Amblyopia has been described as unilateral or bilateral reduction in best-corrected visual acuity caused by form vision deprivation and/or abnormal binocular interaction, without a visible organic cause commensurate with this visual loss. It remains the most common cause of preventable uniconal vision loss in children and young adults. Timely diagnosis and management of amblyopia is crucial because the visual loss is correctable, if appropriate measures are applied at appropriate time.

It is not uncommon to see clinicians getting puzzled over diagnosis of a case of diminution of vision, whether it is functional amblyopia or otherwise. Various treatment options have been tried for management of amblyopia. These are refractive correction, occlusion therapy, penalization, drug therapy, and refractive surgery. There is a lot of confusion still to the best possible management protocol for treating a child with amblyopia. This deliberation was designed with the stalwarts in the field of pediatric ophthalmology so that they could throw some light and share their experience in the management of amblyopia.

Prolima Thacker-Q. What is the prevalence of amblyopia in your center?

Ken K. Nischal: The prevalence of amblyopia at Children’s Hospital of Pittsburgh is difficult to estimate very accurately because of the tertiary and quaternary nature of the practice; however we estimate the prevalence to be 1500 of patients actively being seen in our clinics.

T S Surendran: Our being a tertiary care centre, the prevalence of amblyopia is quite high. It is about 8%.

B.S. Goel: A conservative guess will reveal an incidence of about 1% among all patients attending a hospital. It was seen to be more among urban children than rural.

Frank J Martin: The prevalence of amblyopia in our community is about 3%.

Seyhan B. Özkan: The prevalence of amblyopia in Turkey is 2.29-4% which is more or less similar with the literature information.

Kamlesh: We don’t have exact figures but I can safely say that in children between the age group of 3-15 years, amblyopia is detected in at least in 3-4 in every 100 patients seen in the general OPD and in 30-35% new patients seen in the squint clinic.

Subhash Dadeya: I see 4-5 cases of amblyopia in each OPD of around 100 patients and 20-30% patients in squint clinic are amblyopic. The prevalence in general population is around 4%. The prevalence of amblyopia in our center is higher because of the referral nature of our Hospital.
Summary (Prolima Thacker): Amblyopia affects approximately 1 to 4% of the general population. Although there are no well-controlled studies from India, a study by Goel et al found an incidence of <1% in school children. The incidence was found to be higher in rural schools (0.7%) than urban schools (0.5%) at primary level, probably because of lack of awareness among rural populations about regular eye checkups and the use of spectacles. A study done in Arvind eye centre by Vijaylakshmi et al, notes the prevalence to be 1-4% in India.

Prolima Thacker – Q. What are the risk factors you think are commonly associated with occurrence of amblyopia?

Ken K. Nischal: The risk of developing amblyopia is closely linked to the presence of strabismus, significant refractive error, or conditions that may obscure the light from entering the eye during the sensitive period - from birth to 6-8 years of age. Additional risk factors that have been identified are: prematurity, low birth weight, Retinopathy of Prematurity, malnutrition, maternal smoking, use of drugs and/or alcohol. (Davies R 1972).

T S Suresh: Strabismus, anisometropia, ametropia are the common risk factors associated with the development of amblyopia. Presence of any factor which can lead to visual deprivation such as presence of corneal opacity, congenital cataract, severe ptosis obscuring the visual axis or a vitreous haemorrhage can also be considered risk factors for the development of amblyopia.

B.S. Goel: Risk factors include uncorrected refractive errors, strabismic conditions, unattended congenital cataract and corneal opacities, and varying degree of ptosis. Incidence and severity of amblyopia is more common if the condition is unilateral.

Frank J Martin: Risk factors for amblyopia include strabismus, refractive error, anisometropia, presence of any ocular disease in early childhood and infancy (for example, cataracts or ROP), ocular injury early in life, ptosis, and positive family history of amblyopia.

Seyhan B. Özkan: The main risk factors are family history, premature birth history, albinism, Down syndrome, neurological problems like hydrocephaly and cerebral palsy. Strabismus, refractive errors such as high hypermetropia, myopia or astigmatism, ptosis, opacities of ocular media are the well known etiological factors. Ocular problems such as optic disc hypoplasia, choroidal coloboma and lens opacities are also the risk factors for organic amblyopia. Unfortunately many patients in this group remain untreated as the decrease in visual acuity is attributed to the associated ocular problems. The ones with an existing ocular pathology with a limited capacity for visual function deserve special attention for recognition of the coexisting amblyopia. The missed diagnosis of amblyopia in this group may be the reason of very critical changes of the patient’s life such as the difference of being educated in visually handicapped or regular schools.

Kamlesh: The risk factors commonly seen with amblyopia are the presence of strabismus, uncorrected refractive error, anisometropia, unilateral or bilateral cataracts, severe ptosis, presence of vitreous haemorrhage, corneal opacities/scar, ROP, family history of amblyopia. A number of additional risk factors have been identified:

- Prematurity.
- Low birth weight.
- Retinopathy of prematurity.
- Cerebral palsy.
- Mental retardation.
- Family history of anisometropia, isoametropia, strabismus, amblyopia, or congenital cataract.
- Maternal smoking and the use of drugs or alcohol.

Subhash Dadeya: Following risk factors are commonly associated with occurrence of amblyopia.

1. Unilateral amblyopia is usually associated with strabismus (esotropia > exotropia).
2. High refractive error: Presence of hypermetropia > 3.5 diopter and astigmatism > 1.5 diopter are associated with high incidence of amblyopia.
3. Microtia and small angle esodeviations.
4. Unilateral congenital cataract, ptosis or other media opacities have high amblyogenic tendency.
5. Bilateral cataract and opacities.
6. Family history of amblyopia and squint.
7. Premature birth < 30 weeks or birth wt < 1500 gm.
8. Delayed neurological and visual maturation of unclear etiology.
9. Smoking and alcohol intake during pregnancy.

Summary (Prolima Thacker): Risk factors which may be associated with occurrence of unilateral amblyopia are family history of amblyopia or strabismus, failure to emmetropize, high hypermetropia at the age of 1 year, unilateral cataract or glaucoma, congenital ptosis, opaque cornea, hyphema, vitreous cloudy, prolonged uncontrolled patching, prolonged unilateral blepharospasm, prolonged unilateral atropinization, premature birth of less than 30 weeks gestation or 1500 grams, and delayed visual or neurological maturation of unclear etiology. Risk factors for bilateral amblyopia include bilateral cataract of equal density, high uncorrected ametropia, and motor type nystagmus. It occurs four times more frequently in premature children and six times more commonly in children with delayed milestones. Smoking and use of drug or alcohol during pregnancy have also been associated with increased risk of amblyopia.

Prolima Thacker – Q. What is the importance of critical period in pathophysiology of amblyopia?

Ken K. Nischal: The critical periods in visual development that have been determined are, the development of visual acuity of 20/200-20/20 from birth to 3-5 years, the period of highest risk of deprivation amblyopia from a few months to 7-8 years. This plays an important role in the management of amblyopia as it allows us as practitioners to have realistic expectations of the outcomes. (Blackman H 2004).
T S Surendran: The critical period is important, because any condition which hinders the normal binocular interaction will be highly amblyogenic and treatment if initiated during the critical period will be highly rewarding.

B.S. Goel: Most vision develops in a baby from birth till around 5 years of age maximum till 2 years. If the factor responsible is not attended, the child is likely to develop amblyopia and severity will be proportionate to the age of the child and the nature of the factor responsible.

Frank J Martin: The critical period of vision development is usually referred to as the period from birth until the age of about 7-8 years. This is the period in which amblyopia will develop. Amblyopia will not develop after the critical period as the neural connections have already formed. Amblyopia will persist after the conclusion of the critical period if left untreated.

Seyhan B. Özkan: Amblyopia is not a problem affecting one eye and with the recent information, it became evident that amblyopia is a binocular dysfunction. The major mechanism is not the ‘lazy’ state of one eye but the active inhibition of the amblyopic eye by the better eye that blocks binocularity. The active inhibition by the better eye disrupts the equilibrium between the excitatory and inhibitory signals. Amblyopia develops during the plasticity period of visual system which is supposed to be first 7-9 years of life. However the susceptibility of the visual system is highest during the first 3 months of life, which is called as critical period. The amblyogenic factors that affect the visual function during that period causes severe amblyopia. Bilateral stimulus deprivation at that period disrupts the development of fixation reflex and nystagmus appears as a result of this. The plasticity of visual system is not the same for all of the aspects of visual function and recent studies focus on the possibilities of treatment of adult amblyopia by inducing plasticity of the brain in adulthood.

Kamlesh: The pathophysiology of amblyopia has been derived from the pioneering work of Hubel and Wiesel. Amblyopia is thought to result from competitive or inhibitory interaction between neurons carrying nonfusible inputs from the two eyes or because of the presence of a chronically defocussed image in one or both the eyes. This leads to functional and electrophysiological abnormalities in the striate cortex.

Critical period refers to the period of visual maturation during which any external stimulus may affect vision. Broadly speaking, one can talk about 3 periods for acuity:

1. The period of development of visual acuity (1 month to 3-5 years of age) (critical period)
2. The period during which deprivation is effective in causing amblyopia (a few months to 7 or 8 years of age) (sensitive period)
3. The period during which recovery from amblyopia can be obtained (time of deprivation to the teenage years or even into the adult years) (Plastic period)

The critical period is very important in the pathophysiology of amblyopia. Any obscuration or inequality of visual inputs from the two eyes in the critical and sensitive periods will lead to the development of amblyopia. We rely on the plasticity of the visual system when treating cases of amblyopia.

Subhash Dadeye: The development of normal and equal acuity requires the presence of clear and focused images in both the retinas simultaneously. If both or one of the images are distorted or degraded, amblyopia occurs. Hence amblyopia is a developmental problem in the brain due to an insult during the critical period. There is no intrinsic, organic neurological problem in the eyeball. Visualy significant conditions like monocular or binocular visual deprivation, strabismus, anisometropia or abnormal visual environment during this period results in significant electrophysiological and anatomical abnormalities in the striate cortex and lateral geniculate nucleus (LGN). The neurophysiology reveals that the deprived eye shows a marked shrinkage of its input stripes (ocular dominance columns) and a corresponding expansion of the non deprived eye. Critical period - Hubel and Wiesel coined the term “critical period”: a period of time in early life, during which the visual system shows labiality of deprivation and ability for reversal of the effect of deprivation. It is the time period when the developing visual system is sensitive to abnormal insults caused by stimulus deprivation, strabismus or significant refractive errors. This critical period begins at about 4 months of age, probably passes its peak by 2 years and is well down by 5 years and thereafter undergoes a slow decline to cease by about 12 years of age. The time of onset of the critical period is not uniform for all visual functions, which explains the varied defects seen in amblyopes. The vision deprivation due to media opacities during the first three post natal months produces significant reduction in spatial acuity typically less than 20/200. However, a similar insult after three months of age but before thirty months leads to a less profound visual acuity reduction but still in the range of 20/200. Deprivation from thirty months to eight years differs only in that vision is reduced at a slower rate and is more likely to respond to subsequent therapy. This is also the period during which treatment is possible. If the amblyopia remains untreated until the child is 9 to 12 years of age, the visual defect may be irreversible.

