

# Kids and contact lenses – a missed opportunity?

**F**or many years there has been a reluctance on the part of eye care practitioners (ECPs) to fit children with contact lenses but this is founded on outdated thinking. Today's ECPs must always practise in a professional and ethical manner, mindful of the current literature about fitting children in contact lenses. Over the past year or two there have been a number of excellent articles covering the fitting of children as a speciality of the hospital eye service. The author recommends 'Specialist contact lenses in children' by Lynne Speedwell.<sup>1</sup>

This article will address the problem of the community ECP fitting the child from an early age to give him/her a better chance of overcoming amblyopia, and improve self-esteem and confidence. The UN High Commission for Human Rights defines a child as someone aged below 18 years.<sup>2</sup> This is an unsatisfactory definition because we are attempting to fit children at primary school age, whose needs are different to teenagers. Other clinical studies are more specific, for example Efron *et al*<sup>3</sup> in his study into prescribing habits defined infants (0-5 years), children (6-12 years) and teenagers (13-17 years). In this article the author will refer to the under-12s as children and the over-12s as teenagers.

## Incidence of hyperopia

Virtually all of us enter this world hyperopic but as the eye begins to develop the infant starts to outgrow its hyperopia. A new born baby has visual acuity in the region of 6/120<sup>4</sup> which, by the time the child gets to nursery school, has improved to 6/6 vision. It is that small percentage of children who do not develop 6/6 that should draw the attention of the ECP.

At what point should hyperopia be corrected? This contentious point has been debated for years. With children of 4-5 years old it is not unusual to have an amplitude of accommodation up to 15 dioptres, so a small prescription of +0.75DS to +1.50DS can be easily tolerated with no symptoms or need for a correction.

Children represent an untapped group of potential contact lens wearers. **Jonathan Walker** describes the benefits to the young patient of fitting the latest silicone hydrogel products



**Figure 1** The child may achieve a greater improvement in vision with contact lenses than with spectacles

In a recent Canadian study, Leat *et al*<sup>5</sup> found that of the 698 record cards of patients aged from six months to 19 years, the cut-off for prescribing for 4-6 year-olds was +3.25DS, while for seven-year-olds to teenagers it was +2.25DS. Excessive hyperopia in a pre-school child is undoubtedly a risk factor for the development of amblyopia and esotropia, and indeed it is the responsibility of the ECP to correct it.

Amblyopia is defined as a reduction

in corrected visual acuity without evidence of organic eye disease. It results from unequal vision stimulation during the sensitive period of visual development, most commonly from a squint or visual deprivation caused by unequal refractive errors. A study by Colburn *et al*<sup>6</sup> found that 19 per cent of children sent to him following preschool screening for hyperopia were amblyopic, and almost a third (32 per cent) were esotropic. During the period up to 40 months, a third of the non-strabismic children had developed accommodative esotropia. This study demonstrated the importance of detecting hyperopes (> +3.50DS) at the pre-school age to ensure amblyopia does not result.

Anisometropia is where the child has unequal refractive errors and amblyopia becomes present in the eye with the highest prescription. This phenomenon has greater impact when the patient wears spectacles; when the eye makes movements away from the centre of the lens, the disparity in image size gets greater, thus making the aniseikonia worse. It has been believed for some time that anisometropia of more than 3.5DS constitutes a barrier to fusion, so these patients are left uncorrected with little chance of improving their amblyopia. High degrees of anisometropia cause disparity in image size between the two eyes. Anisometropia that is not caused by a difference in axial length (ie refractive anisometropia), should be corrected with contact lenses. This can be checked by carrying out keratometry on the child. If the K-readings differ by an amount close to the amount of anisometropia, then contact lenses are likely to either eliminate or reduce the symptoms.

## Spectacles or contact lenses?

Spectacles have been the accepted way of correcting children's hyperopia for many years. Both practitioner



and patient rarely considered contact lenses, mainly because of parents' fears and practitioners' reluctance to fit children. There are many reasons for this reluctance; they wouldn't be able to handle them, they would lose them, and you ought to see the state of his bedroom, to name but a few. When asked about suitability, many practitioners would say wait until the prescription has stabilised or wait until they can handle the lenses.

