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Modern management of presbyopia

PART 1: Communicating spectacle considerations

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Defined in its simplest terms by Millodot as: "A refractive condition in which the accommodative ability of the eye is insufficient for near vision work, due to aging"[1], presbyopia is most commonly experienced initially as a gradual inability to focus on near objects. This prompts emerging presbyopes, sometimes through sheer frustration, to self-diagnose and seek a range of optical and non-optical solutions to correct their faltering near vision.

Tactics employed by patients to avoid accepting their impending visual condition may include colour-coding keys, using a magnifying lens or mirror, wearing two sets of spectacles simultaneously, and increasing the font size on their phone and computer[2].

A rising proportion of presbyopes in the population represent a challenge for eyecare practitioners (ECPs) to keep abreast of changing technology, whilst offering a significant commercial opportunity[3]. Traditional single vision, bifocal and progressive spectacle solutions are being challenged by a variety of new approaches[3]. At the same time, the broad accessibility of cheap, over-the-counter, ready-made magnifying and variable-focus spectacle options may lead to many of the available bespoke alternatives being overlooked.

With around two billion people now affected by presbyopia worldwide, and approximately 42 per cent of the UK population being over the age of 45[3], patients presenting with presbyopia-associated symptoms are a daily occurrence in optical practice. As such, dispensing opticians (DOs) have a good working knowledge of this widespread condition, its effects on vision, and its impact on people's quality of life.

It is essential to appreciate, nonetheless, that presbyopia is a dynamic condition; experienced differently not just between individuals but also with changes over time and with increasing age. Methods of correction suitable for a 50-year-old may not work well for someone in their 80s[3] and, similarly, a solution 20 years ago for someone in their 50s may well not be the most appropriate option in 2022. Thus, a detailed discussion with each patient is needed in order to construct a portfolio of spectacles tailored to meet their individual and diverse needs.

UNDERSTANDING PATIENT NEEDS

Whereas spectacle frames are often readily displayed to see and try, lens choices are intangible, and in many cases alien to patients. Therefore, the responsibility for communicating the benefits and compromises of the most appropriate selection sits entirely with the ECP. Honed by experience and backed with extensive product knowledge, actively listening to the patient and interpreting their visual needs is one of the most important skills that can be demonstrated by the DO.

The patient will likely be concerned with their visual comfort at a variety of distances, the physical comfort and appearance of the spectacles, and both the convenience and cost[4]. Through deeper engagement with the patient, the DO has the opportunity to integrate further criteria based on their current visual needs during both work and leisure time, their lifestyle and self-image.

When dispensing a newly presbyopic patient, DOs should also be mindful of the emotional impact of being forced to accept that their near vision is no longer perfect[2]. A mounting dependence on spectacles can affect the way people feel about their own age and ability to take care of themselves[2] and, even from the age of 45, is reported to have a real impact on quality of life[5]. The need for a reading correction is perceived as a sign of age[4], and the patient is coming to terms with changes in daily activities that they have always taken for granted[2]. Today's rising reliance on hand-held digital devices and demand for constant connectivity serve as further sources of frustration and act as constant reminders that the struggle of ageing is real and looming large.

In addition to an inability to read fine print or thread a needle, manifestations of presbyopia include a delay in refocusing and slow drifts in distance refraction[3]. The presbyope will likely be experiencing multiple problems when reading, such as, a need for increased task lighting and symptoms such as headaches, visual fatigue, diplopia and even epiphora[5]. In these challenging times, alterations have occurred in individual's behaviours, their lifestyle choices, and, in some cases, their appetite for change[6]. Communication, compassion and understanding have never been more significant in supporting, motivating and educating patients to make informed decisions and manage expectations surrounding their healthcare.

As well as natural emmetropes, many who have previously undergone surgical intervention to correct distance vision also eventually require correction at near[5]. This can be a source of consternation for post-operative patients, often met with disappointment and reluctance, perhaps even disbelief – and so the conversation needs to be handled with care.