Summary (Prolima Thacker): The post natal maturation of the visual system is influenced markedly by environmental factors and visual information received by the visual cortex. Abnormal visual experiences in early childhood resulting from the presence of strabismus, refractive errors and stimulus deprivation, dramatically alter the functional domains of the two eyes in the visual cortex. Functional and electrophysiological abnormalities in the striate cortex have been correlated with the presence of amblyopia in animal models. Hubel and Wiesel coined the term “critical period”: a period of time in early life, during which the visual system shows labiality of deprivation and ability for reversal of the effect of deprivation. This critical period begins at about 4 months of age, probably passes its peak by 2 years and is well down by 5 years and thereafter undergoes a slow decline to cease by about 12 years of age.
Prolima Thacker- Q. Which is the most commonly encountered type of amblyopia in your clinical setting?

Ken K. Nischal: The type most commonly seen at CHP is a anisometropic and strabismic.

T S Surendran: The most common types of amblyopia seen in our setting are refractive anisometropic and strabismic amblyopia.

B.S. Goel: Uncorrected refractive errors and various forms of strabismus are the commonest cause followed by stimulus deprivation due to congenital cataract, corneal opacity and ptosis.

Frank J Martin: Quite often the anisometropic and strabismic amblyopia go hand-in-hand. The most common types of amblyopia we see in our clinic are refractive and strabismic amblyopia.

Seyhan B. Özkan: The practical classification is strabismic, refractive, deprivation and organic amblyopia. Strabismic-anisometropic amblyopia are the most common types respectively in our clinical practice similar with the previous literature.

Kamlesh: Strabismic amblyopia, usually esotropia in infancy or early childhood, is most commonly seen in our setting (about 50% of all patients).

Subhash Dadeya: Anisometropic amblyopia is most commonly encountered in our clinical practice; however strabismic amblyopia is detected at the earliest.

Summary (Prolima Thacker): Refer to (Table 1). The most common type is strabismic amblyopia followed by anisometric.

Table 1: Etiological Classification Of Amblyopia

| Type of Amblyopia                                                                 | Age 0-1 | Age 1-2 | Age 2-3 |
|----------------------------------------------------------------------------------|---------|---------|---------|
| Strabismic amblyopia                                                             |         |         |         |
| Anisometropia amblyopia (Unilateral or asymmetric)                               |         |         |         |
| • Anisohyperopic                                                                 |         |         |         |
| • Anisomyopic                                                                    |         |         |         |
| Form vision deprivation amblyopia (Unilateral or Bilateral)                      |         |         |         |
| a. Stimulus deprivation amblyopia                                                |         |         |         |
| b. Ametropic amblyopia (Bilateral)                                               |         |         |         |
| i. Hyperopia                                                                     |         |         |         |
| ii. Myopia                                                                       |         |         |         |
| iii. Meridional                                                                  |         |         |         |
| Nystagmus related amblyopia                                                      |         |         |         |
| Organic (Irreversible) Amblyopia                                                 |         |         |         |
| a. Sub clinical macular damage                                                   |         |         |         |
| b. Cone deficiency syndrome                                                      |         |         |         |
| c. Malorientation of cones                                                      |         |         |         |

Table 2: Shows the recommended refractive error beyond which glasses should be prescribed in a specific age group (American academy of ophthalmology).

| Type of Refractive Error | Age 0-1 | Age 1-2 | Age 2-3 |
|--------------------------|---------|---------|---------|
| Isometropia              | >−3.00  |         |         |
| Myopia                   | >−4.00  | >−4.00  | >+5.0   |
| Hyperopia                | >+6.00  | >+5.0   | >+1.50  |
| Hyperopia with esotropia | >+2.00  | >+2.00  | >+2.00  |
| Astigmatism              | >+3.00  | >+2.5   |         |
| Anisometropia(without     | >−2.00  | >−1.00  |         |
| strabismus)              |         |         |         |
| Myopia                   | >−2.50  | >−2.50  | >+1.50  |
| Hyperopia                | >+2.50  | >+2.00  | >+1.50  |
| Astigmatism              | >+2.50  | >+2.00  |         |

is also important. Additional factors to identify any underlying cause include, but are not limited to: cycloplegic refraction, cover testing to identify any strabismus, fundoscopy. Difficulties may arise with uncooperative patients, as this can occasionally make it difficult to identify small abnormalities, small ocular deviations etc.

T S Surendran: Clinically, we diagnose amblyopia when the visual acuity is less or does not improve to normal in the absence of any detectable cause or when there is a difference of visual acuity of two lines between the two eyes. Many times, small angle strabismus such as a microtropia may be undetected and can lead to missing the diagnosis of amblyopia. Careful cycloplegic refraction is also a must in children as many a times we uncover undetected refractive errors.

B.S. Goel: Clinical examination, assessment of vision if child is co operative, refraction and glasses will reveal if amblyopia is present. However, in an uncooperative and young child presence of refractive error especially hypermetropia and anisometropia and any contributing factor will alert presence of amblyopia. Child not allowing occlusion of a selective eye may point to the presence of amblyopia in the other eye and needs further attention and follow up.

Frank J Martin: We diagnose amblyopia by utilising a full and thorough eye examination. The child is first examined by a paediatric orthoptist. The orthoptist checks vision using an age-appropriate vision test. In our clinic, we use forced preferential looking tests in babies and young pre-verbal children (Teller Acuity Cards from the age of approximately 1-8 months, Cardiff Cards from approximately 8 months-2.5 years). Once the child can match or verbally identify shapes, we use single Lea symbols at a distance of either 3 or 6 metres, and incorporate counting if the child will allow it. Once the child is a little more confident, we can assess visual acuity using the Sheridan Gardiner or HOTVX test. Normally we can use this test in crowded single format with or without matching at a distance of 6 metres from...
The diagnosis of amblyopia is not always straightforward. Amblyopia is a diagnosis of exclusion. Diagnosis of amblyopia is based on reduced visual acuity in one eye, but may be bilateral. The diagnostic features of amblyopia are:

1. **Confirm the diminution of vision**
2. **Fixation reflex**

One of the most commonly used clinical methods for diagnosing amblyopia in preverbal children is subject assessment of fixation response as described by Zipt. The presence of alternate fixation rules out amblyopia. However, preference for fixation for one eye suggests poor vision in other eye in presence of squint. The child resists occlusion of sound eye, but will not care, if amblyopic eye is covered. A central, steady and maintained fixation in each eye implies good visual acuity in each eye. Fixation preference testing remains one of the most valuable clinical methods for diagnosis and follows up of amblyopic patients and should be practiced by all ophthalmologists to assess vision in infants and preschool children.

Search for amblyopiogenic factors is a useful strategy for early detection of amblyopia, even when vision recording and detailed examination is not possible. Late detection of amblyopia appears to be a multifactorial problem involving characteristics of the child’s visual problem, the family, and the medical system. Consideration of these factors should help to improve early identification of childhood amblyopia.

**Summary (Prolima Thacker):** A complete ophthalmological examination is mandatory for the diagnosis of amblyopia. Amblyopia is a diagnosis of exclusion. Diagnosis of amblyopia is difficult in preverbal children where visual acuity assessment is not very accurate and in children with mental disabilities. (Figure 1)
Q. How important is refractive correction in the management of amblyopia? Can you elaborate on guidelines being followed by you for prescription of glasses?

Ken K. Nischal: Refractive correction is extremely important in the management of amblyopia. The rationale for correcting the refractive error is to ensure that the retina of each eye is receiving an optically clear image. This can be enough to correct the amblyopia in some cases; hence this is always the first step in the treatment process. If the visual acuity remains reduced after 16 weeks of optical correction, I then initiate occlusion therapy.

T S Surendran: Refractive correction plays an important role in the treatment of amblyopia, particularly in cases of anisometropic and ametropic amblyopia. As mentioned earlier, the role of cycloplegic refraction cannot be understated. We follow the AAO Guidelines for prescription of glasses in children.

B.S. Goel: Atropine refraction initially will help in diagnosis of correct refractive error. Glasses are prescribed straight away and worn as far as possible. Feedback on use and acceptance of glasses will be a good indicator in management. In case PMT may not be possible full correction with spherical, cylindrical and correction of anisometropia is prescribed, with necessary changes on follow up history of acceptance. In case the visual acuity remains reduced after 16 weeks of optical correction, I then initiate occlusion therapy.

Frank J Martin: The first step in the management of amblyopia is to provide the full refractive correction in the form of glasses (or contact lenses if this is more appropriate – for example a unilateral aphakic baby post cataract surgery or a child with high anisometropia of more than 6D where the glasses would cause anisokonia). In the case of anisometropia or suspected bilateral amblyopia, full refractive correction is prescribed and the patient is given a period of three months for adaptation. Vision is reassessed in 3 months’ time. If amblyopia is present, then occlusion therapy is commenced.

Seyhan B. Özkan: The refractive correction is maybe the most important component of amblyopia treatment. The evaluation of the accommodative potential of the patient has utmost importance in refractive correction of the patient with amblyopia. This evaluation can be done by dynamic retinoscopy. It is among my routine examination methods of any child. Let’s consider a preverbal child with +5.0 dioptres of hypermetropic refractive error with well aligned eyes. Is it amblyogenic for this child? How much should we correct? We know that if it is left uncorrected some develop amblyopia whereas some others do not. If the child’s accommodative effort overcomes +5.0 this child does not need glasses and does not develop amblyopia. However if the child’s accommodative effort is insufficient to overcome full refractive error then the remaining part needs to be corrected by glasses. So, the decision of the amount of correction that should be prescribed in a case is based on individual decision.

In high hypermetropia the patient may have no ability to accommodate and with prescription of full cycloplegic refraction and treatment of amblyopia he/she may start to accommodate that usually induces an esodeviation. The parents must be warned about this possibility and to be told not to give up wearing the glasses.

In a patient with an esodeviation the hypermetropic refractive correction is straightforward as full cycloplegic refraction. However if the patient has an exodeviation with a hypermetropic refractive error there appears the concern of increasing the deviation. As a rule visual acuity has the priority compared to the control of the deviation. The amount of hypermetropic correction must be arranged depending on the dynamic retinoscopy results. Some high hyperopes start to accommodate following wearing of glasses that may facilitate better control of the exodeviation.

