Paediatric Spectacle Prescription

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Abstract

The prescription of spectacles in children depends on the individual need of the child and other associated factors like strabismus and amblyopia. Several guidelines have been published to help ophthalmologists when prescribing optical correction in infants and children, including the publication by the American Academy of Ophthalmology. The purpose of this paper is to reassess and review the guidelines to assist the clinician in deciding when to prescribe spectacles in children, and the amount of refractive error which should be corrected, with a view to fulfilling the particular clinical requirements of each child.

Introduction

The correction of refractive errors in children poses several challenges, more so in preverbal children. In children younger than 2 years, obtaining a reliable visual acuity may in itself be difficult. Further compounding factors are the ongoing process of emmetropisation, and the reliability on an objective refraction, unlike in adults where the end point can always be determined – the best corrected visual acuity. Cycloplegic refraction is mandatory in every phakic child, with the choice of cycloplegic agent being atropine sulphate, homatropine and cyclopentolate, depending on the age of the child and the association of strabismus. If a refractive error is detected, the decision of prescribing spectacles is determined by the natural history of refractive errors, magnitude of the refractive error, the age of the child, the visual needs of the child, the presence of anisometropia and associated strabismus. Refraction can be assessed subjectively or objectively, the aim in both cases being to assess the un-accommodated refractive status of the eye.

Refractive changes in childhood

At birth, most infants are hyperopic with an average cycloplegic refractive error of +2.00 D with a standard deviation of 2.00 D. Then follows a period of rapid change of refraction up to the age of one year, followed by a slower phase of emmetropisation. The rate of emmetropisation is usually proportional to the initial error, as those who have higher ametropia generally show greater and faster changes in overall refraction. Most of these changes occur during the first 2 years of life. Emmetropisation is essentially complete by six to seven years and the myopic shift slowly sets in.

| Table 1. Changes in the ocular parameters with growth |
|------------------------------------------------------|
| **At birth** | **Adult** |
| Axial length | 16.8 mm | 23.0 mm |
| Mean Keratometry | 56 D | 43 D |
| Lens power | 45 D | 24 D |

Myopia

It is especially common in premature infants. Some of the considerations for prescribing spectacles for myopia are as follows:

- < 1 year – correction if error is 5D or more. In infants, near vision is needed more than distant vision. Therefore, only very high refractive errors should be corrected.
- 1 to 3 years – correction given if error is more than 3D
- In school going age, myopia should be corrected for function with full correction.
- In intermittent exotropia, myopia may be over corrected.

**Minimum correction to give maximum visual acuity should be the aim.**

Hyperopia will be induced if the strength of the concave lenses is increased. The child will overcome this hyperopia by accommodative effort and will continue to see the same line in the vision chart clearly until the accommodation is no longer sufficient for clear vision. Therefore, with subjective refraction alone, there is a risk of overcorrecting myopia in patients with a good amplitude of accommodation. This error can be avoided by using the duochrome test and by preventing children from looking too long and too intently at the vision charts.

The theory that increased retinal defocus is a factor in the pathogenesis of myopia, led to the Correction of Myopia Evaluation Trial (COMET) study. Insufficient accommodation in children during near work activities may result in retinal defocus, and accurate accommodation would reduce excessive defocus and slow axial elongation. The COMET study was undertaken to evaluate whether Progressive Addition Lenses (PAL) slowed the rate of progression of juvenile-onset myopia as compared to Single Vision Lenses (SVL). The results of the 3 year study provided some support for the COMET rationale—that is, a role for defocus in progression of myopia. The difference was statistically significant (0.20 D over a three-year period) but was not clinically significant. However, myopic children with a larger lag of accommodation and esophoria at near had 0.64 D less myopic progression over three years with PAL.
Review Article

Table 2. Consensus guidelines for prescribing eyeglasses for young children

| Condition                        | Dioptres                  |
|----------------------------------|---------------------------|
|                                  | Age 0-1 year | Age 1-2 years | Age 2-3 years |
| Isometropia (similar refractive error in both eyes) |            |              |              |
| Myopia                           | ≥ −5.00       | ≥ −4.00       | ≥ −3.00       |
| Hyperopia (no manifest deviation) | ≥ +6.00       | ≥ +5.00       | ≥ +4.50       |
| Hyperopia with esotropia         | ≥ +3.00       | ≥ +2.00       | +1.50         |
| Astigmatism                      | 3.00          | 2.50          | 2.00          |
| Anisometropia                    |              |              |              |
| Myopia                           | ≥ −2.50       | ≥ −2.50       | ≥ −2.00       |
| Hyperopia                        | ≥ +2.50       | ≥ +2.00       | ≥ +1.50       |
| Astigmatism                      | 2.50          | 2.00          | 2.00          |

**Additional Factors**
- History of previous amblyopia or strabismus surgery
- Visual acuity
- Acceptance of eyeglass wear
- Possible accommodative esotropia/monofixation syndrome
- Medical comorbidities
- Developmental delay

**Hyperopia**

The major considerations are as follows:

- Children < 2 years – correction may be given for large refractive errors or in cases of anisometropia. For infants, partial correction should be given, such that the uncorrected portion is just above the mean for the age, leaving a stimulus for emmetropisation, which is still larger than the average. Such infants should be monitored very frequently (for example, every month initially) and if strabismus occurs, full correction should be prescribed.

- Children 2-5 years – correction should be prescribed if refractive error is more than +2.5D. As emmetropisation is an ongoing process in this age group, the refractive error is undercorrected so that the stimulus for emmetropisation is present, provided amblyopia or strabismus have been ruled out.

