Детская рефракция.
Очки Детям.

Первая встреча с дитём.

I. Первое посещение (явка).

1. Врач собирает жалобы и анамнез (историю жизни и болезней).
2. Визуально оценивает симметричность размеров глазных щелей, положений век, глазных яблок.
3. Оценивает положение глазных яблок в глазницах, их выстояние из орбит.
4. Определяет прямую и содружественную реакции зрачков на свет и конвергенцию, а также рефлекс с глазного дна.
5. С помощью теста открывания/ закрывания и попеременного закрывания глаз, направляя на роговицу свет, уточняет нет ли косоглазия и гетерофории.
6. При неправильном положении глаз определяет угол девиации (отклонения) по Гиршбергу или с помощью призм, для оценки величины и направленности гетерофории врач может применить тест с призмами и палочкой Maddox.
7. Определяет объём движений глазных яблок во всех позициях взора.
8. Проводит визометрию (исследование остроты зрения каждого глаза).

Минимальный уровень остроты зрения должен быть не менее

0,1- в 0,5 года.
0,2- в 1 год.
0,3- в 2 года.
0,4- в 3 года.
0,5- в 4 года.
0,6- в 5 лет.
0,7- в 6 лет.
0,8- в 7 лет.
0,9- в 8 лет.
1,0- в 9 лет и старше.

У совсем маленьких детей, которым визометрию нельзя провести по таблицам, прибегают к ориентировочным способам определения остроты зрения.

Возрастная эволюция зрения у детей (Е.И.Ковалевский)
1 неделя - 0,002-0,02
1 месяц - 0,008-0,03
3 месяца - 0,05 - 0,1
6 месяцев - 0,1 - 0,3
1 год - 0,3 - 0,6
2 года - 0,4 - 0,7
3 года - 0,6 - 0,9
4 года - 0,7 - 1,0
5 лет - 0,8 - 1,0
7 лет - 0,9 - 1,5
8-15 лет - 0,9 - 1,5

9. Определяет характер зрения (исследование бинокулярного зрения).
10. Далее врач проводит определение манифестной клинической рефракции (о терминах здесь) без закапывания циклоплегиков (препаратов, вызывающих временный парез аккомодации). Самыми частыми, хотя и не единственными способами рефрактометрии являются скиаскопия и авторефрактометрия.
11. Затем врач, зная манифестную рефракцию, пытается корригировать каждый глаз, дабы получить максимальную остроту зрения. Одновременно проверяет изменяется ли угол косоглазия (если таковое есть) в подобранной коррекции или нет.
12. Осматривает за щелевой лампой (биомикроскопия) придаточный аппарат и передний отрезок глаза: область слёзного мешка, слёзные точки, ресницы, веки, конъюнктиву, роговицу, переднюю камеру глаза, радужку, зрачок, хрусталик, передние слои стекловидного тела. Если ребёнка, ввиду возраста, не удаётся осмотреть за щелевой лампой, то осмотр указанных стуктур проводится врачом с помощью бокового освещения и в проходящем свете офтальмоскопа (зеркального или электрического).
13. Осматривает глазное дно (офтальмоскопия) с узким зрачком или может расширить зрачок препаратами короткого действия (тропикамид, фенилэфрин) .
14. Далее врач индивидуально может выполнить измерение внутриглазного давления. Данное исследование не является рутинным в детской офтальмологической практике, но при ассиметрии размеров глазных яблок и миопической рефрации его желательно проводить у всех детей.
15. Устанавливает предположительный диагноз.
16. При выявленном снижении некорригированной остроты зрения, которую врач не смог объяснить болезнями роговицы, хрусталика, стекловидного тела, сетчатки и зрительного нерва, врач назначает Вашему ребёнку циклоплегию и вторую явку на высоте циклоплегии для дальнейшего обследования. Для циклоплегии могут использоваться циклопентолат или атропин.
Врач должен объяснить Вам, как правильно закапывать эти препараты. В случае косоглазия, желательно применение атропинизации в возрастной дозировке в течение 2-х недель, но возможно более длительное назначение. В остальных случаях может применяться циклопентолат трехкратно в день следующего осмотра или более длительно, но атропин дает более точные результаты.

II. Второе посещение (явка).

17. Врач определяет циклоплегическую рефракцию (см. пункт 10).

18. С широким зрачком хорошенько осматривает глазное дно и стекловидное тело (прямая или обратная офтальмоскопия, биомикроофтальмоскопия), также врач может повторить пункт 12, так как хрусталик и стекловидное тело с широким зрачком видны лучше.

19. Оценивает зрительную фиксацию каждого глаза. Это очень важно при выборе лечения амблиопии с центральной и нецентральной зрительной фиксацией (ищите в поисковике форума).

20. Если было замечено на 1-м приёме отклонение глаза от общей точки фиксации, то врач сравнивает угол девиации в условиях циклоплегии, то есть на фоне 2-х недельной атропинизации, с отмеченным ранее на предыдущем осмотре. Если угол изменился врач может назначить атропин ещё на две недели. И так до стабилизации угла (бывает до 3-х месяцев).

21. В случае миопической рефракции, различии в размерах глазных яблок, значительном (более 5 мм.рт.ст.) различии в уровне ВГД или при его повышении врач проводит ультразвуковое измерение переднезадней оси глаза (А-сканирование) или рекомендует выполнить это исследование в том учреждении, где есть такая возможность.

III. Третье посещение (явка). Если была назначена атропинизация, то это посещение может состояться через 3-4 недели после последней инстилляции атропина, когда действие его полностью пройдёт.

22. Врач, зная теперь циклоплегическую рефракцию, определяет максимальную корригированную остроту зрения.

23. По необходимости врач может провести исследование аккомодации субъективным (это, теоритически, может сделать любой окулист) или объективным (очень немногие клиники имеют такую возможность в настоящее время) способами.

24. Устанавливает клинический диагноз.

25. Определяет дальнейшую тактику, объясняет её родителям:

а) при необходимости назначает коррекцию аномалий рефракции (очки, мягкие контактные линзы, ортокератологические линзы), если не сам, то подключает специалистов-контактологов.

б) определяет необходимость лечебных мероприятий.

в) --/-- дальнейших углублённых исследований органа зрения.

г) --/-- консультации других специалистов.

д) --/-- частоту дальнейших посещений и их цель.

е) назначает дату следующего осмотра.

glasses for a young child (birth to six years), the following questions must be considered:

1. Is the refractive error within the normal range for the child's age?
2. Will this particular child's refractive error emmetropise?
3. Will this level of refractive error disrupt normal visual development or functional vision?
4. Will prescribing spectacles improve visual function or functional vision?
5. Will prescribing glasses interfere with the normal process of emmetropisation?