Kamlesh: Amblyopia treatment must never be delayed as early detection and prompt treatment is the key to success. The four primary steps of amblyopia treatment are:
1. Correction of any visual abnormality causing sensory deprivation (i.e. Cataracts, ptosis).
2. Correction of significant refractive errors.
3. Encouragement of use of the amblyopic eye.
4. Observation for and treatment of recurrences.

Prescribing the optimum refractive correction is the first step in the treatment of amblyopia as it provides a clear image to the fovea of the amblyopic eye. Uncorrected refractive error is a major cause of low vision in our patients. With the optimum refractive correction in place, any residual visual deficit is, by definition, due to amblyopia.

Potentially Amblyopiogenic Refractive Errors:

- Isoametropia:
  - Astigmatism >2.50 D
  - Hyperopia >5.00 D
  - Myopia >8.00 D
Anisometropia:
- Astigmatism >1.50 D
- Hyperopia >1.00 D
- Myopia >3.00 D

We follow the American Academy of Ophthalmology guidelines in prescribing glasses.

Subhash Dadeye: It is crucial to treat amblyopia as early as possible, as not only does it reduce the visual quality of the patient, but there is also a significant risk of suffering severe disability from injury to the one good eye. All children should be considered for treatment of amblyopia regardless of age. My approach is based on following principles:
1. First, rule out an organic cause.
2. Present a clear retinal image to the amblyopic eye by eliminating causes of visual deprivation and correcting visually significant refractive errors.
3. Make the patient use the amblyopic eye.

Role of refractive correction
Refractive correction alone improves visual acuity in at least 25-33% patients in cases of anisometropic amblyopia. It is mandatory to carry out cycloplegic refraction in every case of amblyopia and proper optical correction should be prescribed in every case of amblyopia. 1% atropine in children less than 7 years of age and 1% cyclopentolate in older children are used by me to carry out the refraction in my routine practice.

ATS-5 Eye glass phase has concluded that amblyopia improved with optical correction by more than 2 lines in 77% patients and amblyopia resolved with optical correction in 27% patients and additionally, spectacles correction improves binocular visual acuity in bilateral refractive amblyopia as per recommendations of ATS 7, hence need for refractive correction.

Guidelines for prescription of Glasses: The American academy guidelines are followed.

Some special points:
1. Hypermetropia with esotropia: Full cycloplegic correction should be given after subtracting for distance only. Refractive accommodative esotropia corrects with glasses alone. Child should be reviewed with glasses after an interval of 3-6 weeks and change in deviation should be noted and compliance ensured. It is preferred that the glasses are prescribed while the child is still under the effect of cycloplegia for better acceptance of the glasses. However if the child is still not wearing the glasses then the power may be under corrected and increased over weeks.
2. Esotropia with high AC/A ratio: These are esotropic patients where the near deviation is more than the distance deviation due to high accommodative convergence. Such cases respond well to bifocals of 2-3 diopters over their distance correction. Bifocals in children should be of the executive type so that they bisect the pupil.
3. Myopia: Mild to moderate myopia doesn’t cause much amblyopia as the child is mainly concerned with his near world. However it becomes important to correct such errors once the child is of the school going age. And as the rule goes always undercorrect myopia. However in case of exotropia especially intermittent exotropia the threshold for correction should be low. Even the smallest myopic error should be corrected as concave lenses stimulate convergence. As a corollary it is said that hypermetropia should be undercorrected in the same. However we should not compromise with a clear retinal image in this regard.
4. Astigmatism: Astigmatism should be corrected fully. It is important to emphasis the centration of glasses in such cases.
5. Anisometropia: More than 3D of anisometropia should ideally be treated with contact lenses to avoid anisokoria especially in older children. Younger ones may still fuse and develop binocular vision.
6. Pseudophakic/bilateral aphakics: Refractive error should be over corrected by 2-3 diopters in a small child to enable near vision. Once the child begins school and has some distance vision requirement bifocals of the executive type may be prescribed.
7. Unilateral aphakic: These children should be prescribed contact lenses as the anisokoria caused by such glasses may lead to amblyopia.

Summary (Prolima Thacker): In managing amblyopia the two basic strategies is to firstly present a clear retinal image to the amblyopic eye by eliminating causes of visual deprivation and correcting visually important refractive errors. Second strategy is to make the child use the amblyopic eye. Refractive correction is crucial in the management of amblyopia. Refractive correction alone improves visual acuity in at least one third of children aged 3 to 7 years with anisometric amblyopia.

Prolima Thacker- Q. What is the role of occlusion in the treatment of amblyopia? Which schedule of occlusion do you follow in your center? What all parameters are to be assessed on the follow up of patients who have been started on occlusion therapy? How do you schedule the follow up visits of a patient who has been started on occlusion?

Ken K. Nischal: The role of occlusion therapy is to cover the better seeing eye in order to allow the poorer seeing eye to be stimulated. This then improves the inputs from the eye to the visual cortex. At follow-up visits, the patients’ visual acuities are assessed as well as any changes in the alignment of their eyes, as this can improve with improved visual acuity. Patients are usually followed-up every 3-4 months if they are undergoing occlusion therapy.

T S Surendran: Occlusion is the mainstay of treatment for amblyopia. The duration of patching advised depends on the severity of amblyopia and the age of the child at presentation. On follow up we assess the compliance, visual acuity, alignment of the eyes and binocularity. Follow up for patients who come from relatively far off place is usually after 4 to 6 months while for the ones from nearby locations, it is generally 3 months.
B.S. Goel: Occlusion is by far the best option for management of amblyopia. Full time occlusion is considered if the vision in the amblyopic eye is allowing the child to do day to day activity, otherwise enforcement will be difficult. Visual assessment if possible, otherwise good acceptance is the parameters for improvement. It should be continued till optimum/full improvement is achieved; if not alternative methods are considered. Initial follow up on a monthly basis, then to 6-8 weeks and subsequently every 3 months would be optimum. Clinical and subjective assessment is done in preverbal and uncooperative kids.

Frank J Martin: Full refractive correction together with occlusion therapy is the mainstay of amblyopia treatment in our practice. Once amblyopia has been identified, the patient is started on occlusion therapy. Our orthoptist provides a thorough explanation to the family, and the family is given a pack of patching information and samples. Most of our patients are prescribed 2 hours of full occlusion per day. We then review the patient in 2-3 months, at which time we reassess the vision, perform ocular movements, cover test for strabismus looking carefully at fixation ability and preference, test stereopsis, and perform an undilated over-refraction.

If the family is in need of shorter follow-up times or is having difficulty complying with the occlusion therapy, these patients are scheduled for more frequent follow-up within our orthoptic-led clinics. We tend to follow the PEDIG guidelines.

Seyhan B. Özkan: Occlusion is the golden standard method for amblyopia treatment as an evidence based method. We use both part time and full time occlusion in our department and the schedule of occlusion is planned considering the severity of amblyopia, age of the patient, coexisting strabismus and the compliance of the patient. In a child with mild or moderate amblyopia we start with part time occlusion of 2-6 hours. In older children at 9 years of age or more with moderate to severe amblyopia we prefer to start directly with maximal treatment which means full time occlusion because of the decreased time period to achieve successful results and not to waste any time. These are only general guidelines and on some occasions we make some individual changes such as 6 hours occlusion on school days and full time occlusion on weekends. Making the occlusion plan by talking about the daily life conditions with the parents and with the child increases compliance.

On follow up visits we check fixation preference and fixation pattern, visual acuity, binocularity, ocular motility examination including prism cover test with and without glasses. The schedule of follow up visits varies depending upon the age of the patient. In infants below 1 year of age we usually see the patient with intervals of 4-6 weeks. In older ones with part time occlusion the routine schedule is to see the patient with an interval of 12 weeks. If full time occlusion is prescribed then the interval is the same amount of weeks as the age of the patient. For example if the patient is 5 years old the control visit is with an interval of 5 weeks.

Kamlesh: Occlusion of the non-amblyopic eye remains the mainstay of treatment in cases of unilateral amblyopia

The rationale for using occlusion is that occluding the better eye stimulates the amblyopic eye and enhances neural input to the visual cortex. It is also important in eliminating eccentric fixation.

The regimen practiced in our set up is dependent on the age of the patient and is as follows:
- 0-2 yr = 2:1 (2 days in the non amblyopic eye and 1 day in the amblyopic eye);
- >2-3 yr = 3:1 (3 days in the non amblyopic eye and 1 day in the amblyopic eye);
- >3-4 yr = 4:1 (4 days in the non amblyopic eye and 1 day in the amblyopic eye);
- >4-5 yr = 5:1 (5 days in the non amblyopic eye and 1 day in the amblyopic eye);
- >5-6 yr = 6:1 (6 days in the non amblyopic eye and 1 day in the amblyopic eye);

Patients are followed up one week after initiating occlusion in our centre to ascertain compliance. The follow up thereafter depends on the age of the patient. For follow up, a simple rule of thumb is to examine the patient “one week for every year of age”. Thus, a 3 year old child is examined every three weeks. If vision doesn’t improve at all on first follow up visit, the duration of occlusion is doubled and patient reassessed after 3 weeks. This is continued until a minimum period of 3 months or a maximum of 6 months.

The following are checked at each follow up visit:
1. Visual acuity of each eye is tested separately for near and distance & compared with the previous visit
2. Fixation pattern
3. Stereoacuity

The visual acuity should be checked with the same chart at each visit and after removal of the patch from the occluded eye the child should be allowed to get acclimatized first before taking vision.

Subhash Dadeya: There is neither a substitute nor a shortcut for full time occlusion in the treatment of amblyopia despite recent recommendation of amblyopia study group. Occlusion therapy prevents the fixing eye from taking part in the act of vision so that the patient is forced to use the amblyopic eye. In addition, it removes the inhibitory stimuli to amblyopic eye that arise from stimulation of the fixing eye.

We prescribe occlusion according to the thumb age rule as mentioned in the table. (Table 3)

Once occlusion therapy has been initiated, the child must be reexamined at frequent intervals to assess visual acuity & fixation preference

Follow up visit: One week for each year of age e.g. If child is three years of age, child should be examined at interval of three weeks. If at the time of re-examination, fixation has not improved, period of occlusion should be doubled prior to next examination. If still there is no improvement occlusion should be stopped after three months.
Summary (Prolima Thacker): Occlusion remains the gold standard in the treatment of amblyopia. The duration of occlusion depends on the age and the severity of amblyopia. It has to be customized for every patient. At each follow up, the compliance, visual acuity, stereoacuity and fixation preference is seen. (Figure 2)

Table 3. Showing protocol for occlusion schedule

| Age      | Occlusion of Dominant eye | Occlusion of Amblyopic eye |
|----------|---------------------------|---------------------------|
| 1 Year   | 1days                     | 1 days                    |
| 2 years  | 2 days                    | 1 day                     |
| 3 years  | 3 days                    | 1 day                     |
| 4 years  | 4 days                    | 1 day                     |
| 5 years  | 5 days                    | 1 day                     |
| 6 years  | 6 days                    | 1 day                     |
| >6 years | 6 days                    | 1 day                     |

Prolima Thacker- Q. Do you prescribe part time or full time occlusion to your patients? What are the advantages and disadvantages of each that you have encountered in your clinical practice?

