Behavioral optometry

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History and development of behavioral optometry (BEHO)

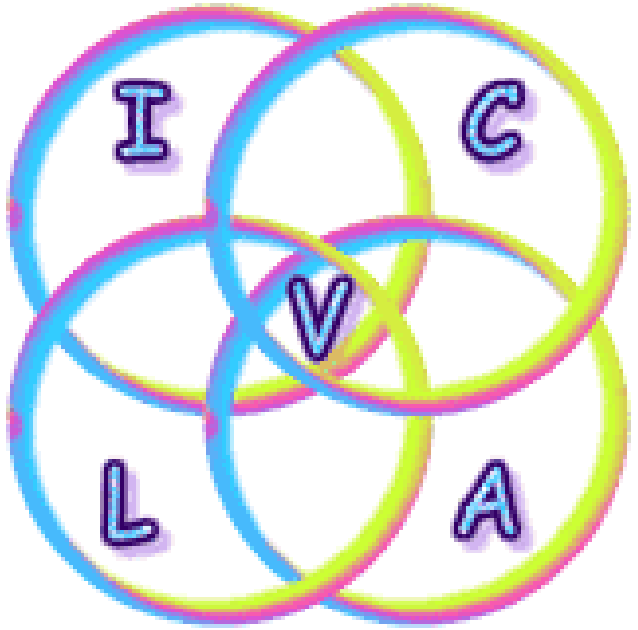
- BEHO is known as the functional optometry and is widening of optometric practice which is used for treating of binocular vision disorders
- BEHO is using many methods of visual therapy (we can place it into alternative medicine)
- Some methods of BEHO have their origin in orthoptics, but is focused on patients without strabismus
- The founder of BEHO is A.M. Skeffington

Optometric Extension Program (OEP)

- Skeffington and E.B. Alexander are founders of so called Optometric Extension Program in 1928 which contain together 21 steps
- We suppose that low power of some visual functions have negative effect on vision quality
- OEP is also international organization (www.oepf.org) which deals with BEHO, post gradual education and edit Journal of Behavioral Optometry

Skeffington's vision model

- Four circle model of vision
  - Centering
  - Identification
  - Anti-gravity
  - Language
- There is connection between vision, brain and body



Source: http://visionhelp.wordpress.com

I. Binocular and accommodative test

Eye refraction

- We need maximal plus correction
- Use vertical prism for image dissociation
- Better eye you can make blurry with +0,25 till +0,75 D
- Adapt correction for far (infinity)

Cover test

- Instruments: Gulden fixation stick, fixation target, occlusion
- Set up: For near we use fixation stick, for far isolated optotype symbol
- Method: Unilateral and alternating. We can measure heterophoria with prismatic lens

Lateral phoria measurement with von Graefe technique

- Instruments: Phoropter or trial lens with frame, isolated symbol (6/9)
- Set up: You can use rotary Risley prism or prismatic bar, in front of right eye put 6 prism BD
- Method: Patient see two objects vertically deviated. Use horizontal prism to move this objects in one line vertically. The same do with objects in 40 cm

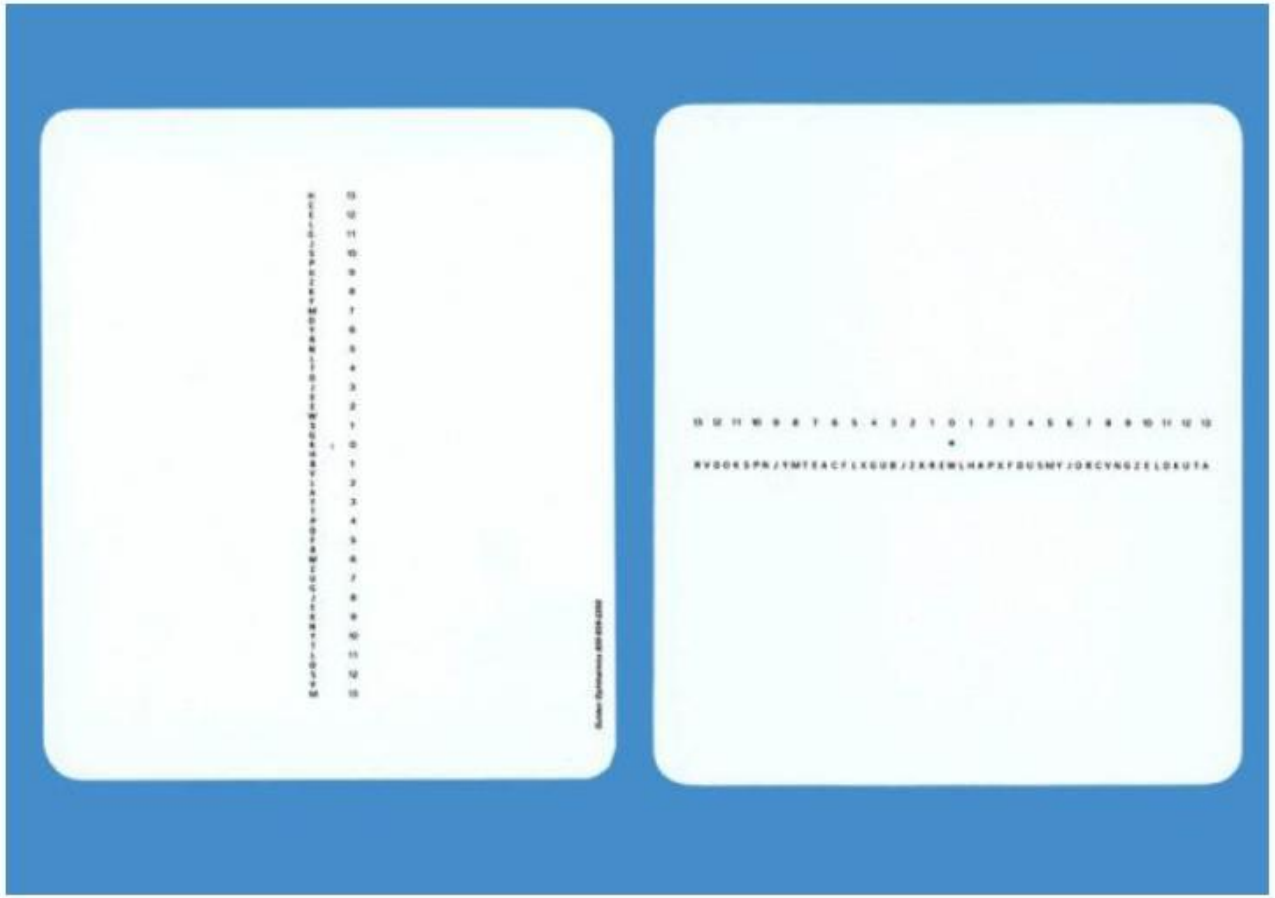
Vertical phoria measurement with von Graefe technique