Distribution of refractive error according to age

Mayer and colleagues[14] (clinical, cross-sectional, predominantly white population)

Age (months)	Mean SE (D)	Lower 95% range (D)	Upper 95% range (D)
1	2.2	-1.1	5.5
1.5	2.1	-0.2	4.4
2.5	2.4	-0.3	5.1
4	2.0	-1.2	5.2
6	1.8	-0.8	4.4
9	1.3	-1.0	3.6
12	1.6	0.0	3.2
18	1.2	-0.6	3.1
24	1.2	-0.5	2.9
30	1.3	-0.6	3.1
36	1.0	-0.6	2.6
48	1.1	-0.6	2.9

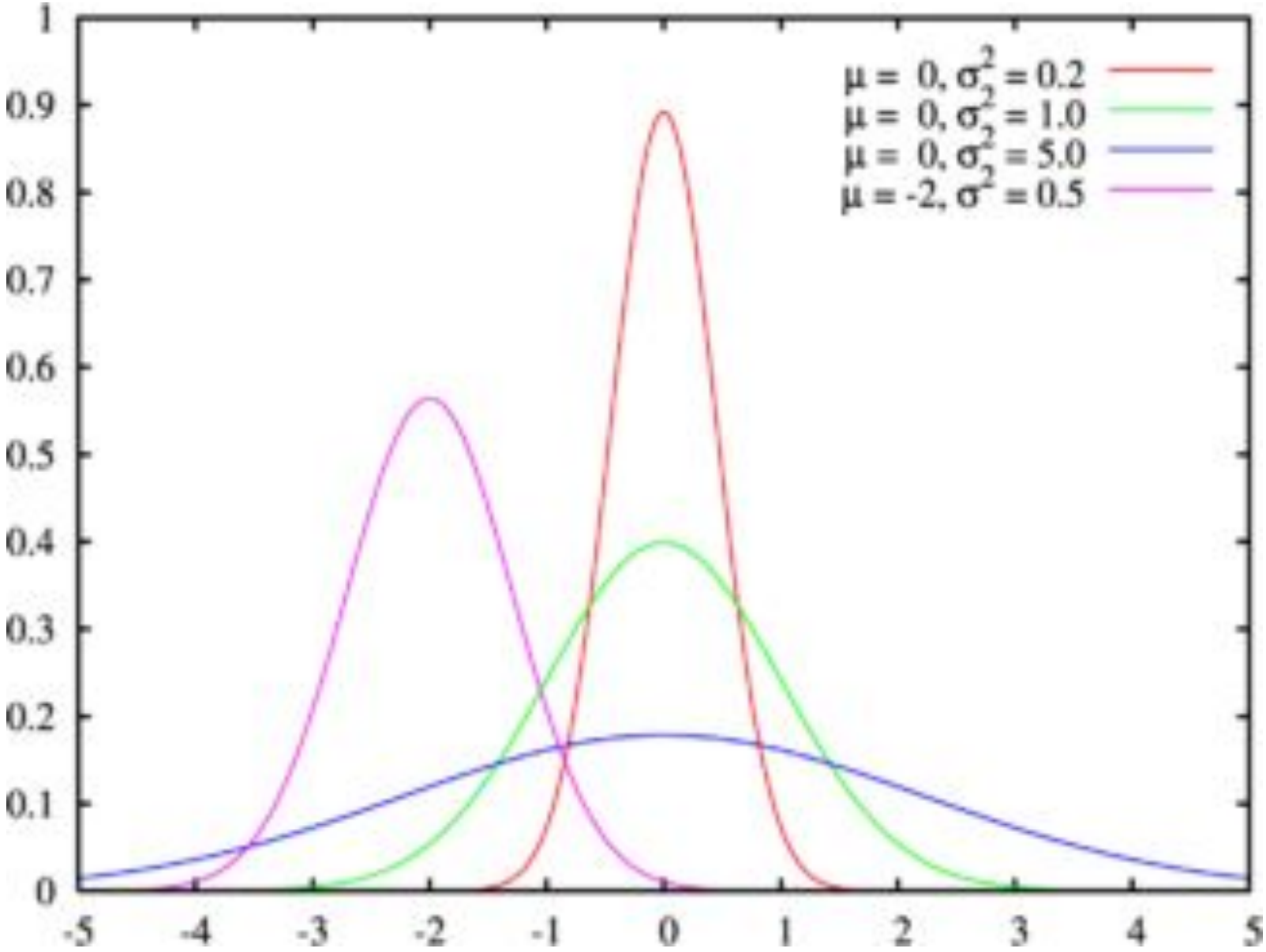
Поговорим об эмметропизации

Emmetropization

- "The developmental process which coordinates growth of the refractive components of the eye to create a non-Gaussian distribution of EORs around emmetropia"

- Dependent of visual experience of the infantile eye.

  - Lambert 1997


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-5
-4
-3
-2
-1
0
1
2
3
4
5
μ = 0, σ² = 0.2
μ = 0, σ² = 1.0
μ = 0, σ² = 5.0
μ = -2, σ² = 0.5

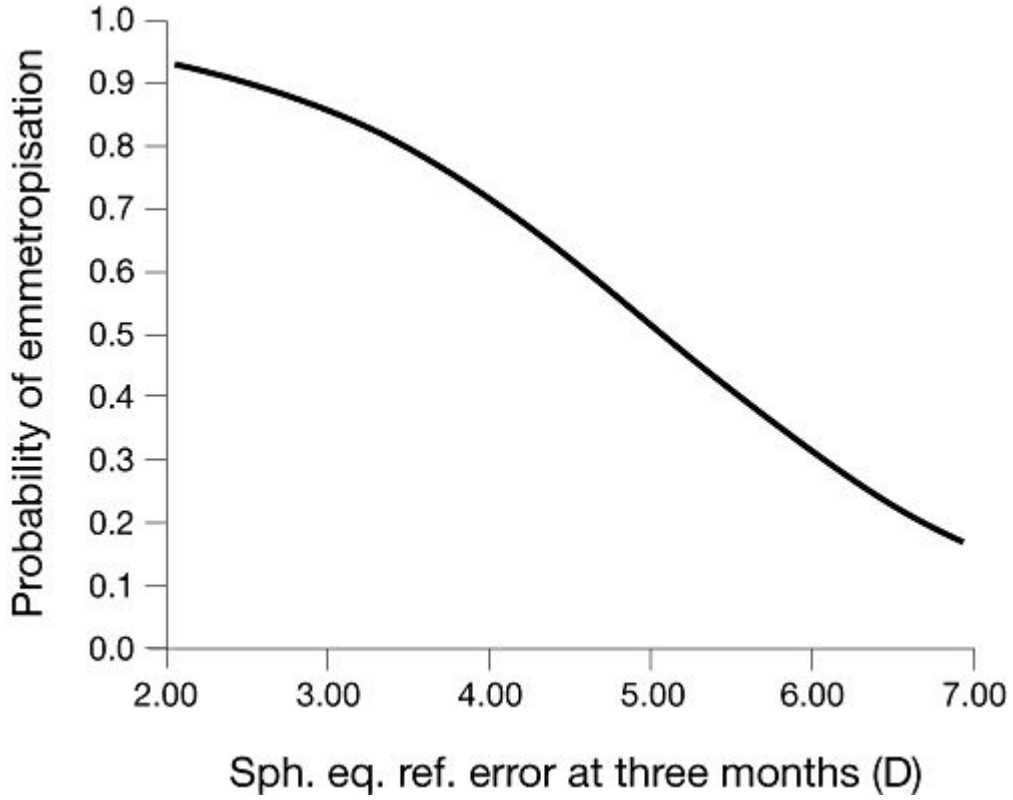
How does emmetropization begin?