Ken K. Nischal: In the majority of cases, I prescribe part-time occlusion. In cases of infants following cataract surgery, I advise 50% of waking hours. Otherwise patients get either 2 hrs per day, or 4 -6 hrs per day.

T S Suresh: We prescribe part time occlusion. Full time occlusion is usually prescribed in cases of severe and dense amblyopia. Part time occlusion has better compliance compared to full time occlusion. As was suggested in Amblyopia Treatment Study, we usually give 6 hours of patching for severe amblyopia and about 2 hours of patching for mild to moderate amblyopia.

B.S. Goel: Initially a part time occlusion/patching is a good option for acclimatization with least effect on the studies of the child. It allows adjustment in gradually increasing the occlusion time though the results may not be as good as with full time occlusion. The incidence of occlusion amblyopia (of the patched eye) with part time occlusion will be minimum or none. If the vision shows improvement, the modality is promising. On the whole full time occlusion is not acceptable though most useful.

Frank J Martin: Part-time occlusion. In cases of mild-moderate vision reduction (vision of up to 6/18) we prescribe 2 hours of occlusion per day. For more severe vision reduction (vision of less than 6/18) we prescribe 4 hours of occlusion per day. Compliance with more than 4 hours of occlusion per day is poor.

Seyhan B. Özkan: I use both part time and full time occlusion depending upon the age of the patient and the severity of amblyopia. The decision is made individually for the patient. The advantage of part time occlusion is the less stress for the patient and the family with less chance for occlusion amblyopia in the better eye. On the other hand the period to reach the target visual acuity is usually longer and in resistant ones it causes loss of time. In those who do not respond to part time occlusion the motivation of the child and the family decreases. It is known that the longer the duration of strabismus the less is obtained in binocularity after surgical treatment. Losing a long time for amblyopia treatment is a disadvantage in those patients.

Full time occlusion decreases the time period to reach the target visual acuity, with the cost of more stress and the risk for occlusion amblyopia. The shorter duration of treatment is advantageous in strabismic patients and in old age groups. However the parents and the child may totally give up treatment as they find full time occlusion inapplicable. It is important not to lose this group of patients and consider alternative part time patching programs.

Kamlesh: Since most of the patients presenting to our clinic have severe amblyopia (VA<20/80), we prescribe full time occlusion. Full-time occlusion is recommended for constant strabismus and moderate amblyopia also (VA 20/80 to 20/40).

Subhash Dadeya: In most of my patients, I prescribe full time occlusion. Patching can be difficult because of the physical discomfort of the patch or its adhesive material, skin rashes or breakdown, compliance with the number of hours of patching, and social stigma related to the patch. Compliance is generally improved with fewer required hours of patching. In full time occlusion all light is prevented from entering the eye. Risk of occlusion amblyopia is more with full time patching, however it is reversible in most of the cases. Issue of social stigma and teasing from peers more so in school time are more associated with full time occlusion. Compliance is better with part time patching. Part time patching does not inhibit inhibitory stimuli. Full time patching is associated with rapid recovery. We feel that full time occlusion is the gold standard in amblyopia management especially in severe cases. It has produced commendable results. However, compliance is an issue. When full-time occlusion is prescribed, performance issues also need consideration. To allow the patient to function at school, at work, or when good visual acuity is
critical, inverse occlusion may be considered with direct occlusion prescribed during less critical tasks. We advise part time occlusion only as maintenance therapy after successful amblyopia treatment & also in some cases of mild amblyopia and intermittent strabismus. One point that needs to be stressed upon is constant usage of the amblyopic eye by the patient (either by near activities or otherwise) during those limited hours of part time occlusion so that the eye is kept active and stimulated. Though this is not in accordance with the results showed the ATS, we still prefer full time occlusion in our centre because most of the patients presenting to our centre have profound amblyopia. Also compliance is a major hurdle in the set up especially since we deal with patients coming from poor socioeconomic strata. If full time occlusion is stressed to these patients then that results in occlusion of around 6-8 hours. In patients with mild to moderate amblyopia in which we are sure the parents understand the need of part time occlusion when the child is active we prescribe part time occlusion.

Summary (Prolima Thacker): Recent randomized clinical trials have shown that 6 hours of part time occlusion in severe amblyopia is as effective as full time occlusion and 2 hours of part time occlusion in moderate amblyopia is as effective as 6 hours of occlusion in children less than 7 years of age.\textsuperscript{16,17} However, patient compliance and understanding and age of presentation have to be taken into consideration.

Prolima Thacker- Q. Once a patient has been started on occlusion, how do you decide that its time to stop occlusion? How do you define occlusion failure? How long is occlusion continued in your centre in a patient who had a favorable response to occlusion?

Ken K. Nischal: If a patient responds well to occlusion therapy, then I will wean them off of the patching gradually to reduce the likelihood that the visual acuity reached, will regress. Occlusion failure can be defined as no improvement in the visual acuity over 2-3 visits, even after increasing the occlusion time, or attempting atropine penalisation drops.

T S Surendran: Occlusion is stopped when the visual acuity improves to normal in the affected eye. Occlusion failure is said to occur when the visual acuity does not improve despite strict compliance over a period of 6 months to one year. Occlusion is slowly tapered over time and on follow up the visual acuity is assessed to check for the stability of visual acuity and then it is stopped over a period of 6 months to one year.

B.S. Goel: Improvement of vision is the sole criterion to continue occlusion therapy. It should be carried out till maximum improvement is achieved, continued further for about 3 months and then gradually phased out. Glasses if applicable should be continued and alignment achieved in the presence of squint to allow optimum recovery in binocular vision. Follow up should be carried out for at least one year and thereafter as per requirement. Occlusion failure is termed when no improvement occurs within next 3 months.

Frank J Martin: There is no easy answer to this as each patient is very different. We like to assess this on a case-by-case basis. It will largely depend on the age of the patient, the level of vision, the motivation of the parents, and the child’s personality.

As a general rule, we stop occlusion once the vision has reached the desired level. Once the vision has been assessed on two or more occasions at the same level, we normally taper off the occlusion over a 2-3 month period and reassess the visual acuity once occlusion has been stopped for a short period (4-8 weeks). If the vision remains stable at the desired level (which normally happens if the patient is outside of the critical age period), we can confidently stop occlusion. If at this visit the vision has dropped (which can sometimes happen if the patient is still within the critical age period), we recommence occlusion for 1-2 hours per day.

Occasionally, occlusion therapy does not lead to any vision improvement. If this is the case, we wait until 3 consecutive vision assessments have recorded no vision improvement until we decide to stop occlusion.

Oclusion failure is fairly rare. We would define a patient as being non-responsive to occlusion therapy if compliance was good to 2 hours of occlusion per day for a period of 6-9 months where the vision was assessed as unchanged 3 times during this period.

Oclusion therapy is continued in our practice until the vision is no longer improving and has plateaued on 2 or more consecutive vision assessments, or if the child has reached the end of the critical period with a favourable vision improvement, or if the child or family has lost motivation to continue with occlusion therapy.

We repeat the full eye examination if there is a poor response to treatment despite good compliance, looking for pathology that may have been missed at the initial examination.

Seyhan B. Özkan: The aim of amblyopia treatment is ideally to achieve equal and 20/20 visual acuity in both eyes and isoaccommodation with equal fixation preference. This goal may not be achieved in many of the patients. In clinical practice when visual acuity reaches to 20/20 level than the patching treatment is tapered because of the risk of recurrence of amblyopia. The duration of the decreased occlusion period depends upon the fixation preference of the patient. If there is no fixation preference we decrease the occlusion with 6 weeks intervals, otherwise we decrease the occlusion with 3 months intervals and check visual acuity before decreasing more. In some cases fixation preference is persistent even though the visual acuity remains stable on 20/20.

In order to accept a child unresponsive to amblyopia treatment we prescribe maximal treatment for at least 3 months. The maximal treatment means full time occlusion. We usually start with part time occlusion depending on the severity of amblyopia and the age of the patient. If we do not see any response we increase the occlusion hours. The most common mistake that we see in clinical practice is to insist on a given schedule of part time occlusion that the patient does not respond.
Kamlesh: Once the patient has been started on occlusion, he’s followed up on regular intervals as described above. Treatment success is defined as a BCVA of the amblyopic eye of 20/30 or better, or a 3-line improvement from baseline after 6 months, or stable isoaquacity maintained for at least 3 months with ongoing treatment. Treatment failure was defined as the BCVA of 20/50 or worse, 0-2 lines of improvement of BCVA in patients after 3 months of occlusion of greater than 75% of all waking hours or a regression in BCVA of 2 lines. We follow up all patients till 12 years of age.

Occlusion is stopped in the following situations:
1. Achievement of isoaquacity between the two eyes, after which maintenance therapy is started
2. Freely alternating fixation
3. No improvement in vision after 3-6 months of good compliance with full time occlusion
4. Occlusion amblyopia
5. We continue maintenance occlusion (occluding the sound eye for 2-4 hours/day) in all patients till 12 years of age after successful amblyopia treatment.

Subhash Dadeya: The occlusion can be stopped,
1. When acuity becomes equal in both eyes
2. When there is true alternation of fixation
3. There is no visual improvement after 3-6 months of occlusion despite good compliance (depending on the age of patient).
Occlusion failure: If there is no improvement in the visual acuity for 3-6 months, we should label it as a failure of occlusion. Care should be taken that patients who are improving but have not recovered should not be labelled as failure after 3-6 months. The visual acuity should be stable. Occluder contact lenses can be used in the treatment of amblyopia when children do not comply with patching. If we have no improvement after at least three intervals of full time occlusion therapy additional occlusion is unlikely to improve visual acuity. It is safe to call such patients as being unresponsive to amblyopia therapy.
Follow up after completion of occlusion treatment
Every 1-2 months for infants
3-6 months for the children of the 3-6 years.
Children above 6 years of age should be followed up every 6 months until the age of visual maturity- 12 years.

Maintaince of vision after amblyopia therapy
Adopt any of the followings:
1. Part time occlusion of normal eye (3-4hrs/Day)
2. Reduce the visual acuity of sound eye slightly lower than amblyopic eye by partial occluder or alternate penalization.

Summary (Prolima Thacker): Occlusion is stopped once the vision becomes equal in both the eyes with presence of isoaccommodation and freely alternating fixation pattern. Treatment failure was defined as the BCVA of 20/50 or worse, 0-2 lines of improvement of BCVA in patients after 3 months of occlusion of greater than 75% of all waking hours or a regression in BCVA of 2 lines. Patients are followed up till 12 years of age.