- Instruments: Phoropter or trial lens with frame, isolated symbol (6/9)
- Set up: You can use rotary Risley prism or prismatic bar, in front of left eye put 12 prism BI and in front of right eye put 6 prism BD
- Method: Patient see two objects vertically deviated. Use vertical prism to move this objects in one line horizontally. The same do with objects in 40 cm

Modified Thorington test: Horizontal and vertical phoria in near

- Instruments: Light point source, Maddox cylinder, Thorington card
- Set up: Patient is using his correction for far, in 40 cm hold Thorington card, in center of car there is a hole
- Method: Firstly we measure horizontal phoria and then vertical phoria (Maddox cylinder is horintaly)

Modified Thorington test



AC/A measurement with von Graefe technique (Thorington card)

- Instruments: Phoropter, trial lenses, trial frame, isolated symbol
- Set up: We introduce isolated letter 40 cm in front of the patient, OS gets 12 prism BI and OD gets 6 prism BD
- Method: We change horizontal prism in vertical line, after that we introduce -1 D ODS and again change horizontal position of letters in vertical line. We expect value 4:1.

Horizontal vergences testing

- Instruments: Phoropter or prism bar, vertical near reading card
- Set up: We use far correction a test distance vergences, finally we will use near card
- Method: We increase prism up to blurring, diplopia and recovery in both direction

Vertical vergences testing

- Instruments: Phoropter, prism bar, near horizontal reading letter card
- Set up: We use far correction a test distance vergences, finally we will use near card
- Method: We increase prism up to blurring, diplopia and recovery in both direction

Vergence facility

- Instruments: Vergence prism (12 prism BO, 3 prism BI), fixating stick
- Set up: Do with habitual near correction
- Method: We change prism in front of one eye and counting cycles per minutes (cpm). Patient tries to maintain fusion. We expect 15 cpm

Negative and positive relative accommodation

- Instruments: Phoropter or trial frame and lenses, near vertical reading card
- Set up: Patient wears habitual far correction, near card is holding in 40 cm
- Method: Patient hold sharp and single image. We use plus lenses until blurry image or diplopia (NRA) and minus lenses until blurry image or diplopia (PRA)

Near point of convergence

- Instruments: Light source, fixation target, red-green glasses
- Set up: Patient uses habitual near correction, watching isolated symbol on fixation target in 40 cm
- Method: The target is slowly moving closer to patient until it is doubled, continuing in increasing fixating distance to make target sharp. We note break point and recovery point.

Stereopsis

- Instruments: Random dot stereotest, polarization glasses
- Set up: Patient watches test through polarization glasses from 40 cm
- Method: We ask which pictures rises from the reading level

Worth test

- Instruments: Worth test for near with red-green glasses
- Set up: Patient wears red-green glasses and holds Worth test in distance 33 cm
- Method: We make patient to watch test with right eye and then with the left eye, finally with both eyes

Accommodation amplitude – pull away method

- Instruments: Fixating target, occlusion
- Set up: Patients wears maximal plus distance correction and watches optotype letter
- Method: We move fixation target far from the patient until patient will see this clearly. Accommodation amplitude is reciprocal value of this distance in meters

Accommodation amplitude – minus lens method

- Instruments: Phoropter, distance glasses, near fixation target
- Set up: Fixation target is placed in 40 cm and testing is monocular
- Method: We introduce minus lenses monocularly until it is blurry. Used diopter (plus 2,5 D) shows accommodation amplitude

Accommodative facility

- Instruments: Fixation target, flipper +/- 2 D
- Set up: Patient wears habitual correction for near, fixation stick in 40 cm, binocular test
- Method: We introduce flipper with plus and minus lenses until patient announces clear object. We calculate cycles (two change = one cycle). Expected value is 11 cpm for patient form 13 to 30 years.

