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Eye spy with my little eyes. A practical guide to paediatric dispensing

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aediatric dispensing involves a different approach and skill set when compared to adult dispensing. There are many variable fitting, communication and lifestyle considerations that can make paediatric dispensing challenging, however, the importance of providing well-fitting spectacles is vital to ensure optimal comfort and the best possible visual outcome for the child.

The purpose of this article is to give an overview of paediatric dispensing and to discuss the key points in relation to frames, lense, and communication.

WHY PAEDIATRIC DISPENSING IS IMPORTANT

Good vision is essential for the development of a child's motor, language and cognitive development¹, and the provision of well-fitting, appropriate glasses to correct eye problems is crucial in enabling a child to reach their full potential.

A meta-analysis study looking at the prevalence of refractive error across the world, reported myopia, hyperopia, and astigmatism in children to be 11.7 per cent, 4.6 per cent and 14.9 per cent respectively², with the levels varying according to region. Spectacles are not solely prescribed to correct refraction error but can also aid in the management of binocular and accommodative anomalies.

Children are not always able to communicate if something is uncomfortable or if they are unable to see clearly, particularly if they are young or developmentally delayed. If glasses are not fitting correctly, comfort and compliance is likely to be poor. Children live in a world that is designed and run by adults and consequently a lot of their viewing area tends to be above their head height.

Glasses that sit too low or slip downwards might result in a child looking over the top of them or change the effective power of the lenses and reduce the visual acuity. It is known that suboptimal vision during the critical period is likely to impede visual development and could cause permanent visual loss. An esophoria that has an accommodative element, could become decompensated and break down into a full esotopia³.

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PAEDIATRIC FACIAL MEASUREMENT	DESCRIPTION OF FACIAL MEASUREMENT	IMAGE	IDEAL PAEDIATRIC FRAME
Crest height	Controls the vertical positioning of the frame on the face. The distance between the lower eyelid and the nasal crest		 Low crest height to sit the glasses higher on the face and to prevent the patient looking over top Pupils situated just above the horizontal centre line Top rim shape that matches the eye socket
Frontal angle	Determines the angle of the pad bridge or the pad on arms in the vertical plane		 Large frontal angle to match the patient's and prevent marks Frontal angle should result in a smooth, full contact between the pad surface area and load bearing area of nose
Splay angle	Determines the angle of the pad bridge or pad on arms in the horizontal plane		 Large splay angle to match the patient's and prevent marks Splay angle should result in a smooth, full contact between the pad surface area and load bearing area of nose
Bridge projection	Determines how far away from the face the frame sits in relation to the eye lashes when they are in their most protruding position	A The	 Inset bridge or a negative bridge projection to avoid lashes rubbing on the lenses BVD kept to a minimum to reduce the spectacle magnification, distortion from the effects of transverse chromatic aberration and to maintain field of view
Pantoscopic angle	Lens tilt about the horizontal axis with respect to primary gaze of a subject	A THE	 Pantoscopic angle normally around 0 degrees (compared to adult average of 10 degrees) to prevent the bottom rims resting on patient's cheeks Small amount can be added to stop the tips of the lashes brushing on lenses
Head/temple width	Horizontal distance from ear point to ear point/temple point to temple point. Temple width corresponds to the distance between the sides at 25mm behind the plane of the front		 Sides should not touch the face before the hairline or leave ridges down the patient's head when the glasses are removed. Frame head width slightly less than the facial head width to ensure adequate grip. Head width can be adjusted by adjusting the angle of let back or applying or removing an inward curve to the side

Figure 1: A description of frame measurements and key fitting points for paediatric frames

As well as affecting vision, a poorly fitting pair of glasses can inhibit the

development of a child's nasal and facial features³. Children have soft cartilage

and prolonged pressure can cause tissues to break down. A poorly fitting



Figure 2: A Jellybeanz frame with a saddle bridge in a 32 eye

curl side for example, could deform the ears, or an ill adjusted strap bridge could cause a permanent ridge over the crest of the nose³.