SOME TWO BILLION PEOPLE WORLDWIDE ARE AFFECTED BY PRESBYOPIA

Although not addressing or providing any treatment for the underlying cause of presbyopia[5], spectacles are generally considered to be the most accessible intervention for the management of related symptoms[5]. Yet, with all the available options, the patient should be led to understand and accept some degree of compromise in the quality and flexibility of vision offered at different distances[5].

PROGRESSIVE ADDITION LENSES

Arguably, with their no jump, seamless blend of continuous vision, progressive addition lenses (PALs) best replicate natural, pre-presbyopic vision by providing an unbroken range of focus from far to near[7]. Since the first generation 'varifocal' lens, considerable advances have introduced wider and more comfortable viewing zones and transition. A huge range of options have become readily available, and prices have reduced comparatively. The optical and cosmetic advantages are, by now, well known and PALs have become a default single-pair solution for patients and practitioners alike[7].

Freeform surfacing, utilising highly complicated computer driven technology, now dominates lens manufacturing[8] and has become commonplace in contemporary PAL production. Precision optimisation of each spectacle prescription is afforded by this revolution in lens surfacing[8] enabling the optics to be matched exactly to every patient's individual visual requirements and customised for the actual position of wear[9].

This advancement in digital lens design has enabled an immense variety of high definition and personalised products requiring ever-more complex fitting measurements and fuelling growth in practice-based digital measurement

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technology to determine exact viewing position. State-of-the-art measuring devices facilitate fast, accurate capture of such data whilst limiting social contact and respecting social distancing in practice.

In addition, some of the sophisticated dispensing aids incorporate further characteristics such as postural and behavioural components[10] in order to fully appreciate the customisation possible in the design parameters. The patient benefits from enhanced visual performance including reduced peripheral lens aberrations, wider zones of clear vision and improved binocular vision[9]. Ultimately, these benefits increase patient satisfaction and reduce incidents of PAL non-tolerance[9]. Precise fitting of each frame to the patient before measurement is, therefore, now more than ever, imperative for accurate dispensing[3].

Even carefully selected and accurately measured PALs are not entirely without limitations. Escalating unwanted peripheral astigmatism linked with increasing prescription power[11] inevitably results in peripheral blur and restricted field of view that requires a level of acclimatisation from the visual system and modified wearer movement patterns. Positioning of the optimal near vision low in the lens requires an unnatural, and sometimes uncomfortable, angle of gaze and a narrow range of intermediate vision can fall short of contemporary visual needs.

These restricted optical zones can impact the wearer's subjective experiences[5], for example, while driving or performing workplace, sports or hobby tasks. Additionally, PALs have been reported to impair depth perception and edge contrast sensitivity[12] contributing to increasing mobility problems, difficulty with step negotiation and risk of falls. Identified as a significant public health concern[5], falls among presbyopic age cohorts need to be kept in mind when dispensing PALs.

Each of the major lens manufacturers has its own, unique approach in pursuit of precision and ultimate personalisation, persistently pushing the frontiers of PAL design and advancing manufacturing techniques. Whether it is binocular harmonisation technology (Hoya)[13] or biometric intelligence (Rodenstock)[14], what is certain from this ongoing global investment in research and development is that progressive lens design continues to be a primary focus of spectacle correction of presbyopia[7].

BIFOCALS AND TRIFOCAL LENSES

With continued availability in a wide range of materials, shapes and sizes, conventional bifocal lenses provide a stable and wide distance area[15] preferred by some and a fixed near portion that is easy to find over the segment line. Without the peripheral swim effect[15] they are useful for those who want the convenience of a single pair of spectacles but do not have a steady head position and for those unable to tolerate restricted horizontal field of view and edge distortion.

Like other dual focus or multi-focus lenses, bifocals and trifocals remain viable solutions for many occupational, sports, hobby and lifestyle scenarios. With options to combine distance and intermediate, or intermediate and near, they are frequently the default choice for some professions such as musicians who may want to read sheet music at a fixed working distance and simultaneously see the conductor and/or the keys or strings of their instrument.

Some wearers find the dividing line between the two fixed zones, and the associated 'jump' in image size and position found in certain types of bifocal, to be distracting and especially troublesome when navigating uneven areas and steps. In addition, as presbyopia advances, the patient's range of intermediate vision becomes gradually more compromised[7].