Monocular Estimation Method (MEM)

- Instruments: Habitual correction in near, retinoscope, MEM card, single spectacle lenses
- Set up: Patient is wearing habitual correction. Examiner is sitting in so called Harmon distance (typical reading distance, around 40 cm)
- Method: Patient is reading with both eyes. Examiner is looking for the red reflex movement. When is the movement of red reflex “with” it means accommodation lag. If the movement is “against” it means accommodation lead. Expecting values are +0,5 D (lag)

Fused crossed cylinder

- Instruments: Phoropter with Jackson’s cylinder (minus in 90 degrees) and grid test
- Set up: Examination in 40 cm, patient wears distance correction
- Method: If the horizontal line is sharper, patient has accommodation lag, we use +0,25 D until both lines are equally sharp

Oculomotor test with saccades

- Instruments: One fixation target in green and in red color
- Set up: Patient is sitting against the examiner with fixed head position. Examiner holds two fixation targets in mid level 20 cm separated
- Method: Examiner calls color of the stick 5 times and patient has to fixate. Examiner evaluates movements of the head, of the body and ability and exactness of the saccades

Oculomotor test for pursuits

- Instruments: Fixation stick or target
- Set up: Examiner is sitting in front of patient and gives no information about the eye movement. Fixation target is in 40 cm
- Method: Examiner is moving with fixation stick in front of patient noticing pursuits and evaluating movements of the head, of the body and ability and exactness of the pursuits