- Few children myopic at birth
- most of those who are either myopic or
- hyperopic will emmetropise.
- The rate of emmetropisation is generally proportional to the initial error.
  - those who start off close to emmetropia or with a low amount of hyperopia show little change
  - those who have higher ametropia generally show greater and faster changes

Emmetropization

- Correcting EORs in infants may have similar effect
  - Higher percentage of children remain hyperopic if corrected with spectacles during infancy
    - (Ingram et al 1991)

      - In Lambert 1997



The probability of reaching 2.00 D by 18 months of age as a function of the level of cycloplegic spherical equivalent at three months of age. From Mutti DO, Mitchell GL, Jones LA, Friedman NE, Frane SL, Lin WK, Moeschberger ML, and Zadnik K. Accommodation, acuity, and their relationship to emmetropization in infants. *Optom Vis Sci* 2009; 86: 666–676. Reproduced with permission.

Normal Growth and Development of the Human Eye

In the human eye, myopia is associated with steep corneal curvature, elongated axial length, or increased lenticular refractive power. At birth, the corneal power is approximately 52 D, flattening to 46 D by 6 months of age and reaching adult curvature of 42–44 D by age 12 years [2]. Newborn ocular axial length is between 15 and 17 mm and rapidly increases in the first 6 months to 19–21 mm. Approximately 2 mm of growth occurs over the next 10 years of life. Lenticular power also changes rapidly in the first 6–12 months of life from 35 diopters to 27 diopters and continues to decrease in a more gradual fashion (24 D–21 D) from ages 2–10 years. Emmetropization refers to the changes in the refractive power of the anterior segment and the axial length of the eye to reach emmetropia [3]. The changes in the optical components during childhood and adolescence are more gradual and can lead to the development of myopia.

Table 5.1 – Newborn vs. adult ocular parameters

	Newborn	Adult
Axial length	16.8 mm	23.0 mm
Mean keratometry	55 D	43 D
Optic nerve length	24 mm	30 mm
Corneal diameter	10 mm	10.6 mm (vertical) × 11.7 mm (horiz.)
Corneal thickness	581 μm	545 μm
Pars plana length	0.5–1.05 mm	3.5–4 mm
Orbital volume	7 cc	30 cc

Estimation

- **½** of variance in refractive error – due to axial length
- **¼** of variance – due to corneal curvature
- **1/20** of variance – due to anterior chamber
- **1/5** of variance – due to measurement errors & variation in lens & refractive index.

Emmetropisation process

- Hyperopic children with ATR astigmatism at six months maintained their hyperopia (approximately 2.00 D on average)

- Hyperopic children with WTR astigmatism lost their hyperopia (ending up at approximately 0.75 D hyperopic at age six years)

Emmetropisation process

- Main tool to predict emmetropisation is to monitor the refraction.
- Those who emmetropise, lose approximately one-half of their spherical equivalent refractive error in the first year and approximately one-third between nine and 21 months.
- With regards to astigmatism, approximately two-thirds of the astigmatism is lost between nine and 21 months.

Emmetropisation process

- Probability of emmetropisation decreases as hyperopia increases.
- Probability is < than 50 % for three-month-olds, who had a cycloplegic spherical equivalent refraction greater than 5.00 D.

Emmetropization

- Children with EOR at birth usually become more emmetropic with age
- Argument against giving glasses early
- Disturbance in emmetropization causes persistent myopia and hyperopia
  - Jensen 1997

Is the refractive error within the normal range for the child's age?

- Most infants are hyperopic by +2.00 D with SD of 2.0
- In Initial 3 months, controversy over refractive status to be static or decreasing.
- Average is +2.16 D

3-12 months

- There is rapid decrease in refractive status from 3 months to 12 months.
- The error decrease to 1. 36 D at 9 months

- What happens after ……12 months?
- This is followed by a period of slower change until two years for hyperopes and four to five years for myopes

Changes during preschool year

- In study of Mohindra and Held (1981), refracted 400 children ≤5 yrs using near retinoscopy.
- For children 0 to 4 weeks they found bell shaped distribution of refractive error ranging from -14 D to + 12D gradually narrowing to range of -3 to +4 D at age of 129 to 256 weeks.
- This demonstrate the process of emmetropization is evident.

Changes during school year

- In a study of 1,432 unselected children, Sorsby, Benjamin, and sheridan (1961) found the mean ocular refraction under cycloplegia, decreased from +2.33D at age 3yrs to 0.93 D at age of 14yrs in boys and from 2.96D at age 3yrs to 0.64D at age 15yrs for girls.

School years (above 6 yrs)

- the refraction with higher hyperopia and with emmetropia remains unchanged
- the refraction with moderate hyperopia still shows a drift towards emmetropia up to nine or 10 years of age
- In the school years, myopia should be corrected for function with full correction

Astigmatism

- Higher astigmatism decrease more rapidly in initial 3-4 years
- Significant WTR, ATR and oblique astigmatism (least common) are all more common
- all types of astigmatism decrease, with infants losing approximately two-thirds of their astigmatism between nine and 21 months (most common: 1.5- 2 yrs)

Astigmatism

- Higher prevalence of astigmatism at birth but decrease in degree and magnitude
  - 69% of children have astigmatism greater than 1.00 D at birth
- 90% Swedish children with astigmatism of +1 or more was reported to decrease.

