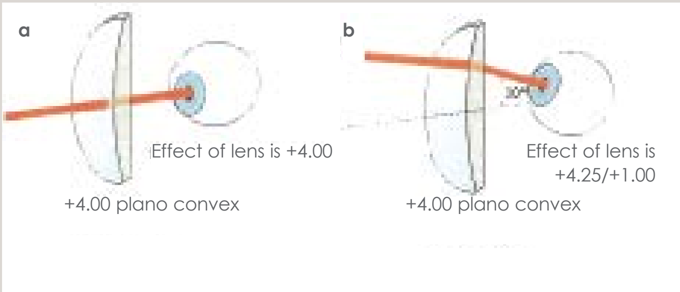

Figure 1: How the back vertex power changes as the eye rotates. *(Courtesy of Professor Mo Jalie)*

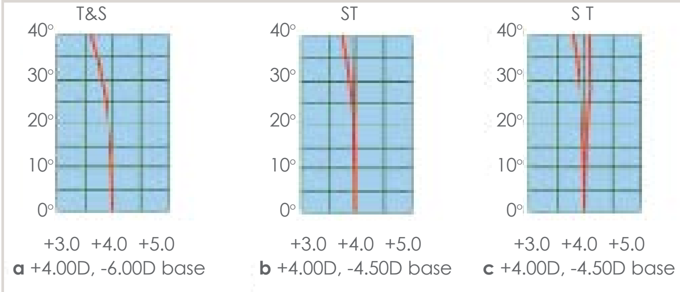

Figure 2: The effect on changing the spherical surface curves on off-axis performance. *(Courtesy of Professor Mo Jalie)*

surface astigmatism which is used to neutralise aberrational oblique astigmatism. Aspheric lenses are flatter, lighter and thinner than lenses with spherical surfaces. Unfortunately the manufacturer can only produce what they think is a good lens, without knowing how it will be placed in front of the eye. The final "as-worn" effect of the lens may therefore be different to the expected effect. When combined with the frame A and B measurements, the positioning of the optical centres will have an effect on the thickness of the lenses. We should do our best to ensure that the patient's PD and the frame box centre distance are similar. Care must also be taken to equalise the edge thicknesses in the vertical meridian.

Changing the position of the lens by altering its vertex distance, pantoscopic angle and faceform angle all affect the as-worn performance of a lens. If these additional measurements are taken as part of the dispensing process and passed on to the manufacturer, then complex computer algorithms can calculate the surface geometry required so that the back vertex power is maintained across the lens. Freeform surface generators **(Figure 3)** can then create a complex lens surface comprising around 40,000 points; thus creating a bespoke, personalised lens.

Let us now look at these three extra measurements which are common to many of the lenses given in **Table 1**. Those discussed below are not universal to all personalised lenses, and some may not require all three additional measurements.

Vertex distance

Hopefully we are all used to taking this measurement for powers over +/- 5.00D and that our optometrist colleagues are recording it on their prescriptions (for the trial frame or phoropter) as both are required to be useful to the dispensing optician. Also it is worth remembering that the vertex distance needs to be checked on collection, as there is no point in taking this measurement during the dispensing processes if it is not used later.

The vertex distance is the distance from the back surface of the lens to the apex of the cornea and should be measured along the line of sight and perpendicular to the spectacle front **(Figure 4)**.

The reason for measuring the vertex distance on dispensing is to see if it differs from that of the trial frame or phoropter used during the refraction. If the measurements are the same then all is well; but often there can be a difference which can lead to an effectivity error; ie, the effective power of the lens will be different to that prescribed. If the lens power is low and the difference in the vertex distances small; then the effective power error will be too small to be noticed by the patient. But with increasing power and larger differences in the two vertex distances; it can sometimes become necessary for the dispensing optician to order a slightly different lens power to that prescribed. Of course any such action must be recorded on the patient's records. The effect of changing the vertex distance is summarised in **Figure 5**. An example

Figure 3: An example of a freeform generator, the Schneider HSC Master

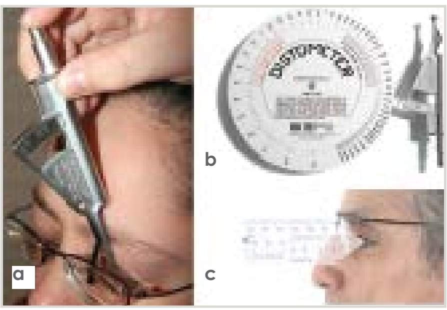

Figure 4: **a** shows a vertex gauge in use, along with **b** a conversion wheel, **c** shows the vertex distance measured with a clear ruler