II. Analysis and classification of the cases

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A – Graphic analysis

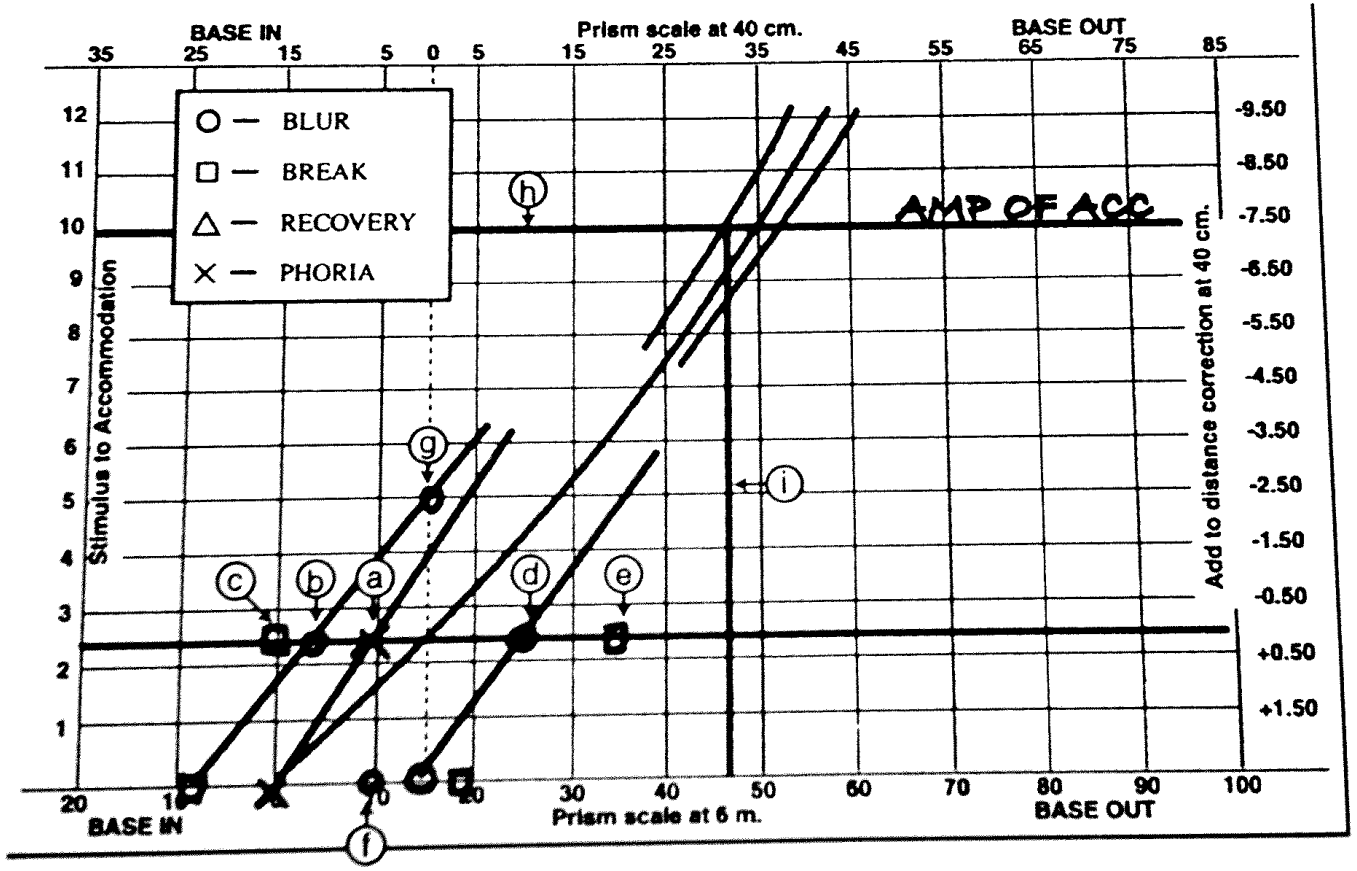


FIGURE 2.1 Sample graphical analysis worksheet showing the test findings that are commonly plotted: **(A)** the dissociated phoria, **(B)** base-in to blur, **(C)** base-in to break, **(D)** base-out to blur, **(E)** base-out to break, **(F)** NRA, **(G)** PRA, **(H)** amplitude of accommodation, and **(I)** near point of convergence.

Graphic analysis – plus/minus

- Plus:
  - There is possible to define area of the clear simple binocular vision, determine AC/A ratio, phorias, PRA, NRA, is possible to use Sheard's criterion (opposite size of fusion should be twice higher than phoria)
- Minus:
  - This method ignore accommodation facility, fusion ability, fixation disparity, MEM
  - There is no possibility to classify disorders of the binocular vision (e.g. accommodation excess, insufficiency)

B – Analytical attitude

- Developed thanks to EOP and contains
  - 21 examinations
  - Comparing measured values with the norm
  - Sorting data into groups
  - Identification and classification of the clinical status

Analytical attitude – EOP norms

TABLE 2.1 Optometric Extension Program Expected Findings

Test	Expected Finding
Distance lateral phoria	Ortho −0.5 exophoria
Near lateral phoria	6.0 exophoria
Base-out (distance)	Blur: 7 Break: 19 Recovery: 10
Base-in (distance)	Break: 9 Recovery: 5
Base-out (near)	Blur: 15 Break: 21 Recovery: 15
Base-in (near)	Blur: 14 Break: 22 Recovery: 18
Negative relative accommodation	+2.00
Positive relative accommodation	−2.25
Fused cross-cylinder	+0.50

Analytical attitude – pros/contras

- Pros:
  - Concept 1: Status of vision system is going worse during aging
  - Concept 2: Vision disorders can be reduced with exercises, prismatic correction etc.
- Contras:
  - EOP is difficult system which needs specific preparing (special education for proffesionals)

C – Morgan’s analysis

- This program was firstly introduced in 1944
- This analysis shows that on defected value from binocular vision system is not significant. Significant is when we detect more than one defected value from specific group of vision parameters

Morgan's analysis – excepted values

TABLE 2.2 Morgan's Table of Expected Findings

Test	Expected Finding	Standard Deviation
Distance lateral phoria	1 exophoria	±2 Δ
Near lateral phoria	3 exophoria	±3 Δ
AC/A ratio	4:1	±2 Δ
Base-out (distance)	Blur: 9	±4 Δ
	Break: 19	±8 Δ
	Recovery: 10	±4 Δ
Base-in (distance)	Break: 7	±3 Δ
	Recovery: 4	±2 Δ
Base-out (near)	Blur: 17	±5 Δ
	Break: 21	±6 Δ
	Recovery: 11	±7 Δ
Base-in (near)	Blur: 13	±4 Δ
	Break: 21	±4 Δ
	Recovery: 13	±5 Δ
Amplitude of accommodation		
Push-up	$18 - \frac{1}{3}$ age	±2.00 D
Fused cross-cylinder	+0.50	±0.50 D
Negative relative accommodation	+2.00	±0.50 D
Positive relative accommodation	−2.37	±1.00 D

Morgan's analysis – grouping of values

TABLE 2.3 Morgan's Three Groups

Group A data
Negative fusional vergence at distance–break
Negative fusional vergence at near–blur
Negative fusional vergence at near–break
Positive relative accommodation
Amplitude
Group B data
Positive fusional vergence at distance–blur and break
Positive fusional vergence at distance–blur and break
Binocular cross-cylinder
Monocular cross-cylinder
Near retinoscopy
Negative relative accommodation
Group C data
Phoria
AC/A ratio

Morgan’s analysis – pros/contras

- Pros:

  One abnormal parameter does not meter

- Contras:
  - This analysis missed evaluation of some parameters: accommodation ability, fusion ability, fixation disparity, MEM, oculomotor parameters

D – Analysis of fixation disparity

- Fixation disparity (FD) is small fixation deviation during binocular viewing. Usually it is only a few arc minutes
- For FD analysis we can use e.g. Mallet test, Wesson card or Disparometer
- Some authors thinks that FD is the best method for solving binocular problems

