emPower to the people

Bill Harvey tries out a dynamic new way of correcting presbyopia which may offer an exciting alternative to current 'static' correction

Liquid crystals have been employed for many years for a variety of functions, from the tiniest of visual displays and signage, to large-scale architectural use in modern buildings with giant screens capable of rapidly sectioning off an area.

Liquid crystal lenses offer the ability to be changed in nature almost instantaneously by the application of a small voltage across them. This makes them a very attractive mechanism for a non-mechanical zoom system, hologram creation and also the instantaneous adaptation of refractive correction in spectacles.

Obviously refractive error changes very gradually in time so the instantaneous change really applies to the correction of presbyopia. If one can instantly change from distance to near correction at the trigger of a switch, it may be possible to correct vision at a range of distances but in a way that can avoid the distortion in the peripheral field that is inherent in progressive lenses of 'static power.'

Historical perspective

As always, there is nothing new under the sun and the influencing of optical properties by the exertion of electrical forces upon lens materials has been studied for nearly 80 years. In 1933, Skaupy introduced an apparatus for reflecting light rays.[8] The optical device incorporated one or more prisms of a double-refractive substance, in this case nitrobenzene, which produced varying deflections of light rays by an application of an electric field. In 1980, Berreman[9] introduced a liquid crystal cell to be used in cameras, telescopes, binoculars, projectors and spectacles. This is probably the first time that such a lens was proposed to be used for spectacles. Since then, liquid crystal lenses have developed and appeared in a variety of forms, with the most common liquid crystal materials being MBBA (p-methoxybenzyli-dene-p-n-butylaniline) or PCB (p-npentyl-p-cyanobiphenyl) with negative and positive anisotropy respectively. An excellent review of liquid crystal lenses appeared in our own *Ophthalmic and Physiological Optics* way back in 1990[10]. In this, Fowler *et al* noted there were still some difficulties to overcome, not least a variability of action with temperature and the isolation of a material of sufficient purity and birefringence capability to make the optics acceptable. However, the article did claim that 'liquid crystal lenses are possibly the spectacle lenses of the future for presbyopic corrections'.

Figure 1 The side of the frame contains the switch, the power source and the motion detection unit

Figure 2 Charging the unit

emPower

Roll forward to March 18 2011. The company PixelOptics launched a new product, called the emPower, at the International Vision Expo East. The product was heralded as 'the world's first and only electronic focusing eyeglasses'. A trawl through YouTube for the product shows that the launch made quite a splash with a number of high profile demonstrations on national television and radio networks. Since then the product has been successfully launched in over 2,000 outlets in the US and when I met up with PixelOptics at the back end of last year, the company was aiming to have its product available in 30-40 outlets in France with a further interest in 22 other countries.

The product is essentially a pair of frames with a 1.67 plastic lens in which is incorporated a small 12x20mm 'button' containing the liquid crystal. Almost completely invisible to the naked eye, the button is connected to the frame side by two electrodes. The side of the frame contains the switch, the power source and the motion detection unit. You can just about make out the button in the example shown in Figure 1.

With a simple switch, a voltage may be applied across the liquid crystal and this immediately changes the refractive index of the button such that it changes from the intermediate (+0.75DS) addition to the near addition. As indicated earlier, this system has the significant advantage over traditional progressive lenses of offering a much greater field of view for intermediate and near tasks. There is also minimal interference of the lower field when walking around, so reducing any risk of stumbling or tripping.

The latest innovation in the emPower design is backed by a campaign marketing the product as 'life activated'. This refers to the way the liquid crystal switch may be activated. A manual touch sensitive switch allows the wearer to simply activate the near add which may then be reduced to intermediate again at the second single touch of the switch. There is also, however, an automatic mode. If the wearer slides a finger along the side of the frame from ear to brow, the motion detectors are activated. This means that whenever the wearer looks down, as they would if about to read, the near button is automatically activated and remains active until the wearer looks up, at which point the button returns to intermediate mode. A single charge of the unit should last for 2-3 days, but the manufacturer recommends overnight charging to ensure full operation throughout the next day (Figure 2).

The main lens is obviously glazed to the full distance refractive error and comes with an anti-glare and anti-reflection coating as standard. If the refraction changes and the wearer wants to keep their original emPower frame, then reglazing is no problem as long as the eye care practitioner is happy with the state of the original. This obviously saves on costs. Dispensing is as simple as for any progressive lens. The template for marking up is shown in Figure 3. Monocular PDs are essential and the centre pupil height marked once the frame fits correctly. Placing the frame face-down on the template allows the lens marking to be completed. Note the two in-lines showing where the electrodes are positioned. These obviously must match up with the appropriate point of the frame to ensure connection. Once this is done, three criteria must be met:

- The inside edge of the eye wire (rimless) or lens edge (semi-rimless) must lie outside all three of the curved red lines
- The hinge midpoint must lie at or above the dotted red 'hinge mid-point' line
- The frame must fit completely within the lens outline to ensure cut-out.

If any of these are not met, then a different frame must be selected.

The EU unit price at the start of this year was €1,400. The wearer receives a complete 'kit' (Figure 4) which includes a full manufacturer's warranty, after making a selection from an ever-increasing range of styles (Figure 5).

Robust

I did try on a pair and I have to admit the power change appears instantaneous and the clarity of the optics excellent. Another concern I always have for electronic gadgetry is robustness and these spectacles appear certainly as robust as any standard appliance.

The temperature dependence has obviously been addressed as PixelOptics maintains that the units are safe to use in a range of temperatures (extremes of winter and summer). The only proviso is not to leave a pair on a hot exposed dashboard or other hot surface for any length of time.

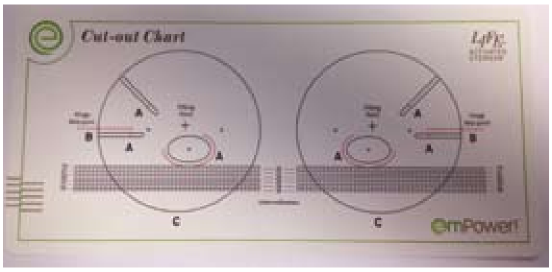

Figure 3 The template for marking up

The electronic circuitry is hermetically sealed so no worries if caught in a downpour. The company claims 'tests have proved (emPower) to work properly even after being under water for a long period of time'. However, such immersion requires that the unit be completely dried out and recharged before reuse.

I am also assured by the suppliers that the voltages in the unit are so small (less than, for example, those in a mobile phone) that there is no issue of health risk nor of setting off alarms or annoying airport security.

The future

It remains to be seen how great an impact this product makes, but I am convinced that in terms of robustness, optical clarity, reliability and ease of use, the emPower is something an eye care practitioner may wish to add to their range as a potentially profitable product. It will also be interesting to see how the science behind the product is exploited elsewhere. At last year's BCLA conference, a research team from Manchester University were looking at the use of liquid crystal technology in contact lenses to correct presbyopia and this may well be another future development of commercial interest. Look out for more on this in a future issue of *Optician*.

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Figure 4 The complete kit

Figure 5 emPower's growing range of styles