Astigmatism of 1 or more (%)	Age
8-30%	1.2 yrs
4-24%	3-4 yrs
2-17%	6-7 yrs

Anisometropia

- Anisometropia (≥1D) is more common in infants than adults.
- spherical anisometropia remains more common in children compared with adults up to four years of life
- Anisometropia is transient in relatively lower level of refractive error, for example, 2.50 D or less and may not lead to amblyopia

Regarding Anisometropia

- No way to predict with certainty whether a particular child's anisometropia is transient or will remain into adulthood.

- Following things should be taken into account:
  - monitor a child over a period of four to six months
  - consider VA—if amblyopia is already present it requires treatment
  - higher levels of anisometropia (for example, >3.00 D or more and particularly 5.00 D or more) are less likely to be transient.
  - children with low vision are less likely to fully emmetropise .
  - Therefore, these children can be prescribed, with the main consideration being to optimize visual function.

Поговорим о циклоплегии.

Indication for cycloplegic refraction

- Accommodative esotropia
- All children younger than 3 yrs
- Suspected latent hyperopia
- Suspected pseudomyopia
- Uncooperative/noncommunicative patients
- Variable and inconsistent end point of refraction

Indication for cycloplegic refraction

- Visual acuity not corrected to a predicted level
- Strabismic children
- Amblyopic children
- Suspected malingering and hysterical patients

Selection and use of specific cycloplegic agents

- Variable degree of pupil dilatation and cycloplegia
- Instill cycloplegic alone or with mydriatrics

Agent	[C%]	Dosage	Max cyclople	Duration of effect	Residual accom
Atropine sulfate	1, ***2***	1D TID 3 days	3-6 hrs	10-18 days	Ngble
Sco-mine HBR	0.25%	1D TID	60 mins	5-7 days	ngble
Cyclo-late HCL	0.5, ***1***, 2	1D TID	30-45 mins	24 hrs	minimal
Tro-mide HCL	0.5, ***1***	1D TID	20-30 mins	4-8 hrs	moderate

TABLE 3. Choice of Cycloplegic Agent for Infants and Children

Patient Age	Drug
Preterm to 3 mo	Cyclomydril (cyclopentolate 0.2% and phenylephrine 1%)
3 mo to 1 yr	Cyclopentolate 0.5%; atropine 0.25% in oil; atropine sulfate 0.5% drops or ointment; scopolamine HBR 0.25%
1 to 5 yr	Cyclopentolate 1%; atropine 0.25% in oil*; atropine sulfate 0.5%–1% drops in ointment; scopolamine HBR 0.25%
5 yr (and adults)	Cyclopentolate 1%

*Not commercially available. See atropine sulfate section.

Apt & Gaffney. Cycloplegic Refraction. http://80.36.73.149/almacen/medicina/oftalmologia/enciclopedias/duane/pages/v1/v1c041.html

Note: No tropicamide in this table.

The prescription must be based on cycloplegic refraction. There are several eye drop regimens utilized depending on age and iris pigmentation:

- ≤6 months of age: one drop OU of cyclopentolate 0.5 % and phenylephrine 2.5 %.
- 6 months to 12 years: 1 % cyclopentolate.
- ≥13 years: 1 % tropicamide and 2.5 % phenylephrine.
- Patients with dark eyes may require two sets of drops 5 min apart.

What does our practice say?

- Advise **atropine** cycloplegic refraction invariably in the children younger than 2 years
- Advise **atropine** cycloplegic refraction in esotropic children (accommodative type) up to 4 years
- After 4 years, advise cyclopentolate cycloplegic refraction up 25-30 years
- Above 30 years, check **amplitude and lag of accommodation**, then advise cycloplegic refraction

Errors of inadequate cycloplegia

- Less hyperopia
- More myopia
- Higher with-the-rule astigmatism

- Same errors as computer autorefraction!

Important notes

- Children with disorders/ Down's syndrome, cerebral palsy, trisomy 13 and 18, and other central nervous system disorders may have an increased reaction to cycloplegics
- Low weight infants may need a modification of dosage

Поговорим об амблиогенных рефракциях

Table A1.4 Refractive amblyogenic risk factors [4]

Anisometropia (spherical or cylindrical): >1.5 D
Hyperopia > 3.5 D in any meridian
Myopia > 3.00 D in any meridian
Astigmatism > 1.5 D at 90 or 180
Oblique astigmatism > 1.0 (>10° eccentric to 90° or 180°)

TABLE 1 DIAGNOSTIC CRITERIA FOR AMBLYOPIA

Criterion	Finding
Unilateral Amblyopia	
Response to monocular occlusion	Asymmetric objection
Fixation preference	Failure to initiate or maintain fixation
Preferential looking	≥2-octave interocular difference*
Best-corrected visual acuity	≥2-line interocular difference
Bilateral Amblyopia	
Best-corrected visual acuity	Age ≤3 years: visual acuity worse than 20/50 in either eye Age ≥4 years: visual acuity worse than 20/40 in either eye

* A 2-octave difference is a 4-card difference in the full set of Teller Acuity Cards, which is equivalent to multiplying or dividing the visual angle by 4.

Когда назначать очки. Общие подходы.

Spectacle prescription guideline

When to consider prescribing	What to prescribe?
Outside the 95% range of refraction at any age according to any currently available data. This guideline could be applied to other refractive errors also.	*Prescribe so as to leave the uncorrected hyperopia somewhat above the mean for the age*
3 to 6 months if outside the 95% range (Partial correction)	In addition to the level of hyperopia determined by cycloplegic refraction, factors that would indicate correction are VA poorer than 6/100 plus non-cycloplegic (Mohindra) refraction that is

NOTES ON MANAGEMENT

- Prescribing if the refraction is outside the 95% limits for a particular age.
- Main aim is to bring the uncorrected portion just within the normal range, for example, to the 95% limit.
- This would leave a large stimulus for emmetropisation and therefore potentially encourage a greater amount of emmetropisation

- It seems that the child's accommodation cannot overcome the very large uncorrected hyperopia but a correction that is small enough to bring them just within the normal range allows them to accommodate for the remaining hyperopia, resulting in esotropia.

- Thus, when a larger prescription is given, it is imperative to see the child approximately four to six weeks after the prescribing appointment

NOTES ON MANAGEMENT

- Many authors recommend monitoring the refraction

  (hyperopia, myopia or astigmatism) in infants and toddlers before prescribing.

- Frequently unchanging or increasing refractions are

  associated with amblyopia.

NOTES ON MANAGEMENT

- Only demonstrable amblyopia indicate immediate prescribing
- The other main factor, which will influence one's likelihood of prescribing for hyperopia, is the presence of heterophoria.
- Correction of hyperopia to optimize alignment

Will this level of refractive error disrupt normal visual development or functional vision?