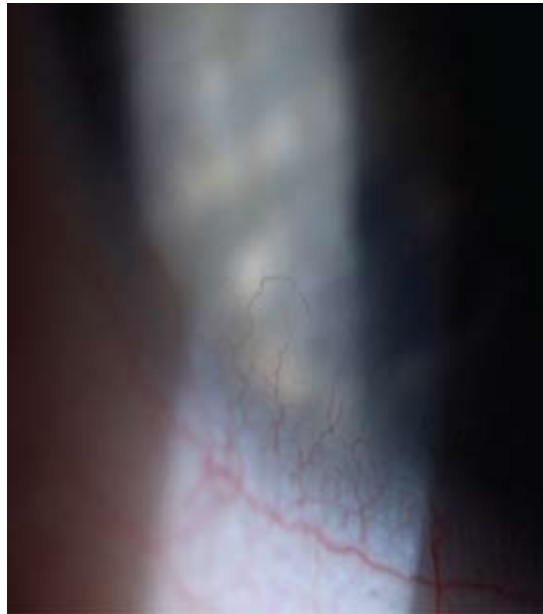
Some of the reluctance to fit children in contact lenses was quite justified, however, as fitting a child has a different set of responsibilities to fitting an adult. Obviously an adult is in a position to make an informed choice; they hear both the advantages and disadvantages of contact lens wear. They are advised about the very small, yet significant risk of infection, the consequence of over-wear and sleeping in their lenses and so on. They are free to ask any question they wish to the practitioner face to face. As far as a 4-8 year-old child is concerned they haven't the experience or knowledge to ask pertinent questions. So much of the information given out by the practitioner is to both parent and child. Parents have to fully understand the very small risks their child is taking, as well as the positive aspect that the child's vision may improve more than if they had chosen spectacles. But it is imperative that the child also fully understands the commitment to contact lens wear.

Sometimes it may be beneficial to let the child feel and touch the contact lens themselves. The practitioner should not always assume the child understands what we mean when we describe a contact lens. It must be considered that the parents may be fully convinced that contact lens wear is in the best interests of their child, but as every parent will tell you, if the child isn't committed to wearing them they will be wasting everybody's time.

### Which lens do I choose?

Once the decision has been made to go ahead with contact lenses, consideration has to be given to which type, whether an rigid gas-permeable (RGP) or soft lens. Because of the complexities of fitting a positive powered RGP, the vast majority will choose a soft lens. If it is to be a soft lens then which modality – one-day, two-week or monthly?

When fitting the hyperopic child, consideration must be given to the choice of material. One of the reasons for practitioners' reluctance to fit soft



**Figure 2** Chronic hypoxic change within the cornea after prolonged contact lens wear

lenses in the 1990s and early 2000s was low oxygen transmissibility. We have known for over 25 years the amount of oxygen the cornea required for daily wear. The Holden and Mertz criterion was originally published in a 1984 paper by Holden *et al.*<sup>7</sup> This criteria of a  $Dk/t$  of 24 ( $\times 10^{-9}(\text{cm mL O}_2)/[\text{mL sec mmHg}]$ ) for daily wear suited the industry well, as most soft lenses back in the 80s and 90s had  $Dk/t$  values in the middle 20s. These  $Dk/t$  measurements were made on -3.00 powered lenses with a centre thickness of 0.06-9mm. When the measurements were made on positive powered lenses a completely different value emerged. The centre thickness of a +3.00 is almost twice as thick at 0.16-0.24mm, so the  $Dk/t$  of a +3.00 56 per cent  $\text{H}_2\text{O}$  soft lens, is about  $14 \times 10^{-9}$ . A compromised  $Dk/t$  such as this on an adult eye can sometimes be clinically acceptable if the patient is adopting a part-time wearing schedule. But in the case of a child where you are trying to get the patient to wear their lenses all day in an attempt to treat the amblyopia it is unacceptable.