Fixation disparity – Mallett test

Fixation disparity analysis – pros/contras

- Pros:
  - Data are gained from binocular vision
- Contras:
  - Testing of FD brings no information about accommodation and oculomotor disorders

E – Integral analytical attitude

- Connects previous systems together and tries to eliminate their disadvantages
  - EOP: Visual system is worsening during ageing
  - Anomaly parameters analysis and their grouping according Morgan
  - Examination of FD during binocular conditions
  - Examination of accommodation and vergence facility, MEM, retinoscopy
- Contains 3 basic steps:
  - Comparing individual and normative data
  - Grouping of parameters and norms
  - Identification of syndrom

Integral analytical attitude - grouping

- Data are grouped into six categories according to visual function, which is tested

1. Positive fusion vergence tests
2. Negative fusion vergence tests
3. Accommodation system evaluation
4. Vertical fusion vergence evaluation
5. Oculomotor evaluation
6. Motoric evaluation and interaction

1 - Positive fusion vergence tests

- Positive fusion vergence (PFV) – soft testing
- PFV – step testing
- PFV – vergence facility
- NRA
- Binocular accommodative facility with plus lens
- NPC
- MEM
- Fused crossed cylinder

Positive fusion vergence (PFV) – soft/smooth testing

- Using phoropter or Risley prism softly growing base out
- Patient tries to see clearly target for far or near
- Measuring is stopped when patient see blurry or doubled target

PFV – step testing

- Using prism bar
- Results can be different in comparing with soft testing PFV, especially in children

PFV – vergence facility

- Using 40 cm distance (= 2,5 D)
- Patient holds vertical test
- We introduce 12 prism BO and 3 prism BI
- If the patient has diplopia probably is not able to use PFV

NRA

- Patient fixates near target
- Binocularly we introduce +0,25 D
- Patient tries to maintain clear target
- If we change accommodation we either change convergence, so we can expect diplopia
- We can do this test monocularly. If monocular NRA is higher problem is in PFV

Binocular accommodative facility with plus lens

- We test convergence when we change accommodation
- We introduce +2 D binocularly
- When patient has AC/A ratio 5:1, should use with +2 D binocularly 10 prism PFV

NPC

- Position of the NPC is influenced by many factors: accommodative convergence, proximal convergence and PFV
- Small value of NPC shows pathological value of PFV

MEM

- Using in binocular conditions
- Normal values are +0,25 to +0,5 D (lag)
- In patients with exophoria and low PFV we can expect low values of MEM (to zero)
- Some patients with exophoria can use accommodation and accommodation convergence to decrease the exophoria

Fused crossed cylinder

- On phoropter place Jackson’s crossed cylinders with minus axis into 90 degrees and use grid test
- Examination distance is 40 cm
- If the horizontal line is clear, patient has accommodation lag, we introduce +0,25 D lens until both lines are equal
- Or we accept the last plus lens before patient see vertical line clearly
- Expected values +0,5 accommodation lag for non-presbyopes

1 - Evaluation of PFV tests

- In patients with exophoria we usually measure lower values of these parameters (PFV)
- MEM and fused crossed cylinder shows usually higher values due to increased accommodation and convergence

2 - Negative fusion vergence tests

- Negative fusion vergence (NFV) – soft testing
- NFV – step testing
- NFV – vergence facility
- PRA
- Binocular accommodative facility with minus lens
- MEM
- Fused crossed cylinder

Negative fusion vergence (NFV) – soft testing

- Using phoropter or Risley prism adding prism BI until blurry or diplopia
- We expect decrease of accommodation due to decrease of vergence accommodation

NFV – step testing

- We use prism bars with BI prism

NFV – vergence facility

- We use 40 cm vertical test introducing 12 prism BO and 3 prism BI
- If it is doubled it shows problem with NFV
- If the target is blurry during measurement it shows that accommodative vergence helps to fusional vergence to keep single image

PRA

- Patient watch near target with distance correction. We introduce -0.25 D
- Accommodation is accompanied with increase of accommodative convergence and depend on AC/A ratio
- Patient has to decrease NFV value to maintain simple binocular vision
- If we cover one eye we can reveal if the problem is in PRA or in NFV

Binocular accommodative facility with minus lens

- We test change of convergence during the change of accommodation
- During patient watching near object we introduce -2 D
- These diopters start increase of accommodation convergence, which depends on AC/A ration
- The result can shows inadequate value NFV or disability to stimulate accommodation
- If we cover one eye and picture is still blurry it shows disorder of accommodation

MEM

- If we have low value of NFV we usually measure higher values MEM (more than 0.5 D)
- Patient try accommodate to maintain simple binocular image

Fusion crossed cylinder

- If we have low NFV values we usually measure high MEM values (more than 0.5 D)
- Patient is trying to accommodate to maintain single binocular image

2 - Evaluation of NFV tests

- Patients with esophoria shows lower NFV values
- MEM and fusion crossed cylinder shows contrarily higher values (lead, e.g. -0.5 D)