However, traditional straight top or round segment lenses are by no means exhaustive of the modern bifocal and trifocal options obtainable. There are specialist alternatives to address some of the disadvantages of bifocal wear; such as invisible round segs, blended segs, double decker segments, and combination lenses (combining bifocal and low add progressives)[16].

These innovations in lens design blur the boundaries between bifocals and PALs; benefitting the patients with advantages such as less visible segment lines, reduced or eliminated 'jump' and potentially providing a stepping stone towards easier acceptance of fully progressive designs[16].

SINGLE VISION LENSES

When presbyopia is the only refractive error related issue experienced, a patient may opt for a simple single vision spectacle solution[11]. Colloquially referred to as 'reading glasses', this tried and tested technology provides a relatively cheap, 'easy on, easy off' solution to aid with any near vision task.

It could be suggested that modern lifestyles with recurrent long periods working at fixed close distance require an intensive ocular effort that can be more comfortably endured with the aid of a single vision correction designed with the appropriate focal length. For this purpose, a single vision pair of spectacles can be the perfect complement to a pair of PALs for such activities as reading and sewing. A bedside pair of readers, for example, can be an invaluable addition.

A supplementary single vision distance correction, for walking and outside activities, might be advantageous for an elderly person identified at risk of falls[12]. Comprehensive lifestyle and visual needs should always be investigated during extensive task analysis with the patient, and any requisite working distances explored together.

ENHANCED SINGLE VISION LENSES

Whilst an entire lens dedicated to a single point focus can be advantageous, the necessity to keep removing or swapping between different spectacles can be problematic; especially where there is a frequent need for corrected intermediate vision. Demand for these more versatile viewing needs can be met with the employment of degressive lenses, whereby a minus (or less plus) power is worked into the upper portion of the reading prescription thus providing a dual focus for intermediate and near.

Although degressive lenses are not to be confused with occupational progressives, their potential uses in occupational situations are almost infinite. Some manufacturers (such as Norville for its Versatile lenses) are able to supply a demonstration kit, or set of glazed lorgnettes, enabling the patient to interactively experience and better understand the benefits, and indeed disadvantages, of such lenses before choosing them. These are valuable dispensing tools for DOs to have at their disposal.

The evolution of today's electronic environment has also led to the development of enhanced single vision lenses designed for 'pre-presbyopes' (typically aged 25 to 40 years)[16]. This generation of lenses, such as the Booster lens offered by Norville[16] or Nikon's RelaxSee lens[17], incorporate a small low plus (or reduced minus) area into the lower portion of an otherwise single vision lens, in order to relieve symptoms of visual fatigue and to assist with adjusting between variable distances and reading of small pixelated characters.

These lenses pave the way for the next generation of emerging presbyopes – and time will tell whether their use will help reduce the emotional impact of presbyopia and ease the visual adaption involved in transitioning to PALs.

OCCUPATIONAL PROGRESSIVE ADDITION LENSES

Carefully chosen progressive lenses offer great all-round vision, allowing the patient to constantly adapt to a wide range of distances. However, they can be troublesome for long periods of fixed intermediate or close work – especially when a higher near vision addition is needed[18]. Back, neck and shoulder posture in particular can suffer – with the need to hold one's head in an unnatural position and, if the intermediate portion is too narrow, the patient may struggle to see clearly as extensive a range as they require[18].

With modern work and leisure computer use, e.g. gaming, it is not unusual for multiple screens to be employed simultaneously. While intermediate/near bifocals can be usefully employed in this situation, they do not afford the viewer any range beyond that of the fixed intermediate distance, e.g. the computer screen(s). This is precisely where occupational progressive addition lenses (OPALs) come into their own.

Designed to accommodate viewing at a restricted distance, OPALs are ideal for office, board room and small class teaching situations. As increasing attention and higher priority is afforded to occupational health and employee comfort (and their link to productivity), opportunities to address computer vision syndrome[19] and office ergonomics become more openly welcomed.