Harvitt and Bannanno<sup>8</sup> in 1999 contested the Holden and Mertz criteria. They used a technique called fluoro-photometry, the principle being that when the contact lens is placed on the cornea, the cornea becomes oedematous. There is a shift within the cornea for the pH to fall, in fact it becomes acidic. After a set period of time the contact lens is removed and atmospheric oxygen permeates into the cornea once more and the pH

starts to rise to previous levels. Harvitt and Bannanno's ground-breaking work proved to be the benchmark for measuring  $Dk/t$  in daily wear. They found a  $Dk/t$  of 35 to avoid oedema in daily wear, which to a large extent still holds today. A conventional +3.00 soft lens, which had a  $Dk/t$  of 18, would only manage half the Harvitt and Bonanno criteria.

### Silicone hydrogels

At the 1999 British Contact Lens Association Conference silicone hydrogels (SiH) were introduced to the eye care profession. Professed to be the answer to continuous wear, SiH lenses have had limited success until the last four or five years when practitioners started to abandon continuous wear in favour of using SiHs for daily wear. The first generation of SiHs showed great potential with longer wearing times and whiter eyes. As time marched on, so the SiHs evolved with improved surfaces and lower modulus.

For the first time in many years, fitting hyperopic children became a reality; even high prescriptions such as +7.00DS or +8.00DS still satisfied the Harvitt and Bonanno criteria for daily wear. At last ECPs could fit hyperopic children without the risk of them developing chronic hypoxic changes within the cornea.

ECPs began to use SiHs with increasing enthusiasm and their popularity was borne out by increased sales. Today SiH lenses are the lenses of first choice for the majority of ECPs, but there has to be a full and comprehensive power range, ideally up to +8.00 with a full toric. It is professional embarrassing for the ECP to have got the parents on-board only to find the child prescription is out of range. A full range of powers on the positive side is essential.

Paediatric ECPs who are actively involved in fitting children in contact lenses not only require their first choice lens to go up to +8.00, but also need an equivalent toric with three or four cylinder powers, with axes that go around the clock every 10°. The issue with fitting soft torics is the method adopted for stabilisation. At some point on the lens it has to be made thicker to avoid the rotational effect of the lens; this increased thickness can be as much as 320 microns, much higher than the centre thickness of a +8.00 (approximately 280 microns). When a conventional material is used to manufacture a prism ballast area the  $Dk/t$  in the

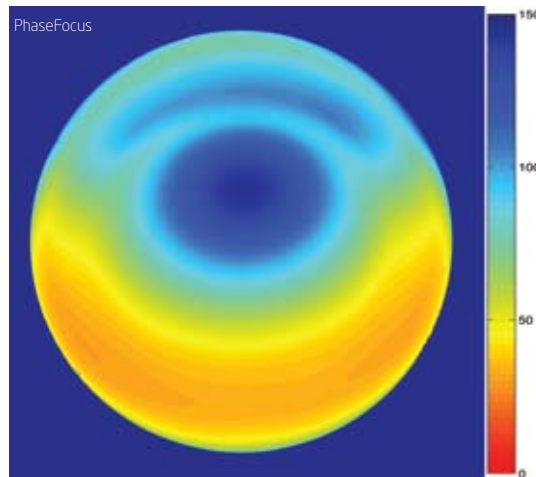


ballast area can be as low as 8.

Figure 2 illustrates the clinical consequence of wearing a conventional soft toric lens for long periods of time. The effects of chronic hypoxia can be seen quite clearly, with limbal hyperaemia and neovascularisation. It can also be seen that the limbal vessels are encroaching into the cornea in an attempt to bring more oxygen. In the drive to reduce amblyopia the ECP is reliant upon the patient wearing their contact lenses all day, so SiH torics are an obvious choice. For many years now industry has quoted the Dk/t value from the centre of the lens, which is fine for minus powers with centre thicknesses of 0.06-0.10mm, but hopelessly misleading for the toric. ECPs should be interested in the transmissibility of the entire lens, including the ballast area where the maximum thickness is found. Companies are now producing Dk/t maps where you can see the variation in Dk/t over the ballast area (Figure 3). The high transmissibility is shown in dark blue, representing a Dk/t of approximately 150, dropping down to 45 in the ballast area. Fortunately the Dk/t of this lens still satisfies the Harvitt and Bonanno criteria of 35 for daily wear, but many of the SiH torics have an area that does not. ECPs should be cautious about choosing a lens by central Dk/t alone.