Further, research has shown that children who wear glasses are more likely to be victimised or bullied⁴ and so cosmetic considerations are vital to ensure a child maintains a good level of self-esteem. Quite simply, if a pair of glasses are not fitting well, they will not look good, regardless of the make or the brand.

Despite the clear need for well-fitting children's glasses, the importance of paediatric dispensing is often overlooked, and it is not uncommon to see children wearing glasses that are not fit for purpose.

DIFFERENCES IN FACIAL MORPHOLOGY

A child's head and facial features are not just small version of adults; the proportions are quite different, particularly around the bridge area, and any frame dispensed to a child should be designed to match a child's anatomical features. Clearly there is much variation in size and shape of children's heads and facial features, particularly when comparing different ethnic populations, but in general, the underdeveloped nasal bone and smaller head size, leads to:

- A lower crest height
- Larger splay and frontal angles
- Negative bridge projections
- Small head/temple width

• Smaller pantoscopic angle³

Figure 1 looks at these differences more closely and the ideal paediatric frame fit.

BRIDGE STYLES

The fitting triangle is a term used to describe how the glasses should be touching at three points on the head only: the bridge and the two ear points. If the frame is touching a child's head anywhere else, the frame is probably not the correct size or needs further adjustment. These three points on the head support the weight of the frame and hold it in position and so fit around these areas is crucial.

The bridge is the major weight bearing surface, holding about 90 per cent of the spectacle weight³. A bridge should be chosen that spreads the weight over as large a surface as possible, within the constraints of the size of the nose and the proximity of the inner canthi. Whichever style is chosen, the shape, splay angle and frontal angle should match that of the patients precisely.

Plastic frames

A regular bridge should be in constant touch all the way round the nose. A fixed pad bridge should spread the weight over the two pads on either side of the nose. If the bridge is too wide, there will be gaps at the sides of the nose, the frame will likely slip and could cause pain and pressure at the apical radius. Keyhole bridges will have a visible space over the crest of the nose.

Metal bridges

The development of flexible, light plastic frame materials combined with the current trends for plastic frames means fewer children are now wearing metal frames; however, they still have their place for some patients. Silicone saddle bridges like those on the Jellybeanz frame (Atlantic Optical) in **Figure 2** are great for absorbing impact and fit broad flat bridges typical with young infants.

Pads on arms and strap bridges will need frequent adjustment, as with wear, the distance between pads can increase and cause the glasses to sit too low. Silicone nose pads are hypoallergenic and will give more comfort and grip on the nose to help prevent slipping. Pad on arms can sometimes be added to plastic frames after removal of the plastic pads at the back.

SIDE STYLES

Loop ends

The advent of 3D printing has allowed us to provide customisable parts of frames to give the best fit. **Figure 3** shows an example of loop ends that have been



Figure 3: 3D-printed loop ends fitted onto a plastic frame. The loop ends are fitted 15mm beyond the ear point



1. Using cutters, crop the required amount from the side, being careful not to cut too close to the metal reinforcement.

designed and 3D printed at Spec Care (UK). The loop ends have been fitted onto a Blitz Kids frame (Norville) and supplied with a Velcro strap to help keep the glasses in place. The material of the loop ends is hypoallergenic and flexes to match the contour of the patient's head to give maximum fit and comfort.

Drop ends

For younger children, sides should be cropped if there is a drop greater than 35mm. Sides on metal frames can be shortened in the usual manner. **Figure 4** shows how sides on cellulose acetate frames can be cropped up to the metal reinforcement easily in practice.

Companies such as Spec Care (UK) can crop the sides if they need to be shortened beyond the metal reinforcement, whilst keeping any logos or designs on the ends, by cutting the side at the joint and re-sinking at the half joint. The bend of the drop should begin at the ear point and give an angle of drop of approximately 45 degrees.

Bends that begin too far forward will irritate the top of the ear, cause the side to lift upwards and add pantoscopic tilt to the front of the frame. If the bend starts too far back, the downward angle of the drop will have to be greater than 45 degrees to compensate and will rub the back of the ear.