- Uncorrected high refractive error (hyperopia, astigmatism and anisometropia) during the first few years of life is a risk factor for amblyopia

- There is an increased chance of monocular or binocular amblyopia in one-year-olds with 3.50 D or more in one meridian,

Some common differences between adults and children

CHILDREN < 5 yrs

- Give refraction on axis as refracted
- Full hyperopic cycloplegic refraction tolerated well if less than age 5 y
- Subjective manifest refraction less important

ADULTS

- Give cyl closer to 90 or 180 degrees
- Maximum tolerated plus even in refractive accommodative esotropia
- Subjective manifest refraction important.

Some common differences between adults and children

CHILDREN < 5 yrs

- Tolerates aneisokonia better but also considered an impediment to fusion and has amblyopia potential
- Anisometropic Rx, Aneisokonic spectacle Rx has a role especially in patients requiring occlusion

ADULTS

- Tolerates aneisokonia poorly
- Will not wear Rx that has a large difference in refraction between the 2 eyes (threshold? Different from patient to patient)

Очки при гиперметропии

- Children have high accommodation amplitudes, and
therefore, mild to moderate hypermetropia does not require correction in the absence of signs such as eso tropia or asthenopic or visual symptoms

Spectacle prescription guideline for hyperopia

When to consider prescribing	What to prescribe?	Comments, rationale and references
≥ 3.50 in one or more meridian at age of 1 year upwards	Give partial prescription Atkinson's protocol : prescribe 1D less than least hyperopic meridian	Based on randomised clinical trials of Atkinson and colleagues and natural history study of Ingram and colleagues
>2.50 at 4 years upward	Still give partial correction of hyperopia Under correct by 1 to 1.50 D*	Based on studies of visual function and functional vision and Mayer and co-worker's
≥ 1. 50 D in the school years without symptom	Full or near full correction may be given at this age, as emmetropisation has	Studies on visual function show that hyperopia ranging from ≥ 1.00 to ≥ 2.00 D may impact visual function .

Prescribing for hyperopia

- >3.50 D in one or both meridian
- Atkinson's protocol based on the plus cylinder format at this was:
  - sphere : prescribe 1.0 D less than the least meridian
  - Cylinder: prescribe half of the astigmatism if >2.50 D

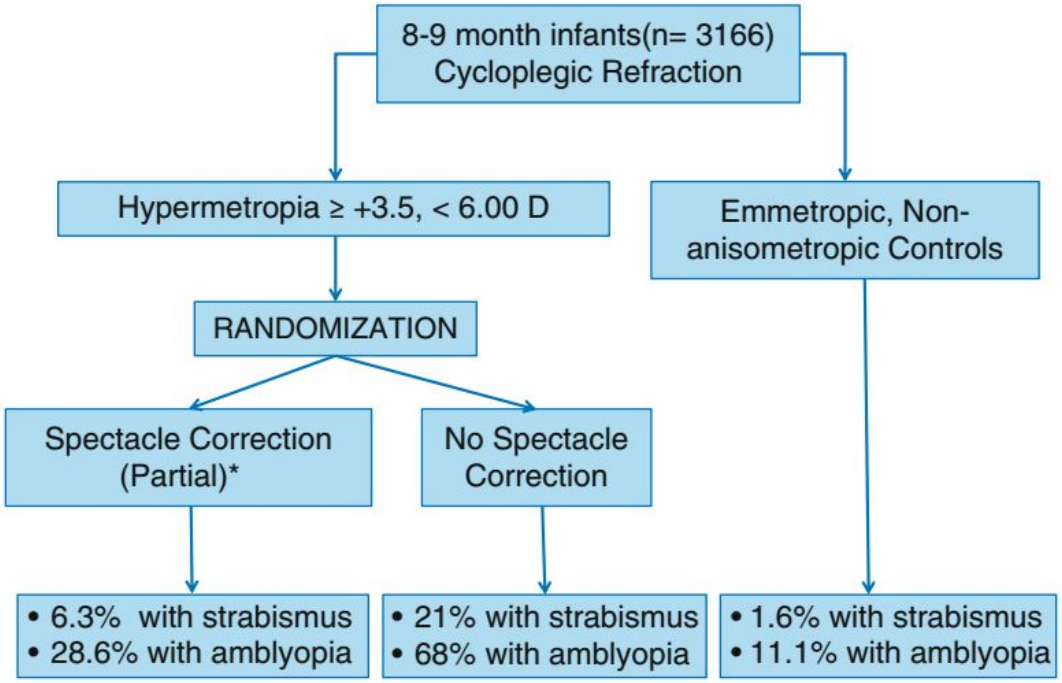


Fig. 3.1 Results of the Cambridge Infant Screening Program [6]. Infants were screened for refractive error by cycloplegic refraction at 8–9 months and followed for 7 years. The percentage of patients who developed strabismus and amblyopia are compared among those with hypermetropia >+3.50 and <+6.00 treated with refractive correction versus those who were observed as compared to emmetropic controls

Table 3.1 Prescribing practices and screening guidelines for patients with hypermetropia

	Age < 1	1–2 years	2–4 years	4–7 years
Miller and Harvey [8]	+5.00 (50 %)		+4.00 (50 %)	+4.00 (50 %)
	+5.50 (75 %)		+5.00 (75 %)	+4.50 (75 %)
AAO PPP [2]	≥+6.00	≥+5.00	≥+4.50	No numerical threshold, consider if improves VA
AAPOS policy statement [10]	Consider for any child >+3.50 hypermetropia in any meridian			
AAPOS vision screening committee[a] [11]	≥+4.50		≥+4.00	≥+3.50

Percentages refer to percentages of professionals who would prescribe refractive correction at specific hypermetropic refractive errors

[a]These are automated screening guidelines, not prescribing recommendations

AAO American Academy of Ophthalmology, *PPP* preferred practice patterns, *AAPOS* American Association for Pediatric Ophthalmology and Strabismus