Prolima Thacker- Q. Is part time occlusion as effective as full time occlusion? What is your preferred duration of occlusion therapy in mild, moderate and severe amblyopia?

Ken K. Nischal: Routinely, I prescribe 2 hours of patching as this has been shown to be as effective as 6 hours of patching per day. Occasionally, I increase this to 4-6 hours in patients with dense amblyopia, as it has shown increased improvement.

T S Surendran: Yes part time occlusion is as effective as full time occlusion. In mild amblyopia the occlusion can be done for two hours, immoderate for 4 hours a day and in severe cases can be done up to 6 hrs a day.

B.S. Goel: Part time occlusion is not as good as full time but more acceptable depending upon the level of improvement for ultimate full occlusion. In mild and moderate amblyopia full time for initial 3 months is continued for about 10-12 months depending upon the response with a checkup schedule of every 6 weeks initially. It may longer in later part of follow up. It will be good to start part time in severe amblyopia and switch on to full time as and when and if accepted.

Frank J Martin: The PEDIG studies have previously found that part-time occlusion is as effective as full-time occlusion. We only ever offer our patients part-time occlusion. We usually start with 2 hours of occlusion, and will sometimes increase this to 4 hours per day if the amblyopia is severe or is unresponsive to treatment.

Seyhan B. Özkan: Part time occlusion may be effective in some patients. However considering the role of active inhibitory signals that originates from the non-amblyopic eye in binocular state, it is expected that the gain with occlusion decrease when both eyes are open. In a retrospective study in our institution we found that full-time occlusion decreases the period to achieve successful results significantly in strabismic anisometropic amblyopia. In part time occlusion I use 2-4-6 or sometimes 8 hours of patching and the starting point of part-time occlusion is dependent on the age of the patient and the severity of amblyopia. If I do not see any improvement in 3 months with any type of part time occlusion I increase the occlusion time without losing time. In infants and in mild/moderate amblyopes I start with part time patching and I do not use full time occlusion below the age of one. Two hours of patching in moderate amblyopia may be enough below the age of one. In ones that I do not want to lose time such as an acquired esotropia with expected binocularity after surgery, or the ones with late diagnosis whose chance for recovery decreases with time I prefer to start with full time patching. The rule is the more the hours of occlusion the less the duration of treatment.

Kamlesh: There have been many randomized controlled trials saying that part time occlusion is as effective as full time occlusion. However, in our set up, we have seen that most of the children presenting to our centre have profound amblyopia. They also present later. In our own experience
we feel that there is no substitute to full time occlusion. The results are the best with full time occlusion. However, the compliance issues and the handicapped induced by full time occlusion cannot be ignored. We try giving part time occlusion in patients with mild to moderate amblyopia in which we know that parents understand the need for 6 hours of occlusion. We have seen many times at our center that due to poor understanding and compliance, if 6 hours of occlusion is explained to the parents, they would just occlude the child for lesser hours than that. Thus, we still prefer full time occlusion.

Subhash Dadeya: No atleast not in our experience. However, amblyopia treatment study 2 was initiated to address following questions

ATS 2A: Is Full time patching (all waking hours) more effective than part time patching (6 hours patching/day) in severe amblyopia (20/100-20/400) in children of 3-7 years of age?

Conclusion: It was concluded that the results of that six hours of daily patching and full time patching are similar to treat severe amblyopia in the children of 3-7 years of age.

ATS 2(B) is 2 hour patching as effective as 6 hour patching in treatment of moderate amblyopia?

Conclusion: It was concluded that in moderate amblyopia 2 hours patching gives similar results to 6 hours of patching and prescribing greater no of hours does not seems to have significant beneficial effects during first four months of treatment.

However, study by Scott et al concluded that full time occlusion produced excellent visual results. Similar conclusions have been reported by Dorey et al and Cleary et al. Furthermore, majority of paediatric ophthalmologists have not shifted to part time occlusion despite the recommendations of ATS, as they are fearful of poor visual outcome with reduced patching hours. Additionally in ATS compliance was not measured objectively and it is quite possible that patients who were prescribed full time patching actually averaged six hours and those prescribed six hours actually averaged two hours patching. A study with use of occlusion dose monitor will through more light on the issue.

I recommend full time patching in mild, moderate and severe amblyopia to fellow strabismologists subject to practical applicability as considering the less educated and less compliant population of ours, because compromising the occlusion duration will compromise the visual outcome.

Summary (Prolima Thacker): Amblyopia treatment study (ATS 2Aand 2B) have shown that part time occlusion is as effective in moderate and severe amblyopia in children less than 7 years of age.\textsuperscript{16,17}

Prolima Thacker- Q. What is the role of penalization in the management of amblyopia? When do you prescribe penalization in amblyopia treatment? What is your experience with penalization as a treatment option for amblyopia? Is it as effective as occlusion?

Ken K. Nischal: The role of optical penalization is to essentially blur the vision of the better seeing eye in order to increase the use of the poorer seeing eye. If the better seeing eye is blurred to a lower visual acuity than the poorer seeing eye, then the patient will favour the poorer seeing eye. Atropine penalization is a good option in cases of manifest–latent or latent nystagmus, as occluding a patient with nystagmus will increase the eye movement and so reduce the visual acuity.

T S Surendran: Penalisation can be used as an alternative to occlusion in the treatment of amblyopia. Atropine eye drops are prescribed twice a week (over the weekend) in the treatment of amblyopia. It works effectively particularly in cases non compliant to patching. It is as effective as patching in the treatment of amblyopia. The modality is decided depending on the patient’s compliance.

B.S. Goel: Penalization is considered if occlusion therapy is not acceptable or not possible due to very poor vision and for maintenance therapy on occlusion treatment. It will be better off when there is no deviation present, and a preliminary alignment surgery may be required for better result. If surgery is not desired penalization should still be prescribed. Atropine penalization in the sound eye with pilocarpine in the amblyopic eye, the later encourages better use of the eye due to improved accommodation and depth of focus is recommended. Short mydriatics are preferred in school going children after school hours to allow continuity of studies. Treatment with penalization lasts longer than with occlusion but preferable with no hassles about child co operation.

Frank J Martin: We only offer atropine penalisation in cases where occlusion therapy has been attempted and has not been possible due to lack of compliance. This generally occurs in patients with developmental disabilities, learning disabilities, sensory issues or young children with dense amblyopia with particularly headstrong personalities. In the rare cases where we use atropine penalisation, we prescribe it to be used on 2 consecutive days each week. In our experience, atropine penalisation is mostly successful in improving the vision to a level where occlusion can then be successfully implemented. We do not advocate for optical penalisation.

Seyhan B. Özkan: Atropine penalization certainly has a role in treatment of amblyopia and may be an alternative in resistant children. I do not use penalization as we live in a sunny climate and the photophobia and the concern of the excessive UV exposure limits its use. I do not think optical penalization alone is effective in practice as the resistant children will easily eliminate the blurring effect of the glasses.

Kamlesh: Classically, penalization has been used as a second line treatment when poor compliance is seen with occlusion. However, now it is increasingly being used as a primary treatment modality. There are two main types of penalization: pharmacologic and optical penalization.
Pharmacologic penalization
Atropine (0.5% or 1%) is instilled into the sound eye to prevent accommodation and blurring vision at near, thus forcing the amblyopic eye to be used preferentially for near vision tasks. Pharmacologic penalization has been usually advocated for mild or moderate amblyopia (20/100 or better), because it is thought to be insufficient when acuity in the amblyopic eye is worse than 20/100.

Optical penalization
Optical penalization for distance, adding plus correction to cycloplegic refraction in the sound eye (until fixation at distance shifts to the amblyopic eye), is a useful alternative to occlusion.

The indications of penalization are limited. These include:
- Moderate amblyopia in uncooperative patients
- Anisometropic amblyopia
- Maintenance therapy
- Occlusion failure
- Occlusion nystagmus

Since most of patients presenting to our clinic have severe amblyopia, pharmacological penalization is not frequently advised, except in the above mentioned cases.

We don’t have any experience with optical penalization. We routinely advise atropine penalization in latent nystagmus, mild amblyopia & children who are not compliant with occlusion.

No, it is not as effective as occlusion.

Subhash Dadeya: We are of the opinion that occlusion remains gold standard in the treatment of amblyopia and penalization can be tried as an alternative line of therapy in patients of occlusion failure, or as maintenance therapy. In view of the difficulties encountered with occlusion therapy in some patients and the occasional complication of occlusion amblyopia, alternative therapies have been tried. Penalization is therapeutic technique performed by optically defocusing the eye with better vision by using cycloplegics or by altering the eyeglass lens to cause decreased vision in non amblyopic eye; it may be either pharmacological or optical. Penalization has the advantage being cosmetically acceptable, but it does not inhibit the abnormal binocular interaction, which is the essential cause for amblyopia. It rarely decreases the vision acuity in sound eye less than that of amblyopic eye, thereby minimizing its use. Indications for penalization are moderate amblyopia in uncooperative patient, anisometropic amblyopia, maintenance therapy, occlusion failure.

Prolima Thacker- Q. Has the recommendations of ATS changed your management of amblyopia patients?

Ken K. Nischal: The ATS recommendations have improved the management of amblyopia, particularly when looking at occlusion time, activities during occlusion, additional methods e.g. patching and atropine treatment simultaneously.

T S Surendran: Yes. We do follow the guidelines given by ATS in management of amblyopia. However, the effect of similar duration and modality of treatment in our population is not yet established.

B.S. Goel: No change.

Frank J Martin: We were following a PEDIG like regime even before the published data. We now have evidence here to justify our treatment regime.

Seyhan B. Özkan: The amblyopia treatment studies gave some guidelines how to ‘start’ the therapy in amblyopic patients. In a young patient I prefer to start with part time occlusion more frequently than before which may be enough for some patients. The improvement of visual acuity only by glasses during 16 weeks even in strabismic infants has changed our clinical practice in ‘some’ patients. In non strabismic children I allow glasses-only in moderate amblyopia and start patching if required. However in older children and in ones with strabisms that requires surgery I do not want to wait for the effect of glasses on amblyopia and start occlusion with the use of the glasses. It is known that the longer the duration of the deviation the less is achieved in binocularity after surgery. The ATS recommendations mainly target to avoid unnecessary treatment to achieve a successful result, on the other hand it may be waste of time for those who do not respond part time occlusion or glasses-only treatment and it may prolong the treatment period. Especially in older age group the time period that is lost for inadequate treatment may lead to loss of the chance for improvement of visual acuity.

Kamlesh: No, full time occlusion remains the mainstay of treatment in approx. 95% of our patients.

Subhash Dadeya: No in majority of patients, However, in select few we try part time occlusion and atropine penalization.
Although the role of near activities do not have enough evidence I advice parents to keep the child’s attention active with the toys and games which attract them most. Computer games may be helpful for child’s attention active with the toys and games which attracts them most. Use of patching along with either medication has been found to produce faster improvement as well as less regression.