3 - Accommodation system evaluation

- Monocular accommodation amplitude
- Monocular accommodation facility with plus and minus lenses
- MEM retinoscopy
- Fusion crossed cylinder
- Binocular accommodation facility

3 - Accommodation system evaluation - introduction

- Accommodation is evaluated successfully during monocular conditions (is eliminated contamination of accommodation with binocular disorders)
- Test for PFV and NFV shows status of accommodation influenced by binocular system
- For example if the patient has low PRA value the cause should be in the insufficient accommodation or in esophoria
- We can confirm insufficient accommodation after revealing pathological NFV

Monocular accommodation amplitude

- Low monocular accommodation values shows accommodation insufficiency in pre-presbyopes
- Patient will low values of accommodation in all test when using accommodation
- Contrarily problem with relaxation of accommodation is not revealed if proper accommodation is measured

Monocular accommodation facility

- While changing plus and minus lenses we change accommodation
- We usually use +/- 2 D lenses
- We calculate cycles per minute (cpm)
- We can get 4 different results (next slide)

Monocular accommodation ability with +/- lenses - results

1. Adequate result in comparison with norms
2. Inadequate result with plus and minus lenses. It can influence other tests (e.g. PRA, NRA)
3. Adequate result with minus lenses and inadequate result with plus lenses shows high accommodation, spasm or excess accommodation
4. Adequate result with plus lenses and inadequate result with minus lenses shows problems with stimulation of accommodation. It could be accommodation insufficiency or ill-sustained accommodation

MEM retinoscopy

- MEM enables evaluate patient’s accommodation response
- Examination distance is 40 cm, expected values are +0.25 to +0.5 D
- Higher values shows accommodation lag, usually followed with low PRA
- Lower values (e.g. minus values) contrarily shows accommodative spasm or excess, usually followed with low NRA

Fusion crossed cylinder

- Higher values (more than +0.5 D) shows accommodation lag or accommodation insufficiency
- Lower values (less than 0 D) shows accommodation lead usually connected with accommodation spasm or excess

Binocular accommodation facility

- If the patient has normal binocular finding (phoria, PFV, NFV) test results (NRA, PRA, low cpm of accommodation facility) shows accommodation anomaly and problem with interaction between accommodation and vergence

3 - Accommodation system evaluation – final evaluation

- Accommodation is better to check monocularly
- The most sensitive are test which tests accommodation during time, e.g. accommodation facility

4 - Vertical fusion vergence evaluation

- Supravergence and infravergence
- Fixation disparity

Supravergence and infravergence

- Right infravergence is compensation mechanism of fusional vergence for right hyperdeviation
- Right supravergence is measured with prism BD in front of OD until patient will see objects doubled

Vertical fixation disparity

- Is the prism which reduces associated heterophoria in vertical direction

5 - Oculomotor evaluation

- Fixation status
- Saccades subjective evaluation according the scale
- Developmental eye movement test (DEM test)
- Subjective evaluation of pursuits according the scale

Fixation status

- Patient should fixate minimally 10 seconds

Saccades subjective evaluation according the scale

- Using oculomotoric test NSUCO (Northeastern State University College of Optometry)
- NSCUCO test:
  - Patient should fixate 2 objects in 40 cm. Both objects are moved 10 cm from medial line
- Evaluation:
  - Fixation ability (max 5 points during 5 movements)
  - Fixation exactness (max 5 points without fixation error)
  - Head and body movement (max 5 points without movement)

NSUCO test of saccades - scoring

Ability

Points	Observation
1	Completes less than two round-trips
2	Completes two round-trips
3	Completes three round-trips
4	Completes four round-trips
5	Completes five round-trips

Accuracy (Can the patient accurately and consistently fixate so that no noticeable correction is needed?)

Points	Observation
1	Large over- or undershooting is noted 1 or more times
2	Moderate over- or undershooting noted 1 or more times
3	Constant slight over- or undershooting noted (>50% of time)
4	Intermittent slight over- or undershooting noted (<50% of time)
5	No over- or undershooting noted

Head and body movement (Can the patient accomplish the saccade without moving his or her head?)

Points	Observation
1	Large movement of the head or body at any time
2	Moderate movement of the head or body at any time
3	Slight movement of the head or body (>50% of time)
4	Slight movement of the head or body (<50% of time)
5	No movement of head or body