- Children > 5 years – correction should be given if refractive error is more than + 1D, as more strenuous near work is required.

Always prescribe fullest correction consistent with good vision.

If esotropia is associated with hyperopia, prescribe maximum power convex lenses which can be tolerated and still give the patient optimum vision. If the hyperopia is overcorrected or if the patient is unable to accept the lenses, the resulting decrease in visual acuity can be a barrier to spectacle acceptance. Bifocals should be given if needed. In exophoria or exotropia, low to moderate degrees of hyperopia can be undercorrected. Lower hyperopia (down to 0.75 D) associated with symptoms (asthenopia, difficulty with focusing, headaches) may need correction. If there is no esotropia and no asthenopic symptoms, it is not necessary to correct low hyperopia. Poor reading skills are also associated with hyperopia of 1.00 D or more. In such cases, 1.50 D or more of hyperopia should be corrected.

**Astigmatism**

A significant astigmatism should be corrected at the earliest to prevent meridional amblyopia from setting in. Some guidelines for prescription in children with astigmatism are:

- Astigmatism associated with spherical error should always be corrected.
- Astigmatism per se of more than 1.5 D is to be corrected.
- Oblique astigmatism should always be corrected as it is more amblyogenic.

**Anisometropia**

The principal factors that govern the prescription of spectacles in anisometropia are aniseikonia and amblyopia. In cases of anisometropia, the best correction for each individual eye is assessed first. Then the binocular correction is assessed, noting the following:

- The presence of diplopia and whether this is due to aniseikonia or a manifest strabismus, with the correction.
- Binocular visual acuity for distance and near should be noted.
- The patients’ binocular status should be noted (stereopsis).

Anisometropia is associated more with amblyopia, so even low errors should be corrected. Aniso hyperopia and cylinder anisometropia are more prone for amblyopia. In cases of anisometropic amblyopia, full refractive correction alone often results in some improvement of visual acuity, mostly during the first four months. Amblyopia therapy may be started after this period, if required. Moreover, the patient may be more compliant with occlusion therapy after this period due to the improved visual acuity in the amblyopic eye.

However, older children may be unable to tolerate the full correction binocularly, and the correction of the more ametropic eye may need to be decreased, even if the visual acuity does remain suboptimal in that eye.

A very large difference in refraction between the eyes may be more suitably corrected with contact lenses, especially in the following cases:

- Inseparable aniseikonia, as in unilateral aphakia
- Better binocular function with contact lenses than with spectacles
- If the difference in refraction between the eyes is more than 4 D, and the visual acuity in the amblyopic eye does not improve with full correction in young children.
Patients with a significant amount of anisometric myopia, may have a head tilt in the primary position, on the side of the more myopic eye, associated with a hypophoria of that eye. This is the “heavy eye” phenomenon.

**Unilateral Aphakia**

The problems associated with unilateral aphakia are:
- Aniseikonia of 20 – 25% with spectacle correction.
- A manifest strabismus, esotropia in young children and exotropia in older children, if the aphakia persists for a long time.
- Stimulus deprivation amblyopia, possibly with strabismic amblyopia.

The correction of unilateral aphakia is done by an intraocular lens implant or by contact lenses. A near correction of +2.5 or +3 DS will be required for the aphakic eye if it is to be used for near work. Treatment of amblyopia and a manifest strabismus may also be required.

**Bilateral Aphakia**

Contact lenses and intraocular lens implants are the preferred modalities of correction of bilateral aphakia, although spectacles may also be used. Irrespective of the method used to correct bilateral aphakia, a near add of +2.5 or +3 DS will be required in both eyes.

**Pseudophakia**

All children with pseudophakia should undergo periodic refraction for optimum visual rehabilitation. A near add will be needed regardless of unilateral or bilateral pseudophakia. The clarity of the visual axis should be ensured at all times. A unilateral pseudophakia may need treatment for amblyopia or a manifest strabismus.

**Spectacle prescription in cases of strabismus**

The rationale of modification of spectacle prescription in children with refractive errors associated with strabismus is to relax accommodation in an esodeviation and to exert accommodation in an exodeviation. This is further governed by two factors, the strength of the refractive error and the visual acuity. The more the refractive error, the less the chances of modification of the prescription. Reduction of visual acuity of one line may be tolerable for the younger children but not in school-going children as they would require good visual acuity for their school work. If full correction of hyperopia does not restore binocular single vision, then a small over correction can be considered or bifocal spectacles may be prescribed. In refractive accommodative esotropia, the full hypermetropic correction should be prescribed, after subtracting the refractionist’s working distance. Children needing a correction of more than 5 D or an older child wearing glasses for the first time, may take a few weeks to accept the correction. Overcorrected minus lenses may be used for the treatment of exodeviations.

**Conclusion**

Screening for refractive errors is important in children, and should be done annually in children. In infants and preverbal children, objective tests are the only means of checking for refractive errors. In older children, both objective and subjective tests can be performed which allows for a greater refinement in optical correction. The art of prescribing spectacles in children is ruled by several considerations. In infants and young children, optical correction of refractive errors is indicated in high refractive errors which may cause unilateral or bilateral amblyopia. Spectacles are also essential if the refractive error is associated with accommodative strabismus, and also in aphakic or pseudophakic children. After prescribing spectacles, the child should be advised a follow up visit after four to six weeks, which allows time for the spectacles to be dispensed and for the child to adapt to them.

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