Summary (Prolima Thacker): Both levodopa29, precursor of dopamine, and CDP-choline (citicoline)31,22 which stimulates availability of a variety of neurotransmitters and modulators, including dopamine. The primary site of action of these drugs is thought to be the cortex, although there is also some evidence of an effect on the retina.23,24 The medical treatment of levodopa or citicoline is inherently bilateral and slightly enhances the vision of the better eye in most. Use of patching along with either medication has been found to produce faster improvement as well as less regression.

Prolima Thacker- Q. What is the role of near activities in the treatment of amblyopia? Do you routinely prescribe such activities?

Ken K. Nischal: A randomised trial led by PEDIG (2008) found that there was no statistical difference between prescribing amblyopia therapy with near activities or distance activities. With patients who have moderate to severe amblyopia, near activities may be prescribed alongside the treatment of amblyopia to encourage compliance and to minimise safety hazards.

T S Surendran: Near activity usually help in better improvement. Yes we prescribe near activities especially in the treatment of severe amblyopia.

B.S. Goel: Near activity, joining the dots with the sound eye, tracing etc. are fun games well accepted by children and should be encouraged along with occlusion and penalization.

Frank J Martin: We routinely recommend occlusion therapy be performed for 2 hours each day whilst performing near work.

Seyhan B. Özkan: Although the role of near activities do not have enough evidence I advice parents to keep the child’s attention active with the toys and games which attracts them most. Computer games may be helpful for this purpose and they also help to break the resistance of the child against occlusion. The advice for near activities...
In their simplest form, active vision therapies for amblyopia involve paper-based near activities such as reading, writing, word puzzles and video games. In a multicenter pilot study conducted by PEDIG in 2005, it was seen that near activities produced improvement in visual acuity in patients with severe amblyopia but not in moderate amblyopia. Yes, we routinely prescribe near activities like reading, writing, knitting, puzzle solving in all our patients.

Subhash Dadeya: It has been suggested that near activities like threading beads, tracing pictures and reading fine print plays a significant role in the improvement of vision in amblyopia and children should be encouraged to do near activities. Park et al studied the outcome of part time occlusion combined with near activities and found that combining the near activities with occlusion causes improvement in vision.

We have conducted a research project titled Role of television exercises as a form of near vision activities and it was conclusively proved that there was improvement in the distance visual acuity, near visual acuity, stereoacuity in both the groups (occlusion and television game groups), but was found to be better in the television games group as compared to full time patching, in the treatment of amblyopia. After completion of this research project we routinely prescribe such activities to our patients.

Summary (Prolima Thacker): Results from a 2005 multi center study conducted by PEDIG (ATS 6) suggest that performing near activities while patched may be beneficial in treating amblyopia.

Prolima Thacker: Q. What is the role of LASIK in the treatment of amblyopia? Do you have any personal experience with the usage of LASIK for treatment of amblyopia? Who are the ideal candidates for LASIK in the treatment of amblyopia?

Ken K. Nischal: The ideal candidates for LASIK are patients with anisometropic amblyopia who are non-compliant or non-responsive to the more traditional approaches of amblyopia therapy such as patching or atropine and who are non-compliant with spectacles or contact lenses. LASIK should be reserved for the older child, as displacement of a LASIK flap results in permanent damage (Tychsen, 2008). Despite the risks, LASIK can be effective in treating amblyopia with associated refractive errors (Alio et al 2011).

T S Surendran: LASIK and other refractive surgeries have been used in the treatment of adult amblyopia. They improve the visual acuity by reducing the spherical aberration induced by the refractive correction and there by facilitate binocular interaction. We do not have personal experience in the use of LASIK in the treatment of amblyopia. As a rule we do not do LASIK before the power stabilises i.e at least 18 years of age.

B.S. Goel: Anisometropia and gross refractive errors may be taken care of by Lasik but unlikely to treat amblyopia alone.

Frank J Martin: We have not recommended LASIK to our clinic patients with amblyopia. There is no laser refractive clinic in Sydney licensed for treatment of children under general anaesthetic.

Seyhan B. Özkan: Despite some encouraging results I do not think that an invasive intervention in a growing eye is logical in order not to wear glasses. Anisometropia could be the only reasonable indication for refractive surgery in children. However correction by glasses and the resultant aniseikonia is usually tolerated well by children. It is demonstrated that it is mainly the level of visual acuity that interacts with binocularity not the level of anisometropia. In my opinion considering the balance with the risks and benefits, the benefit does not rationalize the use of LASIK in children.

Kamlesh: Refractive surgeries like photorefractive keratectomy with excimer laser and even clear lens extraction have been advocated in the treatment of amblyopia. Studies have shown that photorefractive keratectomy can be safely performed in children with anisometropic amblyopia who are non-compliant with refractive correction. Visual acuity and stereopsis were found to have improved in most eyes, even in older children. However, some studies have shown that recurrence of myopia is an issue. No, we don’t have much experience with the use of LASIK.

Subhash Dadeya: Refractive surgery in children to reduce the amblyopiogenic level of refractive error is proving to be relatively stable. Recently Astle et al have described that LASIK is an effective surgical alternative to improve visual acuity in anisometropic amblyopia treatment or in whom other therapy fails. However, we are of the opinion that Lasik should be used as a last resort to treat only desperate cases of amblyopia. We have conducted a study regarding efficacy of lask surgery in treatment of anisometropic amblyopia in adults and it was concluded that although this was a small pilot study, based on our results, we recommend LASIK in desperate cases of adult anisometropic amblyopia.

Summary (Prolima Thacker): The role of refractive surgery is controversial. Recent studies have shown that refractive surgeries in non-compliant children can be safely performed.

Prolima Thacker: Q. Are there any other newer methods for treatment of amblyopia? Do you have any personal experience of such treatment?

Ken K. Nischal: Binocular iPad treatment is currently being investigated. Dichoptic gaming apps for iPad have been found to be successful with treating moderate amblyopia alongside traditional methods of amblyopia therapy (Birch et al, 2015). A mean improvement of 0.06 LogMAR occurred in amblyopic eyes after playing dichoptic games for 4 hours a week over 4 weeks was found in another study by Li et al (2015). Both of these studies reported no change in stereoacuity after treatment, but because the treatment is
allowing the eyes to be used binocularly, there may be an
unreported improvement of other visual functions such
as contrast sensitivity and Vernier acuity. Liquid Crystal
Glasses are also currently being investigated for the use
of amblyopia therapy. The technology allows for programming
of intermittent occlusion of the fellow eye throughout the
day to treat the amblyopic eye. In a small study, 79% of
patients who used the LCD glasses for amblyopia therapy
were found to have improved vision in the amblyopic eye
by 3 lines or more. A few of the patients also demonstrated
an improvement in stereopsis (Spierer et al, 2010).

T S Surendran: Newer methods for the treatment of
amblyopia are dichoptic stimulation, perceptual learning,
and transcranial direct current stimulation. Binocular Video
game based treatment is also gaining popularity.

B.S. Goel: Vision therapy with computer programs are
being advocated for better compliance but do not beat
advantages of occlusion. However, there is a potential for
improvement and innovations as there is better hand to
eye co ordination and ocular stimulus and acceptable over
patching. Still the method is not gaining popularity in spite
of being a domiciliary management.

Frank J Martin: There is hope that amblyopia may be able
to be treated by dichoptic therapy whereby the two eyes
are used together in treatment. Two studies in the United
States have shown promising results by using a specially
generated iPad game and red-green glasses to present
differing images to the two eyes. We do not yet have any
personal experience with these treatments.

Seyhan B. Özkan: The binocular stimulation with computer
games may increase compliance for amblyopia treatment.
These binocular stimulation methods require further study
results in order to see that they do not induce diplopia
similar with anti suppression exercises that were popular
in previous years. On the other hand under binocular
conditions the suppressing signals from the better eye will
be active that may reduce the efficacy of the treatment.
Perceptual learning is based on stimulation of the amblyopic
eye with Gabor patches when the non amblyopic eye is
occluded. In a multicentric randomized study in our country
the increase of visual acuity who received perceptual
learning sessions is compared with the occlusion-only group
and no further benefit is obtained compared to occlusion.

Kamlesh: Few of the newer methods are:

1. Liquid crystal glasses
2. Penalizing filters, like Ryser or Bangerter foils, as
a means of optical penalization are used in mild
amblyopia or as maintenance therapy, in school age
cooperative children.
3. Acupuncture has also been used for amblyopia
treatment in anisometropes in two clinical trials. In
both studies, the acupuncture technique consisted of
five acupuncture needles placed and manipulated for
15 minutes five times a week for 15 weeks. The effect
of acupuncture on strabismic amblyopia has not been
studied. The mechanism of action for acupuncture in
the treatment of amblyopia is unknown and it requires
further investigation.

Subhash Dadeya: Now, there is growing evidence that
patients with amblyopia have a structurally intact binocular
visual system that is rendered functionally monocular
due to suppression. The new approach of treatment (with
use of I Pod binocular home based treatment) aims to
restore binocular vision as the first step, something that
is not achieved after conclusion of conventional occlusion
therapy, even if degree of amblyopia has been reduced. It
was concluded by Robert et al that home based dichoptic
I Pod approach represents a viable treatment approach for
adults with amblyopia. Li et al concluded that Binocular i
Pad treatment rapidly improved visual acuity and visual
acuity was stable for at least three months following the
cessation of treatment. The initial results of study being
undertaken at our center regarding use of Mobile games in
treatment of amblyopia are encouraging.

We are also conducting another study regarding use of
omega fatty acids in the treatment of amblyopia.

Summary (Prolima Thacker): The newer methods are liquid
Crystal glass29, iPad dichoptic visual games30, acupuncture31,
penalizing filters32 and trans cranial magnetic stimulation.32

Prolima Thacker- Q. How frequently is relapse seen and
what can be done to prevent a relapse?

Ken K. Nischal: To reduce the risk of relapse, it is important
to continue amblyopia therapy through 2 stable and
consecutive visual acuities. After two stable visual acuities
have been recorded, it is important that amblyopia therapy
is not abruptly discontinued as relapse is most commonly
seen after immediate discontinuation. It is important to
gradually wean the patient off of amblyopia therapy. For
instance, if patching has been prescribed for 2 hours per
day, the patient must taper the patching to 1 hour per day
for 6 weeks, then to 30 minutes per day for 6 weeks and then
can stop patching. Patients are more at risk of relapse if they
have strabismus, or compromised binocularity, particularly
younger patients due to the presence of cortical plasticity
and a fixation preference.

T S Surendran: About 25 percent of children have relapse
once they improve their vision and they are taken off
patching therapy. To prevent a relapse the treatment like
occlusion should not be stopped suddenly. It is better to
wean occlusion over a period of time when the visual acuity
stabilises.