ENHANCED LENSES CAN RELIEVE SYMPTOMS FOR PRE-PRESBYOPES

However, to consider OPALs merely as 'office lenses' would do a great injustice to the multitude of potential uses. What about, for example, artists, painters, electricians, dentists, DOs? The list is, undeniably, endless.

As is the way with multifocal lenses, there is a play-off between width and depth and most lens suppliers offer both wide and deep OPAL designs within their portfolio. For example, the Computer and Workplace lens from Shamir[20], or Nikon's Online Wide Neo and Home & Office Neo[17].

A short and wide design offers an upgrade to single vision lenses that removes the requirement for the wearer to lean forward to view their screen, and can be especially useful for anyone needing a broad field of clear vision; a bookkeeper for example. A deeper (and therefore narrower) version lends itself to multi-tasking in a wide range of indoor home and office situations, such as simultaneous tablet use and watching television, crafting or cooking.

There is significant skill involved in successfully dispensing OPALs, including gauging the appropriate lens selection (and therefore working distances) through discussion with the patient and taking accurate measurements. Considered communication, helping the patient to understand how the selected lenses will work for them personally, without getting too technical, is absolutely fundamental to patient satisfaction with any occupational lenses.

The benefits of the increased range should be established with the patient, for example, by holding a -0.75D lens in front of their near vision correction in their spectacles, if they have them, or in a trial frame.

Additional time needs to be allocated for collection too, in order to facilitate comprehensive demonstration and repeated explanation of the completed spectacles. Most important of all, to remind the patient that their new lenses are not, under any circumstances, to be used for driving.

OPALS ARE IDEAL FOR OFFICE, BOARD ROOM AND SMALL CLASS TEACHING SITUATIONS

FUTURE CONSIDERATIONS

Although the continuously evolving offering of conventional ophthalmic lenses still meets the basic requirements of the majority needing near vision correction for now, most would concede that there are limitations and inconveniences associated with spectacle wear – not least the necessity to have the correct pair at hand[3].

Changes in technology, and in the ways we live and think, are coming along at a frantic pace and although the principal functions of optical practice remain fundamentally the same, solutions for correcting refractive error will ultimately need to adapt.

Hand-held electronic devices, such as smartphones and tablets, are now ever-present (in some cases literally) from a very young age and there is growing evidence to show that this change in the way our eyes are used is affecting the ways in which they develop[21], introducing new eye movement patterns and altering body posture.

Developments in spectacle lens design have been influenced by extensive research into evolving consumer insights and modern visual behaviour and widespread investment in new technologies[7]. Whether modern technological advances, however, are satisfying, or driving, demand for ever-more optimal visual experience (for example, 8K televisions) is very much up for debate.

Over many years, alternative designs of 'tunable lens technology' have been widely investigated by scientists seeking substitutes for conventional optical lenses with both instruments and spectacles in their sights. After more than a century of patents and prototypes, practical variable-power spectacle lenses suitable for presbyopic correction are now commercially available[3]. Dial adjustable specs, based on the Alvarez dual lens principle[22], with variable focus from -6.00D to +3.00D are obtainable and cheap to purchase from generic online retailers, such as Amazon and eBay.

Also enjoying years of scientific attention and iterative progress, liquid crystal lenses use a battery to supply an electrical current and regulator circuit to regulate the voltage to control variable refractive index and consequently the focal length. Although the physically moving Alvarez lenses have not been widely adopted yet, spectacles utilising liquid crystal lenses aka 'smart glasses' are reported to be the 'next big thing'[23] set to transform the optical and digital world.

Prescription lenses, sunglasses and 'electrochromic' lenses are already available in early models with integrated features such as still and video cameras, Bluetooth bone-conduction headphones, noise-cancelling microphones, and social media connectivity (e.g. Rayban Stories). In April 2022, EssilorLuxottica won the prestigious Best of the Best Red Dot Design Award for Rayban Stories[24] ("the highest distinction in the competition, awarded to pioneering designs"[25]) perhaps indicating that 'the next big thing' has, in fact, already arrived.