Particularly in European countries where prescribing one-day contact lenses is quite common, it is understandable that the parents will enquire about the one-day modality. Without doubt the one-day modality is a simple and convenient way to wear contact lenses, which in a busy world are what patients require. Many of the one-day lenses are made from the old FDA group IV material, being high water content and ionic. These materials are comfortable lenses and ideally suited for the one-day market, but with Dk/t struggling to make double digits in positive powers, it is not the ideal choice. Recently we have seen the introduction of SiH one-day lenses, offering the convenience factor and adequate oxygenation of the cornea even in positive powers. This is a more expensive way of wearing contact lenses, but some parents are prepared to pay the extra for the convenience of avoiding contact lens solutions.

Finally in choosing a lens, consideration should be given to the optics. These young children will inevitably have large pupils,



**Figure 3** High transmissibility is shown in dark blue, representing a Dk/t of approximately 150, dropping down to 45 in the ballast area. Image courtesy of PhaseFocus

so the correction of spherical aberrations becomes an issue. Two SiH brands that have been proven to correct spherical aberrations; the Bausch+Lomb PureVision 2 (which disappointingly stops at +6.00DS) and CooperVision's Biofinity which carries the full range up to +8.00DS. Both these lenses have demonstrated effectiveness at correcting spherical aberrations at the +4.00 and above power range. An important feature when fitting hyperopic children is the quality of the retinal image. By using an aspheric lens, the image is enhanced, thus increasing the chance of improved acuity.

### The fitting process

Efron *et al*<sup>3</sup> analysed data from 105,734 lens fits in more than 38 countries from 2005 to 2009. The proportion of children defined as less than 18 years old varied greatly, with

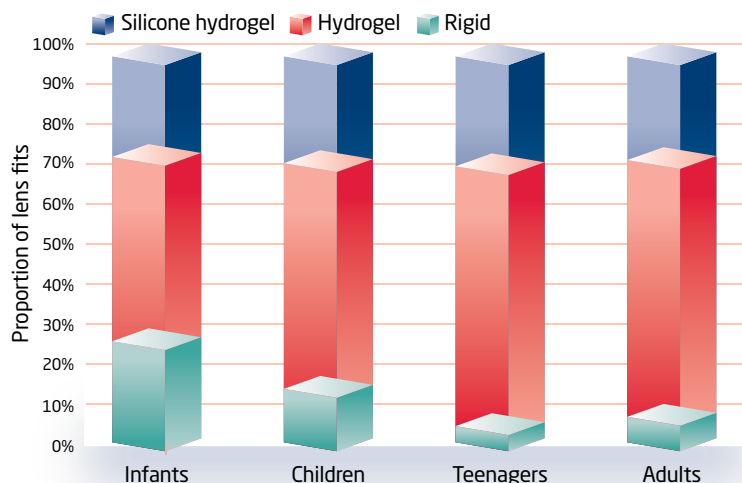
Iceland showing 25 per cent of cases fitted, down to 1 per cent for China. Figure 4 gives the breakdown of lens types fitted in the survey and it is interesting to note that over half of the infants and children were fitted in conventional hydrogel materials, a statistic that in the author's opinion needs addressing.

Interestingly, the survey showed a higher proportion of infants and children were fitted in toric lenses than teenagers and adults.

So is fitting children so different to adults? The ACHIEVE study by Walline *et al*<sup>9</sup> drew the conclusion that 'contact lenses significantly improve how children feel about their physical appearance, their acceptance among friends, and their ability to play sports. Contact lenses even make children more confident about their academic performance if they dislike wearing spectacles'.