B.S. Goel: Poor follow up and compliance is responsible for
relapses. Management of a relapse is easier than the primary
management as the eye already has achieved optimum
vision and we can foresee better prognosis in relapse than in
a primary case. Follow up at the end of treatment every 6-8
months should be mandatory.

Frank J Martin: A relapse in vision can occur with occlusion
therapy, although thank fully this is not very common.
This is most likely to occur if compliance has decreased, or ophthalmic follow-up has been lost. Relapse can be prevented with regular attendance at ophthalmic and orthoptic appointments, and by ensuring good compliance with occlusion therapy.

Seyhan B. Özkan: Relapse is common if the amblyogenic mechanisms are still active after cessation of occlusion treatment. These mechanisms are strabismus with fixation preference and monofixation syndrome. Close follow up is the rule even after successful treatment. Especially the late recurrences are problem as the child grows the chance for regain of vision decreases.

Kamlesh: Relapse is seen in approximately 20-25% of patients after successful amblyopia treatment, within the first year after treatment cessation, the majority of recurrences appearing within the first 6 months. The factors affecting amblyopia recurrence are not clear. It has been suggested that poor initial visual acuity, strabismic amblyopia, abrupt cessation of treatment and low age at the end of treatment are risk factors. We always wean off therapy by gradually decreasing the hours of occlusion on subsequent follow up visits & finally put the patient on maintenance occlusion till 12 years of age.

Subhash Daderya: Relapse are seen in in 25-33% of patients and ATS found When 2 hours of daily patching was stopped, the recurrence risk was low, in contrast to when 6 to 8 hours of daily patching was stopped abruptly without weaning.

• Hence when the child reaches a point where he/she is ready for a cessation of treatment, patching hours should be weaned before treatment is stopped.
• Carry home message — Do not stop occlusion therapy abruptly

Risk Factors for recurrence
• Better amblyopic eye visual acuity at the time of cessation of patching.
• When greater improvement was seen during previous treatment.
• Any previous recurrence.

The risk of recurrence is inversely correlated with age. Regression is seen in 14% cases per year (nearly 25% recur after first year post therapy) and hence the need for maintenance therapy along with a careful monitoring. In patients with intense patching (6-8 hours per day), recurrence is more common when the treatment is not tapered, than when treatment was reduced to 2 hours per day prior to cessation as proven in a study. When at any visit the amblyopia recurs, it is advisable to patch two to three times at a higher level than when the amblyopia recurred and when the acuity recovers again, a still slower tapering is advised. Patients with untreated strabismus may be prone to develop recurrence. Hence realignment of the visual axis is a must. It should be preferably done within six months of completion of amblyopia therapy.

Summary (Prolima Thacker): Frequency of relapse is 20 to 25%.

Prolima Thacker- Q. Is amblyopia treatment mandatory before strabismus surgery?

Ken K. Nischal: Amblyopia treatment is indicated before strabismus surgery, as it can influence the control of a deviation. An increase in vision in the amblyopic eye, or equal vision between the two eyes may improve the control of an intermittent esotropia or intermittent exotropia so that the patient is mainly esophoric or exophoric for most of the day so that strabismus surgery can be prevented. Good, equal vision before surgery can improve surgical outcomes. A young patient with equal vision has a higher possibility of regaining binocular single vision after surgery and is less likely to require reoperation.

T S Surendran: Yes. It is prudent to treat amblyopia before considering squint correction surgery. A child with poor vision has higher chances of recurrence of squint.

B.S. Goel: Strabismus surgery requires prior amblyopia treatment if present but follow up for late onset due to residual deviation and co existing factors require attention.

Frank J Martin: Where amblyopia can and has been documented, we always treat amblyopia as a first-line treatment. The timing of strabismus surgery can vary, and occlusion therapy for amblyopia is almost always initiated prior to strabismus surgery. It is well known that the eyes are more likely to maintain alignment after strabismus surgery if the vision is improved. The best outcomes from strabismus surgery are in patients with equal vision.

Seyhan B. Özkan: I do believe it is. As a striking example, I must tell about my 5 year old patient, who had constant exotropia with high hypermetropia and amblyopia. In follow up visits we observed that the patient was converted into a fully accommodative esotropia after wearing glasses with full cycloplegic refraction and occlusion therapy for amblyopia.

Kamlesh: We advocate amblyopia treatment before taking up the patient for strabismus surgery as we fear non-compliance with occlusion following successful correction of strabismus. Moreover, it might be difficult to interpret fixation preference in post-operatively straight eyes with small deviations. However, it is not mandatory. We believe that early surgery maybe undertaken in patients of infantile esotropia because it reduces the waiting period for surgery. Early alignment not only improves cosmesis but it also aids in the development of fine motor skills and visually directed skills. However, it must be emphasized to the parents that amblyopia therapy must be continued post-operatively.

Subhash Daderya: It has been traditionally taught that treatment of amblyopia should be done prior to surgical intervention. Surgery may have to be postponed till completion of amblyopia therapy resulting in its delay for months or year in intractable amblyopia, thus depriving...
the benefits of early surgery to these patients. Lam et al. have suggested that performing surgery before the completion of amblyopia therapy does not affect the motor or sensory outcome adversely provided amblyopia therapy is continued postoperatively. Hence, the question that arises is why wait till completion of amblyopia therapy and deny the benefits of early surgery to these patients? We conducted a study to resolve this issue and concluded that it is not mandatory to treat amblyopia prior to surgery if amblyopia therapy is continued postoperatively, unless it is a case of infantile esotropia with moderate amblyopia.

Summary (Prolima Thacker): Classical teaching says that equal vision in both the eyes is important for the maintenance of squint correction in patients with amblyopia. Hence, amblyopia treatment is initiated first to equalize the vision in both the eyes before squint surgery except in infantile esotropia. However, studies by Dadeya et al. and Lam et al. show that performing corrective surgery in children before full resolution of amblyopia is safe and efficient if the amblyopia therapy is continued after surgery. This strategy permits earlier surgery without postponing the operation until full resolution of amblyopia.34,35

Prolima Thacker- Q. What is your approach to a patient who has amblyopia with nystagmus? What are the special considerations that should be kept in mind when such treating such patients?

Ken K. Nischal: We prescribe amblyopia therapy to a patient with nystagmus in days per week, instead of hours per day. The intensity of nystagmus can increase when one eye is covered if latent nystagmus is present. The increase of nystagmus blurs the vision further, so being occluded does not treat amblyopia. However, after around 4 hours, the latent nystagmus tends to dampen. This means that after 4 hours of occlusion, the patient will begin to benefit from occlusion therapy.

T S Surendran: We can give occlusion itself for children with nystagmus and surprisingly, they do tolerate patching therapy quite well. Even in literature, patching as a modality of treatment for amblyopes with nystagmus has been mentioned. The other option is to give frosted glasses in such scenarios or use atropine penalization.

B.S. Goel: The situation of amblyopia is tricky as no form of therapy may be useful as the condition is usually bilateral and due to lack of macular/foveal fixation. The patient will have best advantage with nystagmus surgery to move the eyes in null position or reduce the severity by other surgical means. The overall prognosis will depend upon additional cause of nystagmus if any but always remains very poor and discouraging.

Frank J Martin: The treatment of amblyopia in patients with nystagmus should be assessed on an individual basis. Many of our esotropic patients have latent nystagmus. The threshold for treating amblyopia in children with nystagmus may be different to those without nystagmus because most types of nystagmus will increase in amplitude when one eye is occluded. If occlusion therapy is to be commenced, this should be performed using an opaque occluder such as microprene tape. Bangerter filters may also be used, but these are more expensive. Micropore and Bangerter filters allow some light into the eye and will minimise any increase to nystagmus whilst the eye is occluded.

Seyhan B. Özkan: It is demonstrated that despite the latent component patching increases the visual acuity in the amblyopic eye. I prefer part-time patching in order to allow the child to have some period with less nystagmus. Penalization may offer a benefit for this group of patients.

Kamlesh: Refractive correction is the first step in treating patients of nystagmus with amblyopia. Since occlusion of the sound eye exacerbates nystagmus, it decreases rather than enhances the function of the amblyopic eye. Thus, we generally advise penalization in such patients. However, in patients with severe amblyopia in whom it is difficult to lower the visual acuity of the sound eye to a level below the visual acuity of amblyopic eye, we have advised occlusion to encouraging results. Occlusion may also be prescribed in patients who show systemic side effects with atropine. Since many such patients have ametropic amblyopia, where neither occlusion nor penalization is effective, we have also given a trial of levodopa-carbidopa.

Subhash Dadeya: If nystagmus is idiopathic infantile, then the patient has to be treated in a conventional way. However, in manifest latent nystagmus, partial patching doesn’t work and full time patching is required, but, we have to keep in mind that occluding one eye makes the nystagmus worse. Hence, atropine has been suggested as an alternative to a skin occluder, but it is usually less effective.

Summary (Prolima Thacker): Presence of nystagmus makes the treatment of amblyopia difficult as occlusion increases the nystagmus. Trial of optical and atropine penalization can be tried in such patients after appropriately correcting the refractive error.

Prolima Thacker- Q. How do you treat a patient who has amblyopia with eccentric fixation? How is their response to treatment?

Ken K. Nischal: We have attempted inverse occlusion but without luck.

T S Surendran: Patients with eccentric fixation usually do not do too well with patching therapy. A trial of patching can definitely be given initially. If no improvement is noted, pleoptics and antisupression exercises may be tried. Usually these patients do not show good response.

B.S. Goel: There was a time when inverse occlusion was carried out to break the fixation and then cautiously carry out conventional occlusion. Presently eccentric fixation is not considered significant in management and conventional method is used for management. However, visual acuity may not show comparable improvement due to parafoveal or paramacular area being used for viewing.

Frank J Martin: We treat patients with eccentric fixation...
undergoing occlusion therapy much the same as those without eccentric fixation. The only consideration would be to educate carers and parents to allow them to adopt a head posture and to not expect them to be looking directly at the object they are viewing. In our experience, occlusion therapy in patients with eccentric fixation encourages stronger vision at the eccentric viewing point rather than encouraging foveal fixation. As such, there is usually limited improvement with occlusion therapy in eyes using eccentric viewing points. However minimal this improvement may be, we think it is still a worthwhile treatment to try.

**Seyhan B. Özkan:** The ones with eccentric fixation are more resistant to therapy and I prescribe longer occlusion time in those mostly as full time occlusion. If central fixation cannot be obtained the expectation for the increase in visual acuity is lower as the paracentral fixation does not allow to reach 20/20 vision.

**Kamlesh:** In all children with eccentric fixation, direct full-time occlusion, with adjustments for performance (inverse occlusion), is the treatment of choice. We have seen good results with this treatment in children below 5 years of age. However, eccentric fixation persists in older children, though visual acuity may show progressive improvement.