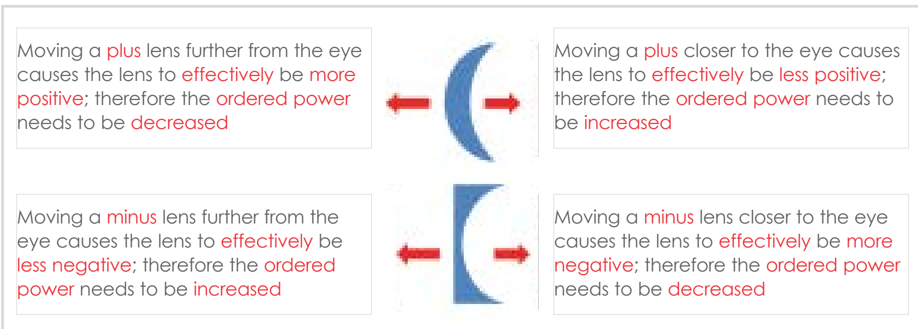

Figure 5: The effect of changing the vertex distance on back vertex power

Continued overleaf

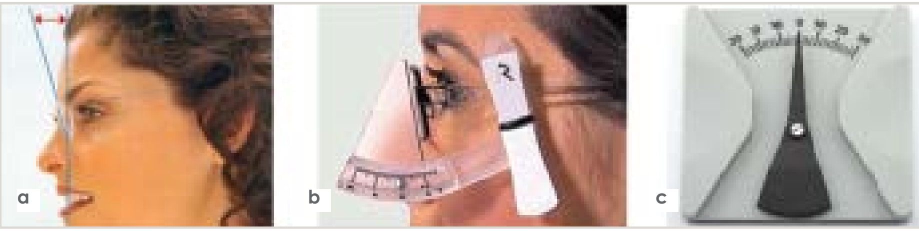

Figure 6: **a** shows what the angle is, **b** the Rodenstock device, **c** a device from Zeiss

$$F_{SPH} = F\left(1 + \left(\frac{\sin^2\theta}{2n}\right)\right)$$

$$F_{CYL} = F_{SPH}\tan^2\theta$$

Figure 7: Formula to calculate the change in effective power for a given pantoscopic angle

Figure 8: Face from angle

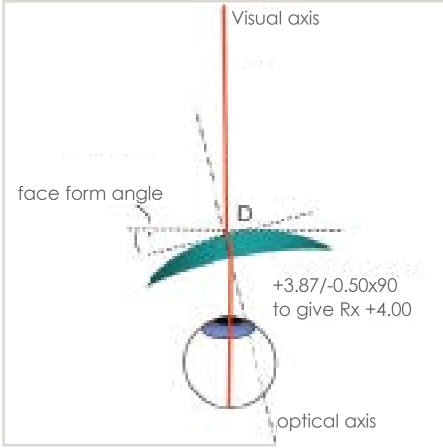

Figure 9: The effect of applying face form angle to a prescription

of the effect a change to the vertex distance is to consider a 7.00D lens. A movement of 5mm will result in a change of 0.25DS in the effective power of the lens. This is found by using Fx = 1000/(f-x), where Fx is the new effective power of the lens, f is the original focal length and x is the change in vertex distance. If you consider the difference in vertex distance achieved simply by changing from a plastic frame to a metal, pad-on-arms frame, then on higher powers it becomes a very important measurement to consider.

Pantoscopic angle

The definition is that it is the angle between the optical axis of a lens and the visual axis of the eye in the primary position, usually taken to be horizontal[1]. Put more simply it is the angle of the frame front inclined towards the face. This is shown diagrammatically in **Figure 6**, where the angle formed is positive, as the frame's lower rim is inclined towards the face; which is usually the case. If the angle was negative, then it could be called a retroscopic angle[2], which might be found with snooker spectacles. Pantoscopic angle and the vertical fitting position are closely linked; remember that 2° of pantoscopic angle results in a 1mm change in the vertical position of the optical centre. If the pantoscopic angle is increased, then the optical centre should be lowered, and vice-versa for a decrease in pantoscopic angle. This change to the vertical centration results in the optical axis of the lens to pass through the eye's centre of rotation; thus improving performance of the lens in the 'as-worn' position, to more closely match that of the trial frame lens position.

However tilting a lens before the eye induces aberrational astigmatism which is due to the pencil of light passing obliquely through the lens. Here is an example, a -5.00DS lens made in plastic of refractive index 1.5, is tilted from a pantoscopic angle of zero to 12.5°. The equation given in **Figure 7** can be used to calculate the resultant (as-worn) back vertex power; the answer being that our prescribed -5.00DS is now -5.08DS/-0.25DC x 180 in the new 'as-worn' position.