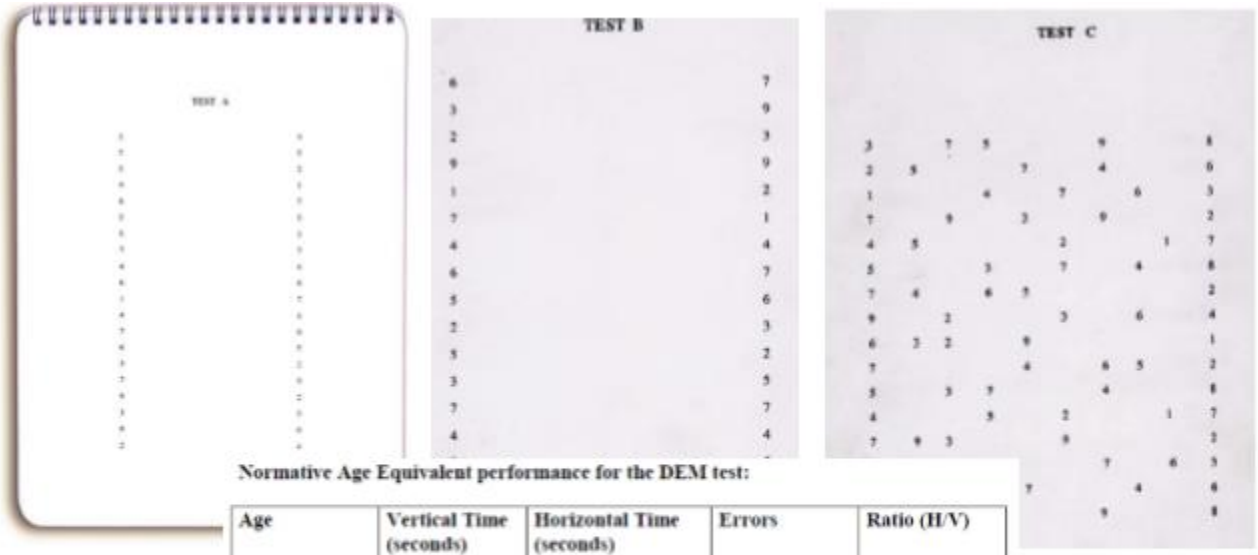
NSUCO test saccades – minimal criterion

	Ability		Accuracy		Head Movement		Body Movement	
Age	Male	Female	Male	Female	Male	Female	Male	Female
5	5	5	3	3	2	2	3	4
6	5	5	3	3	2	3	3	4
7	5	5	3	3	3	3	3	4
8	5	5	3	3	3	3	4	4
9	5	5	3	3	3	3	4	4
10	5	5	3	3	3	4	4	4
11	5	5	3	3	3	4	4	5
12	5	5	3	3	3	4	4	5
13	5	5	3	3	3	4	5	5
14 or >	5	5	4	3	3	4	5	5

Developmental eye test (DEM test)

- If the patient has problem with NSUCO test we use DEM test
- Patient has to read symbols form test as quick as possible without errors
- 80 letters vertically 80 horizontally. We calculate time. The result is ration between time for horizontal and vertical direction

DEM test – picture and table



Normative Age Equivalent performance for the DEM test:

Age	Vertical Time (seconds) Mean (S.D.)	Horizontal Time (seconds) Mean (S.D.)	Errors Mean (S.D.)	Ratio (H/V) Mean (S.D.)
6.0 - 6.11	63.11 (16.59)	98.26 (32.61)	15.22 (11.49)	1.58 (0.45)
7.0 - 7.11	54.83 (9.20)	87.94 (28.18)	12.50 (12.91)	1.60 (0.41)
8.0 - 8.11	46.76 (7.89)	57.73 (12.32)	4.61 (6.91)	1.24 (0.18)
9.0 - 9.11	42.33 (8.20)	51.13 (13.30)	2.17 (4.10)	1.21 (0.19)
10.0 - 10.11	40.28 (7.43)	47.64 (10.11)	1.91 (2.68)	1.19 (0.17)
11.0 - 11.11	37.14 (5.42)	42.62 (7.61)	1.68 (2.34)	1.15 (0.13)
12.0 - 12.11	35.14 (5.87)	39.35 (8.11)	1.11 (1.17)	1.12 (0.10)
13.0 - 13.11	33.75 (6.53)	37.56 (7.23)	1.61 (2.15)	1.12 (0.12)

Subjective evaluation of pursuits according the scale

- We use NSUCO test
- Examiner holds fixation object in 40 cm and makes circles with diameter around 20 cm clockwise twice and than twice counterclockwise
- Result:
  - Fixation ability (max 5 points during 5 movements)
  - Fixation exactness (max 5 points without fixation error)
  - Head and body movement (max 5 points without movement)

NSUCO test – score for pursuits

TABLE 1.10 NSUCO Scoring Criteria: Direct Observation of Pursuits

Ability

Points	Observation
1	Cannot complete 1/2 rotation in either clockwise or counterclockwise direction
2	Completes 1/2 rotation in either direction
3	Completes one rotation in either direction but not two rotations
4	Completes two rotations in one direction but less than two rotations in the other direction
5	Completes two rotations in each direction

Accuracy (Can the patient accurately and consistently fixate so that no noticeable refixation is needed when doing pursuits?)

Points	Observation
1	No attempt to follow the target or requires greater than 10 refixations
2	Refixations 5 to 10 times
3	Refixations 3 to 4 times
4	Refixations 2 times or less
5	No refixations

Head and body movement (Can the patient accomplish the pursuit without moving his or her head?)