2. File the tip to the desired shape. Use a finer file to give a smooth finish.

Figure 4: Cropping cellulose acetate sides in practice

Curl sides

If curl sides are used, the curls should fit around the root of the ear but stop just before the ear lobe with the ends slightly angled in to follow the contour of the head. Ideally a silicone covering should be used to provide comfort and stability. Curl sides should be measured from the dowel point to a tangent at the back of the ear, on both the right and left. Curl sides can be fitted onto both metal and plastic frames.

SPECIALIST PAEDIATRIC FRAMES

Advances in design and material mean there are now many different options available that give good fits without the need for extensive modifications or sacrificing the fit and visual performance for cosmetics. Children tend to be more active, and less cautious when dealing with potentially hazardous situations, and so robust frames are needed that can withstand the knocks that they are bound to encounter, without causing injury.

Modern polymers are now more impact resistant whilst still retaining rigidity to create a stable platform for the lenses. The specialist paediatric frames shown in **Figure 5** are made from lightweight, robust materials and have all been designed to take into account a child's anatomy and developing features. Each of the frames have their own fitting systems and features. There is not one style of glasses that will work for all of children and it is important to have a range of different sizes, makes and styles available to try. New guidance now means that the Small Frame and Special Facial Characteristics Supplement can now be claimed for frames such as these when there is clinical need⁵. The reason for the use of such frames must be recorded in the patient's records and the current

Small Frame Supplement criteria of boxed

centres of 55mm or less must also apply.

SPECTACLE STRAPS

Fitting a spectacle strap can be useful for young or active patients, or those with high prescriptions that can make the glasses front heavy and prone to slipping. The frames in **Figure 5** are all provided with spectacle straps, but they can be added onto most frames.

Centrostyle provides silicone straps that are available in different sizes and colours. Straps should fit at the base of the head and be secure enough to hold the glasses in position but without pulling too tightly on the bridge (see **Figure 6**). When the strap is fitted well, there should be room to fit a couple of fingers between the patient's head and the strap.

Miraflex (Dibble Optical)

Made from one piece with no metal parts, these frames are virtually unbreakable. Lenses must be glazed extra securely in these frames to prevent them popping out.

Tomato (Tomato Glasses UK)

The sides can easily be adjusted to give the perfect nonslip fit. The bridge design is great for children with negative bridge projections to prevent lashes rubbing. The bridges come in a variety of widths and can be fitted into 1 of 3 different vertical positions to match the patient's crest height.



Centrostyle (Centrostyle)

These flexible frames are available for babies from a 36 eye all the way up to a 54 eye – useful for children with larger head widths or older children with learning disabilities. A deep bevel helps to prevent the lenses being knocked out.



The unique hinge design allows sides to be flexed without breakage. Sides can be removed to fit a headband into the front - great for patients in wheelchairs with headrests.

Figure 5: Examples of specialist paediatric frames

Be sure to check how soft the ears are; straps are not suitable for children that have soft cartilage in their ears as the downward pressure can cause them to stick out. Silicone frame locks are another option to help hold the glasses in position.

BABIES

A child as young as six weeks old may be prescribed glasses, if they are born with congenital cataract. The initial challenge when dispensing to children this age is sourcing frames that are small enough. The Jelly Beanz frame is available from a 32 eye, and the Tomato Glasses baby frame from a 35 eye. Swiss Flex (PKP Optics) also supply baby frames starting from a 36 eye for larger babies.

During the first few months of life, a baby is not able to support their own head and so the glasses must be secure enough not to move around when the baby is being held. Head circumference increases rapidly during the first six months of life, increasing by around 0.5cm a week in the first two months and 0.25cm a week between two and six months⁶ – and so a baby may need several pairs of glasses during the first year of life.

CONGENITAL CATARACTS

Recent research⁷⁻⁸ has concluded that for children born with unilateral congenital cataract, there is no difference in visual outcome for patients treated with intraocular lenses (IOLs) and those left aphakic and treated with contact lenses. However, children who receive an IOL are more likely to suffer with post-surgical complications and need further surgery something that should be avoided in children to reduce the exposure to anaesthetics. Consequently, there is likely to be an increase in the number of patients who are born with congenital cataracts, being left aphakic and being treated with contact lenses and glasses. These children will need lenticular lenses with a UV filter (Figure 7).