Faceform angle

(Figure 8)

Also called the frame wrap/bow or the dihedral angle (the British Standard term is Faceform angle), this can be thought of as the horizontal version of pantoscopic angle. The effect is far more noticeable for sports eyewear as they are usually highly curved; but that is not to say that it does not have an effect for normal ophthalmic frames.

When increasing the angle, the induced errors can be compensated for by decentration using the same rule of thumb that we use for vertical centration and pantoscopic angle (ie, 1mm for every 2°). This will assist with the unwanted induced prism; although it does not help with the overall field of vision as the eye roams around the lens. With a personalised lens the manufacturers can use the provided monocular PDs along with the faceform angle to design a lens

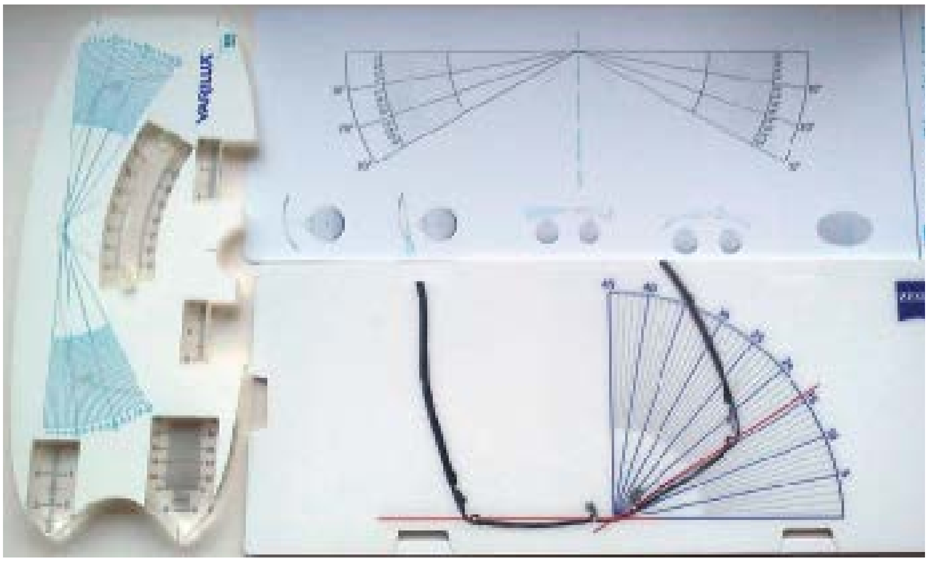

Figure 10: A selection of devices for measuring face form angle

Figure 11: Facial asymmetry, on the left is the original image, the centre is a right mirror image and the right hand image is a left mirror image

Figure 12: Some examples of computerised dispensing terminals **a** Zeiss relaxed vision terminal, **b** Essilor Visioffice, **c** Anyview pro from BiB

to take into account the final sitting position of the lens.

If we take a +4.00DS prescription taken from a trial frame with a zero face form angle and then dispense the prescription into a frame with a face form angle of 20°, to achieve the desired back vertex power of +4.00DS, we would need a lens with a compensated power of +3.87DS/-0.50DCx90. Luckily most frames have smaller faceform angles, but the compensation is necessary as the visual axis of the eye is not the same as the optical axis of the lens **(Figure 9).**

There is an array of devices available for taking this measurement, some of which are shown in **Figure 10**; but practice is required to become proficient.

Verification

When these lenses arrive at the practice from the manufacturer it is normal to check that the prescription meets the appropriate BS EN Standards. But care needs to be taken with personalised lenses. When checking using a focimeter the lens is usually placed perpendicular to the lens holder so that there is no pantoscopic angle and the optical and visual axes are parallel. However this does not take into account the 'as-worn' position of the lens, where light will be entering the eye differently to the focimeter as the optical and visual axes are not parallel[3]. The laboratory should provide the practice with the "measured powers" for which to check against. It is also a recommendation that the details of the measured power are noted on the patient's record for future reference.