**Subhash Dadeya:** Amblyopia is associated with eccentric fixation in a large no of patients. Von-Noorden has conclusively proven that conventional occlusion of the sound eye is the most effective method of treatment even in cases of Amblyopia with eccentric fixation. However, it is usually less effective in such sort of patients.

**Summary (Prolima Thacker):** Though treatment options like inverse occlusion, CAM stimulators and pleoptics are present; they do not show very encouraging results. Patients with eccentric fixation are given longer duration of occlusion and the poor prognosis is explained to the parents.

**Prolima Thacker- Q. What is the role of inverse occlusion?**

**Ken K. Nischal:** Inverse occlusion therapy may be necessary to disrupt eccentric fixation. Fixation is monitored usually over the course of two months with a visuoscope. After 2 months, amblyopia therapy can commence. A patient with eccentric fixation is more likely to have dense amblyopia (Stewart et al, 2005), so may need more rigorous amblyopia (6 hours per day). Despite rigorous amblyopia therapy, the prognosis is worse for an amblyopic patient with eccentric fixation vs an amblyopic patient with central fixation.

**B.S. Goel:** It may be occasionally preferable to use inverse occlusion in eccentric fixation but generally not required.

**Frank J Martin:** We do not use inverse occlusion. The theory of inverse occlusion is to occlude the amblyopic eye in cases of amblyopia with eccentric fixation, in the hope that the eye will then “forget” its eccentric viewing spot and switch to foveal fixation. In our experience, there is usually a reason an eye has switched to an eccentric viewing spot (ie: a macula lesion or such). There is also the risk that you may make the amblyopia more dense by occluding the amblyopic eye.

**Seyhan B. Özkan:** I do not use inverse occlusion for treatment of eccentric fixation and I prefer to use that period with the attempt to increase the visual acuity by occluding the non-amblyopic eye. We use occlusion of the amblyopic eye if full time occlusion is prescribed in cases younger than 7 years, to prevent occlusion amblyopia. In a 6 year old patient if full time occlusion is used the amblyopic eye is occluded one day per week.

**Kamlesh:** Inverse occlusion is done in patients with eccentric fixation. In this the amblyopic eye is occluded so as to make the eye to lose/forget its pseudo fovea. We do not advocate inverse occlusion because studies do not show very favorable results with inverse occlusion. There is also the risk of increasing the severity of amblyopia in the affected eye by occluding it further.

**Subhash Dadeya:** These days only role is to acclimatize the patient for occlusion therapy.

**T S Surendran:** Duration of patching in unilateral cataracts is ideally for half of the waking hours. It may be increased slowly starting from 2 hours a day and gradually increasing the number of hours. The patching has to be aggressive in such cases to get the best results. Bilateral cataracts without any squint do not usually need any patching.

**Prolima Thacker- Q. What will be your occlusion schedule in a 6 month old case of operated pediatric cataract?**

**Ken K. Nischal:** We prescribe patching for a 6 month old patient with an operated unilateral cataract for 50% of waking hours to minimise the density of the stimulus deprivation amblyopia in line with the recommendations of the Infant Aphakia Treatment Study (IATS, 2010).

**Seyhan B. Özkan:** We prescribe occlusion for 3 months and assessment made for further developments. Intermittent occlusion should be carried out 2-3 hours a day for 3 months and assessment made for further developments in a case with mono ocular cataract. If bilateral, there are less chances of amblyopia but a possibility should always be considered and alternating patching intermittently be carried out. A long time follow up is a must.

**B.S. Goel:** With a lens implantation glasses may or may not be required depending on the surgical results and surgeon’s choice. Get accustomed to binocularly for 4 weeks and check fixation and presence of amblyopia and micro nystagmus by cover test and presence of deviation even if small. Intermittent occlusion should be carried out 2-3 hours a day for 3 months and assessment made for further developments in a case with mono ocular cataract. If bilateral, there are less chances of amblyopia but a possibility should always be considered and alternating patching intermittently be carried out. A long time follow up is a must.

**Frank J Martin:** The ideal situation would be to commence occlusion therapy as soon as possible. If the baby has had an IOL implanted, we would commence occlusion therapy once the baby has recovered from the cataract surgery, at about 4 weeks postoperatively. We would start with 2-3 hours of occlusion therapy each day, and build up to half
the waking hours. We would reassess the vision in 2 months, or sooner if there are any difficulties. If the baby is aphakic, they need to be fitted with a contact lens and/or glasses. This can be a difficult time for the family, and an individualised approach is needed. Once the family is confident with the contact lenses, we would then start occlusion therapy for 2-3 hours per day, and build up to half the waking hours. Often we are seeing these families very regularly in the early days, so we can assess the vision often.

Seyhan B. Özkan: I usually start with 4 hours patching in such a case and I do not use full time occlusion with the concern of occlusion amblyopia.

Kamlesh: In our center in a 6 month old operated for cataract are generally left aphakic, if the axial length is less than 18.5 mm. Immediate prescription of glasses is the first step to ensure a clear retinal image. Occlusion therapy is started with part time occlusion of the sound eye for half of the waking hours as soon as the child has recovered from the surgery. The child is kept under close follow up to assess fixation pattern and visual acuity.

Subhash Dadeya:

a. Most researchers seems to favour occluding for no more than 50% of time.
b. Even reducing this further in first 6 months, allowing 1 hour occlusion per month of age to a maximum of 6 hours /day.
c. This treatment schedule allows more time for binocular interaction.

Summary (Prolima Thacker): The Infant Aphakia Treatment Study recommended occlusion 50% of waking hours to minimise the density of the stimulus deprivation amblyopia in an infant with unilateral pseudophakia.

Prolima Thacker- Q. How important is screening in amblyopia prevention and management?

Ken K. Nischal: It is important to diagnose amblyopia as soon as possible. Amblyopia is a reversible reduction in vision, provided it is diagnosed and treated within the critical period (up to 8 years of age). Generally speaking, amblyopia can be treated more effectively the younger the patient is. Patients have better visual outcomes when treated for less dense forms of amblyopia, so it is important to screen early as the density of amblyopia increases with time. It is particularly important to screen for and manage comorbidities of amblyopia early, such as congenital cataracts and strabismus to ensure that the patient has the best visual outcome after treatment.

T S Surendran: Screening is important in the prevention and management of amblyopia. Amblyopia if detected at an early age i.e during the critical period of visual development has a better prognosis for treatment.

Frank J Martin: Screening of young children is incredibly important in the detection and treatment of amblyopia. One of the most prevalent types of amblyopia we see in our practice – refractive amblyopia, has no signs. The eyes look normal. Because young children do not know any different, and because often they do not have the vocabulary or cognition to tell us that they cannot see, to our knowledge they are asymptomatic. Thus most cases of purely refractive or anisometropic amblyopia are not detected unless the vision is screened. The majority of cases of refractive or anisometropic amblyopia that we see in our clinic are initially detected through the Statewide Eyesight Preschool Screening test (StEPS), which is conducted on all 4 year olds in NSW. These cases may otherwise not be detected until it is too late for occlusion therapy to be effective.

Seyhan B. Özkan: The role of screening programs cannot be ignored and I do believe that it is something that should be done.

Kamlesh: Because treatment is more likely to succeed if initiated at a younger age, it is crucial to make the diagnosis of amblyopia as early as possible. The time constraints for treatment imposed by a limited period of visual development and maturation create the need for screening programs. The earlier amblyopia is detected and treated, the better its prognosis. All children should undergo a screening evaluation for amblyopia or its risk factors.

Subhash Dadeya: It is our duty to diagnose amblyopia at the earliest so that treatment can be started immediately to avoid children becoming unnecessarily unfit for technical and professional jobs having disastrous effects on employment and carrier options. The physician’s role in fighting amblyopia is two fold: 1) prophylaxis 2) therapy. As in other diseases it is easier to prevent amblyopia than to treat it. An amblyopic eye losses its function but retains its anatomic integrity. Early recognition and treatment of the problem in children can help to prevent permanent visual loss. All children should have a complete eye examination at least once between ages 3 and 5. Special techniques are needed to measure visual acuity in a child who is too young to speak. The philosophy to treat as early as possible has led to recommendations to screen for amblyopia as soon as a child can undertake a visual acuity measurement task. On the other hand several studies have reported that visual acuity outcomes are similar in 3-year-old and 6-year-old children after treatment for amblyopia. Hence screening strategies should involve screening at school entry rather than at age 3 or 4 years as currently recommended.

The physician should also establish the laterality of squint if present. No danger of amblyopia is connected with alternating squint, but physician should be alerted to recognise the danger of amblyopia whenever he /she see a unilateral squint. Any child below six years of age who sustains an injury to the eye resulting in occlusion of the visual axis is at risk of developing amblyopia. Hence after treating the child for the injury a good follow up of the
visual acuity should be done. Electrophysiological studies show altered response in the amblyopic eye. Relative changes and decreased amplitudes of waveforms are seen in these children. These changes are only supportive and not conclusive for diagnosis.

Summary (Prolima Thacker): Since the earlier the amblyopia treatment is started the better the response, early detection and treatment is extremely important. Also, the time constraints imposed by a limited period of visual development and maturation create the need for screening programs imperative.

Prolima Thacker- Q. What should be the time interval between amblyopia therapy and surgical intervention?

Ken K. Nischal: There should be at least 2 stable and consecutive visual acuity measurements and 3 stable and consecutive alignment measurements before undergoing strabismus surgery.

T S Surendran: Surgical intervention can be done as early as the amblyopic eye visual acuity reaches normal.

B.S. Goel: Eyes should be aligned as soon as possible before discontinuing occlusion/patching when normal vision has been obtained. Sufficient post operative follow up should continue for relapse and management accordingly.

Frank J Martin: Each case is different and needs to be assessed accordingly. We schedule the child for surgery once the level of vision is good enough to maintain fixation.

For successful amblyopia management we require:
1. Early diagnosis
2. A thorough orthoptic and ophthalmological evaluation and prescription of appropriate optical correction
3. Excellent compliance with occlusion
4. Support be available to parents to encourage occlusion
5. That if a child is not responding to amblyopia treatment despite good compliance we must re-evaluate the child to exclude the possibility of underlying pathology.

Seyhan B. Özkan: The amblyopia therapy must be done prior to surgical intervention as the level of visual acuity influences the deviation. If a successful outcome with amblyopia treatment is achieved surgical treatment can be done without losing time.

Kamlesh: As soon as the vision is equalized in both the eyes the patient can be taken up for squint surgery. The need for maintenance therapy post surgery should be explained to the parents to prevent relapse.

Subhash Dadeya: Surgery should be preferably done within six months of completion of amblyopia therapy for successful results.

Summary (Prolima Thacker): Surgery is usually deferred till vision becomes equal in both the eyes and fixation is maintained in the amblyopic eye except in cases of infantile esotropia where early surgery is recommended.
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