SPECIAL FACIAL CHARACTERISTICS

Patients with learning disabilities or conditions such as cerebral palsy, Down syndrome or craniosynostosis are more likely to have refractive error and/or reduced accommodation and require glasses. Children with learning disabilities for example are 28 times more likely to have eye or vision problems⁹. These children often have additional fitting requirements and need specially modified or handmade frames. A few considerations are listed below:

 Patients in wheelchairs with head rests need neater frames that do not extend far behind the ear to prevent movement when the patient turns their head. Curl sides are a good option to provide stability. For patients with limited head control who spend a lot of time leaning on one side, supported by a head rest, the Nanovista frames with a strap attached to the front



Figure 6: Fitting a spectacle strap

(Figure 5) can work well so that they are not leaning on a solid spectacle side.

- Patients who suffer with seizures or self-injurious behaviour like head banging or eye poking, should ideally be dispensed Trivex or polycarbonate lenses into a frame with no metal parts, to reduce the risk of harm from trauma.
- Approximately four out of 10 deaf children have some problem with eyesight¹⁰ so ensuring a patient can wear their glasses and their hearing aid comfortably is vital. A poorly fitting spectacle side could



Figure 7: An infant with aphakia wearing 34mm bowl lenticular lenses with a UV filter

be detrimental to the fit of a hearing aid. A frame with a narrow side or a neat curl side will work best. **Figure 8** shows an example of a 3D-printed side printed for a patient with microtia who has a small, low set ear.

Research by Maggie Woodhouse¹¹ has shown that children with Down syndrome have facial measurements that differ from other children of the same age (for example, smaller crest heights, shorter length to bends and narrower pupil distances), and standard frames will not give a satisfactory fit. The Erin's World frame is specifically designed to take into account these facial measurements. Tomato Glasses can also work well, fitting the silicone bridge on the lowest setting to account for the lower crest height and adjusting the length to tangent to account for the shorter length to bend.

LENSES

As with paediatric frames, paediatric spectacle lenses need to withstand a child's active lifestyle and be safe in case of an accident. A further consideration is UV; a child may spend a lot more time outdoors and with clearer media and larger pupils, this can make them susceptible to damage from UV rays.

Whilst CR39 lenses are commonly dispensed, balancing clarity, durability, lightness of weight, scratch-resistance and low price¹², polycarbonate will give greater impact resistance and thinner and lighter lenses. However, polycarbonate is relatively soft and consequently prone to scratching, and the V value is only 30, which may induce chromatic aberration and cause colour fringing for some patients.

In comparison, Trivex is also lightweight and provides higher levels of impact resistance whilst still maintaining a high V value (45) and good UV protection. High index lenses should be used for high prescriptions, but the V value will vary between 32 and 41. Although one might assume 1.74 will produce the thinnest lenses, this is not always the case as 1.74 requires a thicker centre substance¹² because it is more brittle than 1.67.



Figure 8: A 3D-printed side for a patient with microtia

Some patients may have a high myopic prescription even when young, associated with prematurity, a retinal dystrophy or another genetic disorder. The boxed centre distance of the frame should match the patient's pupil distance as closely as possible to reduce temporal thickness for myopes and nasal thickness for hyperopes.

Ideally, the lenses should not be decentrered anymore than 3mm each eye¹³. Not only will this reduce the risk of trauma if the patient falls, but it will also improve the cosmesis with well centred pupils. For patients with smaller pupil distances but larger head widths, this can be overcome by selecting frames with larger lugs, or by increasing the angle of let back on the sides and gently bowing the sides around the temples.

When ordering high minus prescriptions, ask for a heavy safety chamfer. Alternatively, you can add this on by hand, by filing the temporal edges down with a hand file. The crest height of the frame is also important here. If the optical centres are set high in the frame because the crest height is too large, a larger blank size will be required creating more thickness at the top rim on plus prescriptions and at the bottom rim on minus prescriptions. For plus prescriptions, use the smallest blank size possible and order surfaced lenses when needed. Powers over a -20.00D and +10.00D may require a lenticular lens.