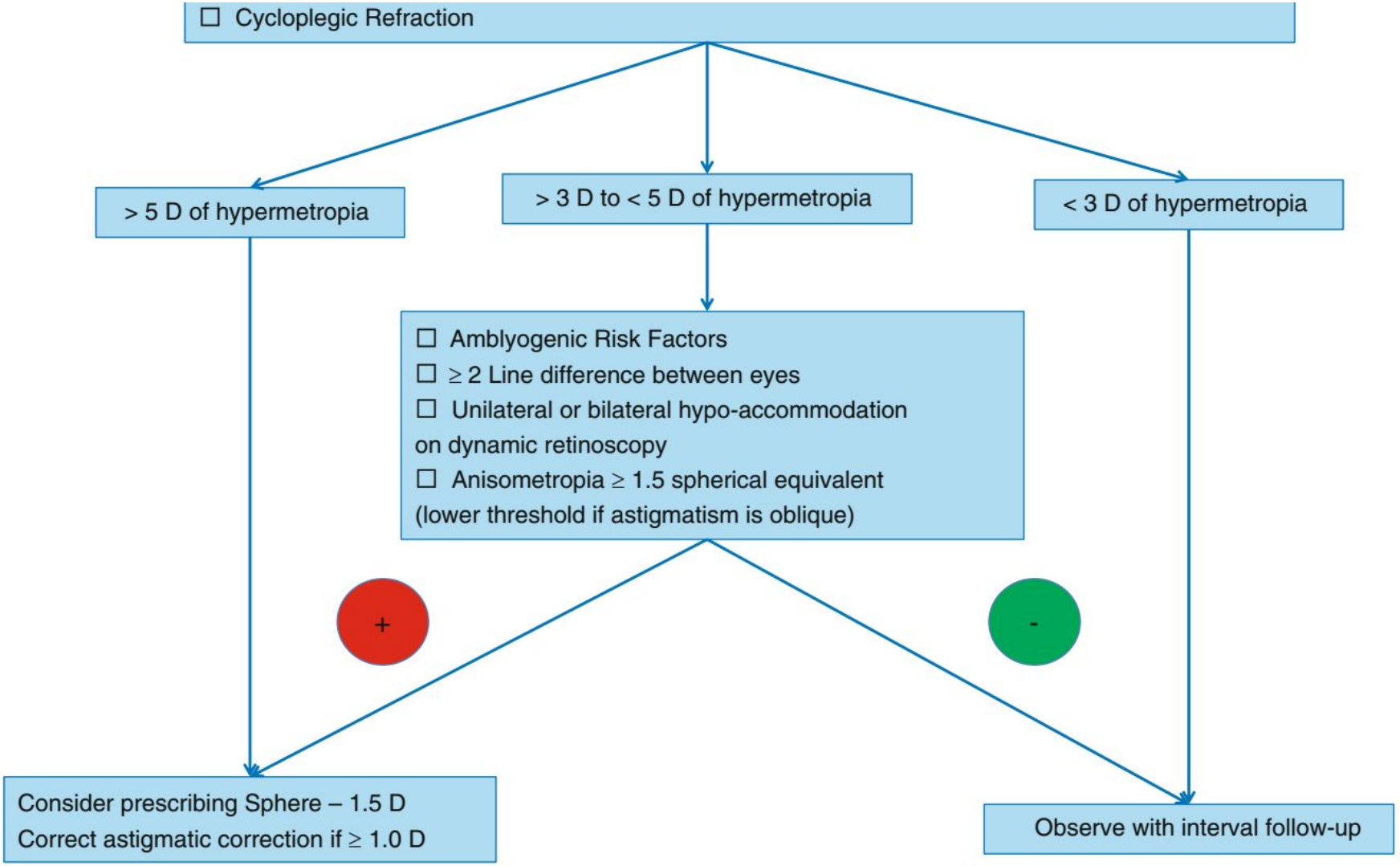


Fig. 3.2 Algorithm to evaluation and management of hypermetropia

Accommodation & Convergence

- Stimulus for binocular adjustment at near
  1. Change in vergence of light reaching fovea
  2. Temporal disparity of 2 images relative to 2 foveas

- Normal conditions: a unit change in accommodation (D) is accompanied by a unit change in convergence (meter angle)

- Change in convergence produced by change in accommodation = accommodative convergence
  - Meter angle: Angle formed by each visual axis with a line perpendicular to interpupillary line
    - (Moses in Adler' s Physiology of the Eye 1987)

- Partial correction of hyperopia greater than 3.50 D at

  nine to 11 months resulted in improved VA at four years of age and may reduce the incidence of eso
- In children with 5.00 D or more,
  - 25 to 43% have acuity of 6/12 or worse
  - 87 per cent have acuity worse than 6/6.
  - Poor accommodation and stereopsis

Очки при астигматизме

Spectacle prescription guideline for astigmatism

When to consider prescribing	What to prescribe	Comments, rationale and references
>2.50 D at 15 months of age upwards	Decrease cylinder by 1.00 D or give 50%	15 month of period is the most critical period
≥ 2. 00 D at 2 years or upward	Give partial cylinder up to 3 to 4 years after which give full cylinder	Based on finding of better VA in children whose astigmatism was corrected at this age and at 2 years approximately 5 to 10% have astigmatism ≥ 2.00D
≥ 1.50 D at 4 years upwards	Give full cylinder and in case of previously uncorrected high astigmatism, reduced prescription may be given to allow child to adapt	Based on studies of Cowen and Bobier 95th percentile for astigmatism was 1.25 in children in mean age of 4 years
≥ 1.00 D oblique astigmatism from	Correct ¾ to the age of 2 and then correct the full	Oblique astigmatism is risk factor for amblyopia. Mayer and

Table 5.1 American Association for Pediatric Ophthalmology and Strabismus preferred practice patterns for prescribing astigmatic correction

	Refractive error		
Condition	Age <1 year	Age 1–2 years	Age 2–3 years
Astigmatism	≥3.00 diopters	≥2.50 diopters	≥2.00 diopters
Astigmatic anisometropia (without strabismus)	≥2.50 diopters	≥2.00 diopters	≥2.00 diopters

[a]Adapted from the American Association for Pediatric Ophthalmology and Strabismus PPP panel recommendations, 2012
Pediatric Eye Evaluations ppp-2012. Table 3
http://www.aao.org/preferred-practice-pattern/pediatric-eye-evaluations-ppp--september-2012. Accessed maarch 2014.

for *oblique* astigmatism—plus axis between 15° and 75° or 105° and 165°—it is probably preferable to correct oblique astigmatism of smaller magnitudes [2]. As an example, a 3-year-old with a cycloplegic refraction (CRx) of *plano + 1.50 × 090 OU* would not necessarily require glasses, while a 3-year-old with CRx of *plano + 1.50 × 045 OD* and *plano + 1.50 × 135 OS* is preferably prescribed glasses based on current recommendations.

if astigmatic errors of magnitudes less than those listed above are present in conjunction with amblyogenic or visually significant degrees of hyperopia or myopia, they should be fully corrected to provide the most focused image possible. For example, a 2-year-old with a CRx of *-6.00 + 1.00 × 090 OU* should be prescribed the 1 diopter of astigmatism, even though 1 diopter of WTR astigmatism found in isolation does not warrant glasses in a toddler. Finally, older school-aged children with smaller degrees of astigmatism may benefit from spectacle correction if it provides relief of symptoms such as blurry vision or asthenopia.