In recent times, electro-tech rumour mills worldwide are glowing red-hot as the sun rises on the dawn of a new technological revolution that is the widespread availability of super-smart glasses and mainstream adoption of augmented reality (AR).

AR uses a visual device to overlay transparent movement-sensitive digital graphics over a real time real world view; creating the illusion that they "occupy the same space"[26]. Applications are already employed in the military and for medical, commercial and educational purposes. Domestic examples are readily recognised in televised sport, with live scores overlaid like a holograph on the field of play, or swimmers and runners seemingly chasing a bar indicating a target to meet.

Using this technology, smartspecs with incorporated small computer screens (e.g. Vuzix's Blade) allow wearers to watch a film while they work, do the housework, or go about their chores. Built in gyroscopes and motion tracking ability enable basic AR app integration, for example, sat nav or phone and message notifications.

Research in 2019 by Jonghyun Kim *et al*[27] proposed an eye gaze-tracking accommodation-supporting transparent display termed 'foveated AR'. Their work

incorporated a complex system of cameras and mirrors to create a tunable varifocal lens system with a wide field of view, high resolution and thin form in a 'head-mounted' or 'near-eye' display. Foveal feedback provided focal clues that introduced an 'always-in-focus' display system.

By their own admission, these brave ideas made great advances – far exceeding the capabilities of previous systems. Their ultimate aim: to combine variable "prescription corrective optics, adaptive sunglasses, and AR display into a single accessory that is personal and always worn".

In January 2022, Apple was granted a patent titled 'tunable and foveated lens systems'[28] which, much simplified, paves the way for a lens system (of stacked voltage-modulate liquid-filled optical materials surrounded by electrodes and embedded between transparent substrates) within a wearable device, that automatically adjusts to correct a wearer's vision (using 'foveation').

In the patent[28], Apple claims that the lenses can be configured to correct for "myopia, hyperopia, presbyopia, astigmatism, higher order aberrations and/or other vision defects" and combined with AR content.

Although, as is common with the pre-launch of new electronic products, there is rumour, hype and speculation about the pending release of 'smart glasses' from a number of digital technology companies, the prospect of such futuristic concepts becoming reality appears to be on the horizon.

CONCLUSION

Person-centred care, ensuring the patient is always the absolute focus of individual health care decisions, is fundamental to optical practice and no less so for dispensing patients with presbyopia. Such care and attention can only enhance satisfaction and encourage loyalty, and should be a primary foundation stone of building modern-day practice.

An ever-extending portfolio of traditional, contemporary and technically innovative solutions provides a mind-blowing range of spectacle-based corrections for patients with presbyopia. It is fully integrated within the expertise of the DO to deconstruct the marketing speak of industry manufacturers and suppliers to unearth the technical details of all the available products and match them, like an intricate game of pairs, to their patient needs.

Complex task analysis remains key to unlocking patient needs and impactful dialogue about presbyopia. Explaining in lay terms the ageing eye and patient prescription is paramount for managing outcomes and expectations. However, in this new age of constant connectivity, instant gratification and digital stimulation overload, ECPs need to be prepared to think further outside of the box.

As the first of the millennial (Gen Y) generation turn 40, and innovative electronic solutions become mainstream, it may be time to disregard the box altogether. Before long, there may no longer be any box.

SMARTSPECS LIKE VUZIX BLADE INCORPORATE SMALL COMPUTER SCREENS

REFERENCES: *References and a bibliography are available with the online version of this article.*

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LEARNING OUTCOMES FOR THIS CPD ARTICLE

DOMAIN: Communication

1.7: *Communicate effectively with presbyopic patients to ensure they are able to take an active part in decisions made about their methods of spectacle correction.*

2.1: *Appropriately adapt your communication to provide presbyopic patients with information in a way that is understandable to the individual.*

DOMAIN: Clinical Practice

7.5: *Provide effective patient care for presbyopic patients and recommend ophthalmic dispensing solutions based on current good practice.*

NEXT MONTH'S CPD ARTICLE, MODERN MANAGEMENT OF PRESBYOPIA PART 2, WILL LOOK AT CONTACT LENS OPTIONS FOR PRESBYOPIA.

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