More time may be required with children at the fitting and collection appointments, but this may prove very worthwhile later on. Once a child has grasped the insertion and removal technique or the cleaning routine they tend to comply. While the older parent invariably complains of the tedious length they have to go with their contact lenses, children more readily accept it. So investing time in teaching, wearing schedules, and cleaning techniques will eventually prove to be more beneficial and result in a more compliant patient.

As mentioned earlier, amblyopia caused by anisometropic hyperopia can prove difficult to resolve. It can become more difficult to treat if there is uncorrected astigmatism. Additionally, if the axis to the astigmatism is oblique it will be more



**Figure 4** Data from 105,734 lens fits in more than 38 countries from 2005 to 2009<sup>3</sup>



difficult still (meridional amblyopia), often giving poorer results than those with their astigmatism either horizontal or vertical. So a great deal of attention needs to be given to the lens of first choice and, once chosen, needs to be carefully assessed while on the eye. The visual acuity should be as good if not better than with spectacles. When fitting a SiH toric lens great attention must be given to the rotation, as just a few degrees off axis can create an unwanted induced cylinder with a corresponding loss of vision.

When treating hyperopic children who have reduced visual acuity, aftercare appointments are very important. Many of these children have a limited window of opportunity for their vision to improve which doesn't want to be lost through missed appointments. Well-trained support staff can ensure that the child keeps his/her appointment by either phone or text. Small improvements in the visual acuity can pay dividends in the long term, so the method of recording vision takes on a new level of importance. The traditional Snellen letter charts have been used for many years, but their specificity can be questioned. High and low contrast logMAR charts may be more accurate.

Contact lenses offer children freedom from their spectacles, and this is very much the case when a child requires occlusive therapy (Figure 5). We have all seen that poor child with a patch over her good eye in an attempt to reduce the amblyopia in the other eye. This is quite an ordeal for these children, with the stigma of wearing a patch, reduced vision, and strongly impaired stereopsis. They have no binocular vision and inevitably have to be sidelined both in the playground and physical activities. Generally it is advised that occluders are worn for less than 10 hours per day. This reduces the chance of the occluding lens being beneficial. In one study Joslin *et al*<sup>10</sup> found that almost 30 per cent of subjects successfully wore an occluding contact lens after failure of traditional occlusion therapy. Using SiH contact lenses for occlusive therapy has many obvious advantages, both visual and psychological.

ECPs should be mindful that modern SiH contact lenses offer a completely new option for some of the orthoptic disorders they see in practice. It was mentioned earlier in this article that hyperopic children could benefit from contact lenses. Additionally, there



Rex Features

**Figure 5** Contact lenses offer the child who requires occlusive therapy freedom from patched spectacles

are the accommodative esotropes. Children often avoid wearing their spectacles, especially when they can accommodate and bring their unaided vision down to an acceptable level. With this high level of accommodation comes increased convergence, and sometimes unbeknown to the child an esotropia. Contact lenses resolve this situation, with a better appearance for the child and a return to some form of binocularity.

### Summary

The contact lens industry has invested huge sums of money over the years into the development of SiH lenses. The more recent generation of lenses offer whiter eyes, not only increased wearing times and improved comfort, but more importantly increased oxygen permeability (Dk).

While many ECPs associate high Dk with sleeping in lenses, there is probably a more beneficial function in fitting children. If we accept the Harvitt and Bonanno criteria for daily wear as a minimum Dk/t of 35, then previous generations of conventional lenses are not adequate.

To be of benefit to children the lenses must be worn all day, as a limited wearing of 8-10 hours is of

little use. The higher the Dk of the material, the greater the chance of fully oxygenating the cornea. This also applies to SiH torics, because the thickness of the ballast area or the area used for stabilisation will be thicker than even the centre of the lens. Once more the use of a SiH is preferred to achieve a satisfactory Dk/t over the entire lens.

Fitting children in contact lenses can be both professionally rewarding as well as a 'practice builder'. The parents and family of the child will communicate with their friends and so the word gets out. That opportunity is not to be missed! ●

### Acknowledgement

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