Очки при анизометропии

Spectacle prescription guideline for anisometropia

When to consider prescribing	What to prescribe	Comments, rationale and references
≥ 3.00D at 1 year upward	Prescribe full anisometropia if amblyopia is already present, if there is no amblyopia reduced anisometropic correction could be considered	≥ 3.00 D of anisometropia is less likely to be transient according to report of Abrahamsson_
≥ 1.00 D but < 3.00 D after 1 year of age	Monitor for 4 to 6 months and if persist prescribe myopia and hyperopia according to age	Based on report of transient myopia
≥ 1.00 D of spherical hyperopic anisometropia, ≥2.00D of spherical myopic anisometropia, ≥ 1.50 D of cylindrical anisometropia after	Prescribe myopia and hyperopia according to age	This level of amblyopia is found to be amblyogenic at this age

Очки при миопии

Myopia

When to consider prescribing	What to prescribe	Comments, rationale, and refrences
< -2 .00D myopia from one year	Reduce by 0.50 or 1.00 D until school age	MEPED study showed that < -1.2 to -1.7 is the lower end of 95% range in African American
4 years to early school years	In correction of low amount of myopia improves vision , correct it. Give full correction for high amount of myopia	Congdon and colleagues found the correction of ≤0.75 D improved VA.
School age myopia	Prescribe full correction. In cases of myopia with near esophoria , larger lag of accomodation or shorter habitual reading distance, PAL may be considered	Guideline for bifocal correction based on the correction of Myopia Evaluation Trial Study for 6 to 11 years old

- Infants and very young children are most interested in objects at an arm's length up to 2 m from them, and therefore, low levels of myopia are easily tolerated. In contrast, school-age children may benefit from correction of low levels of myopia to meet visual demands of school activities' viewing

Prescribing for myopia

- < -5.0 D during the first year, reduce by 2.0 D. Under correct because emmetropisation occurs in myopia

Management of Myopia

A cycloplegic refraction is necessary in children, especially under the age of 12 years [8]. Uncontrolled patient accommodation during retinoscopy may lead to an overestimation of the magnitude of myopia. Symmetrical, uncorrected myopia of low magnitude usually results in distance blur, which may be asymptomatic in young, nonschool-aged patients. Myopic correction in nonschool-aged children for refractions less than −1.50 D is rarely needed [4] (Case 1). In contrast, low-grade myopia in school-aged children may warrant correction to meet the visual demands of the patient (Case 2). Correction of myopic anisometropia depends on the age of the patient, and correction should be considered if ≥−4.00 in patients <1 year of age and −3.00 in patients >1 year of age to reduce the risk of amblyopia [4].

In young children, spectacles are the most common form of myopic correction. Contact lenses become an option in older children, although risks of infection must be stressed. Limiting factors for contact lens success in children include ability to insert and remove lens, hygiene, and motivation of parent or caregiver.

Five-Year Clinical Trial on Atropine for the Treatment of Myopia 2

Myopia Control with Atropine 0.01% Eyedrops

Audrey Chia, FRANZCO, PhD,[1,2] *Qing-Shu Lu, PhD,*[3,4] *Donald Tan, FRCS, FRCOphth*[1,2,4,5]

Purpose: To compare the safety and efficacy of different concentrations of atropine eyedrops in controlling myopia progression over 5 years.

Design: Randomized, double-masked clinical trial.

Participants: A total of 400 children originally randomized to receive atropine 0.5%, 0.1%, or 0.01% once daily in both eyes in a 2:2:1 ratio.

Methods: Children received atropine for 24 months (phase 1), after which medication was stopped for 12 months (phase 2). Children who had myopia progression (≥ -0.50 diopters [D] in at least 1 eye) during phase 2 were restarted on atropine 0.01% for a further 24 months (phase 3).

Main Outcome Measures: Change in spherical equivalent and axial length over 5 years.

Results: There was a dose-related response in phase 1 with a greater effect in higher doses, but an inverse dose-related increase in myopia during phase 2 (washout), resulting in atropine 0.01% being most effective in reducing myopia progression at 3 years. Some 24%, 59%, and 68% of children originally in the atropine 0.01%, 0.1%, and 0.5% groups, respectively, who progressed in phase 2 were restarted on atropine 0.01%. Younger children and those with greater myopic progression in year 1 were more likely to require re-treatment. The lower myopia progression in the 0.01% group persisted during phase 3, with overall myopia progression and change in axial elongation at the end of 5 years being lowest in this group (-1.38 ± 0.98 D; 0.75 ± 0.48 mm) compared with the 0.1% (-1.83 ± 1.16 D, $P = 0.003$; 0.85 ± 0.53 mm, $P = 0.144$) and 0.5% (-1.98 ± 1.10 D, $P < 0.001$; 0.87 ± 0.49 mm, $P = 0.075$) groups. Atropine 0.01% also caused minimal pupil dilation (0.8 mm), minimal loss of accommodation (2–3 D), and no near visual loss compared with higher doses.

Conclusions: Over 5 years, atropine 0.01% eyedrops were more effective in slowing myopia progression with less visual side effects compared with higher doses of atropine. *Ophthalmology 2016;123:391-399 © 2016 by the American Academy of Ophthalmology.*

Atropine for myopia

- Atropine 0.01%
  - Given daily for 2 years
  - Over 5 years, more effective in controlling myopia progression
  - Minimal side effects
  - Negligible effects on pupil size, accommodation, no effect on near acuity
  - Modulated and sustained effect, no rebound

1. *Chia A, Chua WH, Cheung YB etal. Atropine for the treatment of childhood myopia: safety and efficacy of 0.5%, 0.1%, 0.01% (Atropine for Myopia 2) Ophthalmology 2012; 119.347-54.*
2. *Chia A, Chua WH, Wen L, et al. Atropine for the treatment of childhood myopia: changes after stopping atropine 0.01%, 0.1%, and 0.05%. Am J Ophthalmol 2014; 157: 451-7.*
3. *Chia A, Lu QS, Tan D. 5-year clinical trial on atropine for the treatment of myopia 1: myopia control with atropine 0.01% Eyedrops. Ophthalmology 2015; epub ahead of print.*
4. *Chia A, Lu QS, Tan D. 5-year clinical trial on atropine for the treatment of myopia 2: myopia control with atropine 0.01% Eyedrops. Ophthalmology 2016; 123: 391-399.*

Aphakia or Pseudophakia

- Overcorrect by 2 to 3.00D because child's world is near.
- After 2 to 3 years, distance correction with bifocal is better option

Итого.