Anti-reflective coatings will offer the same benefits as with adults. Screens are

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now an integral part of a child's everyday life and so reducing glare for many children will be beneficial, especially for children with learning disabilities who use electronic communication aids such as Eye Gazes. Further, it will improve the cosmetics of the glasses by making children's eyes more visible through the lenses. As lens index increases, so too does reflectance – and so anti-reflective coatings are a must for any indexes higher than a 1.6.

MEASUREMENTS

Accurate measurements are essential in paediatric dispensing as any errors will be exaggerated on a smaller patient. As children do not grow symmetrically, ideally monocular PDs should be taken, covering each eye in turn. This is not always possible with a wriggly child, so inner canthus to outer canthus might be the best you can do.

Vertical centration is also important, particularly for higher powers and patients with anisometropic prescriptions to avoid any unwanted prismatic effects. Also consider the gaze and head posture of the patient; patients with ptosis and a chin elevated head posture for example, might require the optical centres to be set lower in the frame.

An add may be prescribed for patients with pseudophakia or patients who under accommodate. For example, more than 75 per cent of children with Down syndrome cannot accurately accommodate on near targets¹⁴. Young children need a large bifocal to allow them to see the larger objects they tend to view and to enforce use, ideally a D35. The top of the segment should be set at the lower pupil margin, whilst still ensuring there is enough space for distance vision. Progressive powered lenses will give better cosmetics for older pseudophakic children.

COMMUNICATION

As practitioners we must balance the wants and needs of both the parent/carer and the child, who often have conflicting points of view (referred to as the duality of the patient), whilst ensuring the highest standards of dispensing. Adults involved in the care of children play a key role in maintaining compliance, so sufficient importance needs to be placed on the fit and the wearing of the glasses. It can be a shock for parents/carers to discover their child needs glasses and some will need more help, support and empathy than others, particularly if they are not spectacle wearers themselves.

Children may be reluctant to try on glasses, especially if they have undergone cycloplegic refraction. Making the dispensing area as friendly as possible with lots of toys and colours can help put the child at ease. Keeping up with the latest children's television programmes and popular characters is a great way to start a rapport with a child.

Never underestimate the important of positive body language and smiling. Smiling, using pleasant tones, being at eye level and a relaxed body posture shows the child that they are in a safe, secure, happy environment. Making it into a fun game and demonstrating measurements on the parents first can show the patient that there is nothing to worry about and help to allay fears.

Often there is only a limited window of opportunity where a patient is compliant, so it is important to be as efficient as possible. Flashing lights and toys are invaluable for distracting infants to allow you to take your measurements and try frames on (**Figure 9**). Giving the child the final choice of the frame, from a selection of suitable options, will give the child a sense of ownership over their glasses and encourage wear. Children with learning disabilities might prefer to be seen when it is quieter in practice and may take longer to process information and reply, so give them enough time to respond to questions. Always talk to the patient directly and let them know what you are going to do before you do it. Some children may use Makaton, a unique language programme that uses signs, symbols and speech. Learning a few Makaton signs can really aid in communication and help build a rapport.

For some children, going from no spectacle correction to full-time glasses wear might not be possible due to the feel of the glasses on their face or the way the world looks with their optical correction. Wear time might have to be built up gradually. Give guidance on adaptation, for example, distraction and positive association. If the child wears the glasses when they are doing something they love, they will be more likely to associate them with a positive experience and be more motivated to wear them. Getting an autistic child to wear the spectacles whilst they are active, and their vestibular system is engaged, might also aid in adaptation¹⁵.

Follow-up appointments to refit and adjust the glasses are vital, to ensure comfort and continued wear. Sometimes it is not possible to get the perfect fit first time, and parents need to know



Figure 9: Using sparkly toys to get the child's attention in order to assess frame fit and take measurements

that they can come back if something is not working.

CONCLUSION

Providing well fitting, appropriate and comfortable glasses for children is of the utmost importance for their eyesight and overall development. Paediatric dispensing is one of the most rewarding parts of being a dispensing optician. Witnessing a child seeing clearly for the first time with their new glasses, and building a rapport with them over time, can be a privilege and a joy.

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