Final thought

Before dispensing these lenses it is worth talking to your supplier to make sure you have an understanding of the lens and what the lab requires for personalisation, as some manufacturers may only require one of the extra measurements discussed above; while a different manufacturer will want all three. The advantage of these personalised lenses is that they aim to provide our patients with a greater level of optical accuracy and visual performance than conventional lenses. The effect of each measurement on its own might be small, but when combined the overall effect can have more impact on the back vertex power in the 'as-worn' position. All three of the measurements discussed are also inter-dependent e.g. changing the pantoscopic angle can also affect the vertex distance since increasing the angle can cause the lenses to sit further from the eye. A final note on measuring is that we cannot assume that patients are symmetrical **(Figure 11)** and taking these additional measurements is a way of optimising each lens, as well as showing off our skills and expertise. Care must also be taken to refine our measuring techniques as some patients can find these close proximity measurements disconcerting; this is where good communication skills are required. It is also worth remembering that there are several computerised systems available which not only add some 'show' to the dispensing process, but can assist with taking the measurements **(Figure 12)**. They can be particularly useful if the patient has trouble maintaining a natural head position, particularly during the measurement of the pantoscopic angle.

The content of this article gives a brief overview of the efforts taken by manufacturers to design spectacle lenses which give optimum clarity of vision to our patients. If anyone is interested in pursuing this subject further they might consider undertaking the Association of British Dispensing Opticians' Honours qualification in spectacle lens design.

References

1. Jalie M. *Ophthalmic Lenses and Dispensing* 3rd ed. London: Butterworth Heinemann, 2008; chapters 2 & 3
2. Millodot M. *Dictionary of Optometry and Visual Science* 7th ed. London: Butterworth Heinemann, 2008
3. Jalie M. The Measurement of Spectacle Lens Power – Part One, *Dispensing Optics*, July 2012, pp4-11

Further reading

1. BS EN ISO13666:1999. *Ophthalmic Optics – Spectacle Lenses - Vocabulary*. London: British Standards Institution.
2. *Ophthalmic Lens Availability* (2012) for listings of many freeform single vision lenses
3. Brooks C.W. and Borish I.M. *System for Ophthalmic Dispensing* 3rd ed. St Louise Missouri, Butterworth Heinemann, 2007; chapter 5

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MCQs overleaf

Multiple choice questions (MCQs):

Single vision lenses - now it's personal

1. Which lens is not a personalised single vision lens?
a. Kodak Digital SV
b. Essilor Stylis
c. Zeiss Clarlet Individual
d. Hoya Nulux EP

2. For a prescription of R +11.00DS L +11.00DS with a refraction vertex distance of 13mm, a frame is dispensed with a vertex distance of 9mm. What will be the required power supplied to ensure the correct effective power?
a. +10.75
b. +10.50
c. +11.25
d. +11.50

3. Which computerised system is not intended to measure and record the required measurements for a personalised lens?
a. Relaxed Vision Terminal
a. Visioffice
a. Accufit
a. Anyview Pro

4. What alteration needs to be made to the vertical position of the optical centre of the lenses if the pantoscopic angle is increased by 5°?
a. It should be raised by 5mm
b. It should be lowered by 5mm
c. It should be raised by 2.5mm
d. It should be lowered by 2.5mm

5. What will be the cylindrical element of the new effective prescription if the lens -8.00, made of plastic refractive index 1.5, is tilted 10° in front of the patient's eye?
a. None – the cylindrical element will be insignificant
b. +0.25
c. -0.25
d. +0.50

6. If tolerance tables state that no more than 1^{Δ} of unwanted prism can be tolerated by a patient, which mono centration error (horizontal) falls WITHIN this tolerance, and is therefore acceptable?
a. 3mm mono centration error on +4.25/-1.00 x90
b. 2mm mono centration error on -4.50/-0.75 x 90
c. 4mm mono centration error on +2.75/+2.50 x 90
d. 2mm mono centration error on +7.25/-1.75 X 90

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Reminder for the end of CET period

Registered practitioners are reminded that the current CET period ends on 31 December 2012. However, the GOC have requested that all points for the period must be confirmed by 21 December. By that date, to ensure continued registration with the GOC, you must have accrued 36 points as a dispensing optician or an optometrist, or 54 (36 +18) points as a contact lens optician on the GOC's CL Specialty list. The points must be confirmed on your CEToptics record. Pending, or unconfirmed points will not count towards your requirement. If you have any enquiries about your points record, contact CEToptics (0843 208 5487), or for other enquiries, contact the ABDO CET Office (01206 734155 Tuesday - Friday). ■

CET points

All points from ABDO-provided CET this year will be uploaded to CEToptics by 21 December. Please check your CEToptics record as 20 December approaches, and contact the CET department if you are missing any points from ABDO CET. Points from other CET Providers should be queried with that Provider, as the CET department has no access to your CEToptics record, and cannot answer queries about CET from other Providers.

To contact the ABDO CET department telephone 01206 734155 or email pstevens@abdocet.infoman.org.uk or pstevens@abdo.org.uk ■