Table A1.1 Practice patterns generated by consensus for prescribing refractive correction

	<1 year	1–2 years	2–4 years	4–7 years
Miller and Harvey [1][a]				
Myopia	−4.50[a]		−3.00[a]	−2.00[a]
Hypermetropia	+5.50[a]		+5.00[a]	+4.50[a]
Astigmatism	+3.00[a]		+2.50[a]	+2.00[a]
AAO PPP [2]				
Myopia	≥−5.00	≥−4.00	≥−3.00	No specific numbers, prescribe based on symptoms
Hypermetropia	≥+6.00	≥+5.00	≥+4.50	
Hypermetropia/ET	≥+2.50	≥+2.00	≥+1.50	
Astigmatism	≥+3.00	≥+2.50	≥+2.00	

[a]Numbers based on 75 % (majority) of American Association for Pediatric Ophthalmology and Strabismus (AAPOS) members would prescribe glasses.
AAO American Academy of Ophthalmology, *PPP* Preferred Practice Patterns

Table A1.2 American Academy of Ophthalmology Preferred Practice Patterns for treating patients with anisometropia without strabismus [2]

	<1 year	1–2 years	2–3 years
Myopia	≥−4.00	−3.00	−3.00
Hypermetropia	+2.50	+2.00	+1.50
Astigmatism	2.50	2.00	2.00

Table A1.3 American Association for Pediatric Ophthalmology and Strabismus Vision Screening Committee Guidelines for automated preschool screening of refractive error [3]

	12–30 months	31–48 months	≥49 months
Hypermetropia	≥+4.50	≥+4.00	≥+3.50
Astigmatism	≥+2.00	≥+2.00	≥+1.50
Anisometropia	≥+2.50	≥+2.00	≥+1.50

TABLE 2 GUIDELINES FOR REFRACTIVE CORRECTION IN INFANTS AND YOUNG CHILDREN

Condition	Refractive Errors (diopters)		
	Age <1 year	Age 1–2 years	Age 2–3 years
Isoametropia (similar refractive error in both eyes)			
Myopia	–5.00 or more	–4.00 or more	–3.00 or more
Hyperopia (no manifest deviation)	+6.00 or more	+5.00 or more	+4.50 or more
Hyperopia with esotropia	+2.50 or more	+2.00 or more	+1.50 or more
Astigmatism	3.00 or more	2.50 or more	2.00 or more
Anisometropia (without strabismus)*			
Myopia	–4.00 or more	–3.00 or more	–3.00 or more
Hyperopia	+2.50 or more	+2.00 or more	+1.50 or more
Astigmatism	2.50 or more	2.00 or more	2.00 or more

NOTE: These values were generated by consensus and are based solely on professional experience and clinical impressions because there are no scientifically rigorous published data for guidance. The exact values are unknown and may differ among age groups; they are presented as general guidelines that should be tailored to the individual child. Specific guidelines for older children are not provided because refractive correction is determined by the severity of the refractive error, visual acuity, and visual symptoms.

* Threshold for correction of anisometropia should be lower if the child has strabismus. The values represent the minimum difference in the magnitude of refractive error between eyes that would prompt refractive correction.

conclusion

- Prescription of spectacles thus must be done keeping factor like emmetropization and amblyogenic factor in mind.

Spectacle prescribing

- Prescribing spectacle from cycloplegic finding is an art rather precise science
- How to prescribe spectacle?
  - Concept of emmetropization is necessary
  - Esotropic children younger than 4 years, full refractive correction is prescribed
  - With older children, amount of plus can be reduced till fusion is maintained

Что если ребёнок не переносит очки?

I. The Prescription Is Not Accurate or There Is an Optical Problem with the Lenses

1. Step 1: Examine the optics of the glasses.
   - Verify that the lenses were made as prescribed: Optical labs grind lenses in minus cylinder format, and it is possible that the glasses prescription was transposed incorrectly if it was written in plus cylinder format.
   - Use a lensometer to measure the glasses prescription and confirm it was made as prescribed.

Clinical Skill: Lens Transposition from Plus to Minus Cylinder

- Step 1. Add the sphere and cylinder together to get the new spherical power.
- Step 2. Change the sign of the cylinder (+ becomes – and – becomes +); do not change the amount of the cylinder.
- Step 3. Change the axis by 90°.
- Example 1: +3.25+2.50 × 135 in plus cylinder format

?

becomes +5.75–2.50 × 045 in minus cylinder format.

- Example 2: +3.25–2.50 × 135 in minus cylinder format

?

becomes +0.75+2.50 × 045 in plus cylinder format.

2. Step 2: Verify that the lens is well centered in front of the child's visual axis.

3. Step 3: Consider distortions related to polycarbonate material:

4. Step 4: Consider a defect in or an inappropriate base curve of the lens.

Step 5: Consider aniseikonia in patients with significant anisometropia.

- This can be corrected with base curve adjustments or contact lenses.

II. The Glasses Are Not Manufactured Well or Are Not Fitting Well

- *Vertex distance*: The posterior surface of lenses should generally be 12–15 mm from the corneal plane. This becomes especially significant when lens power is above 5–6 diopters.

Increasing vertex distance	Makes a "plus" lens more "plus"	Makes a "minus" lens less "minus"
Decreasing vertex distance	Makes a "plus" lens less "plus"	Makes a "minus" lens more "minus"

- *Pantoscopic tilt:*
- *Face form:*

- Poorly fitting frames:
  - Frames that are too tight on a child's cheeks or those that pinch behind their ears will not be comfortable.
  - Nose pads that are not adjusted appropriately or missing will be uncomfortable.

III. Behavioral Issues

- Behavioral problems of the child may limit success with glasses.
- Sometimes children just do not like the color or style of their frames anymore or they do not want to wear them anymore due to peer pressure from classmates.
- In addition, some patients with Down syndrome or pediatric patients with sensory integration disorders such as autism spectrum disorder may have difficulty adjusting to glasses.
- Discuss with a co-managing occupational therapist to see if the glasses can be integrated into their therapy session or look for additional strategies that might increase compliance.

IV. There Is a Change in the Child's Refraction, a Binocular Vision Disorder, or a New or Previously Undetected Eye Problem

- Repeat the cycloplegic refraction and subjectively manifest if the patient is able.
- Consider cycloplegic eye drops to help the child adjust/accept the hyperopic correction.
- Rule out a binocular vision disorder or accommodative dysfunction.
- Perform a dilated eye exam to rule out ocular health changes.