Points	Observation
1	Large movement of the head or body at any time
2	Moderate movement of the head or body at any time
3	Slight movement of the head or body (>50% of time)
4	Slight movement of the head or body (<50% of time)
5	No movement of head or body

NSUCO test – criterion for pursuits

TABLE 1.11 NSUCO Pursuit Test Minimal Acceptable Score by Age and Sex (>1 standard deviation from mean)

	Ability		Accuracy		Head Movement		Body Movement	
Age	Male	Female	Male	Female	Male	Female	Male	Female
5	4	5	2	3	2	3	3	4
6	4	5	2	3	2	3	3	4
7	5	5	3	3	3	3	3	4
8	5	5	3	3	3	3	4	4
9	5	5	3	4	3	3	4	4
10	5	5	4	4	4	4	4	5
11	5	5	4	4	4	4	4	5
12	5	5	4	4	4	4	5	5
13	5	5	4	4	4	4	5	5
14 or >	5	5	5	4	4	4	5	5

6 - Motoric evaluation and interaction

- Test for phoria values and direction
- Fixation disparity
- AC/A ratio

Test for phoria values and direction

- You can use Maddox test, Thorington test or Graefe technique
- You should measure direction and value of the phoria for distance and near
- Distance phoria is usually caused by error of tonic vergence
- Near phoria depends on AC/A ration
- Phoria is compensated with fusion vergences
  - For exophoria compensator is PFV
  - For esophoria NFV
  - For right hyperdeviation right infravergence

Fixation disparity

- The main advantage is that testing is realized during binocular conditions

AC/A ratio

- AC/A ratio shows relationship between distance and near deviation
- AC/A influences solving of binocular vision disorder

Visual disorders classification and syndrome identification

Binocular anomalies – classification

- Duan's classification
  - Convergence insufficiency
  - Convergence excess
  - Divergence insufficiency
  - Divergence excess
- This classification is not suitable because there are no groups with same deviation for far and near
- Wick shows classification with groups according vergences (distance phoria) and AC/A ratio
- Nine possible groups are connected with vertical anomalies and accommodative anomalies according Duke-Elder and Abrams (p.73)

Binocular anomalies - table

TABLE 2.4 Classification of Binocular, Accommodative, and Ocular Motor Anomalies

Binocular anomalies

Low AC/A ratio

1. Orthophoria at distance–convergence insufficiency
2. Exophoria at distance–convergence insufficiency
3. Esophoria at distance–divergence insufficiency

Normal AC/A ratio

1. Orthophoria at distance–fusional vergence dysfunction
2. Exophoria at distance–basic exophoria
3. Esophoria at distance–basic esophoria

High AC/A ratio

1. Orthophoria at distance–convergence excess
2. Esophoria at distance–convergence excess
3. Exophoria at distance–divergence excess

Vertical anomalies

1. Right or left hyperphoria

Accommodative anomalies

1. Accommodative insufficiency
2. Ill-sustained accommodation
3. Accommodative excess
4. Accommodative infacility

Ocular motor anomalies

1. Ocular motor dysfunction

Category 1: Binocular disorders with low AC/A

1. Ortophoria at distance – convergence insufficiency
2. Exophoria at distance – convergence insufficiency
3. Esophoria at distance – divergence insufficiency

1 - Ortophoria at distance – convergence insufficiency

- Patient has normal tonic vergence and low AC/A
- The result is intermediate or high exophoria at near
- Symptoms: Asthenopia, headaches, blurry vision and diplopia, symptoms are worse on afternoon
- Signs: Near exophoria, reduced PFV at near, reduced vergence facility with prism base out, intermittent near suppression, low AC/A, fail accommodation facility with +2 D, low MEM and FCC (fusion crossed cylinder), low NRA and fixation disparity

2 - Exophoria at distance – convergence insufficiency

- Low tonic vergence and low AC/A
- Symptoms: Asthenopia, headache, blurry vision, diplopia, symptoms are worse in the evening, impossible to concentrate
- Signs: Near phoria is greater than distance phoria, reduced PFV on far and near, reduced vergence facility far and near with prism base out, intermittent near suppression, prolonged NPC, low AC/A, impossible to pass through test of accommodation facility with +2 D, low MEM and FCC, low NRA, exo-disparity for far and near.

3 - Esophoria at distance – divergence insufficiency

- Patient has esophoria for distance (high tonic vergence) and low AC/A, far phoria is greater than near phoria
- Symptoms: Distance asthenopia, intermittent blurry vision and diplopia, symptoms worsening in the evening
- Signs: Distance esophoria is greater than near, reduced distance NFV, reduced vergence facility with prism base in, distance eso-fixation disparity

Category 2: Binocular disorders with normal AC/A

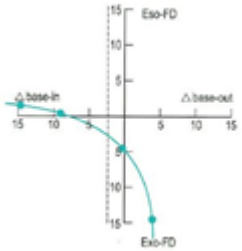
1. Ortophoria at distance – fusional vergence dysfunction
2. Exophoria at distance – basic exophoria
3. Esophoria at distance – basic esophoria

1 - Ortophoria at distance – fusional vergence dysfunction

- Patient has distance and near orthophoria and decreased fusion reserves
- Symptoms: Asthenopia, blurry vision, symptoms are worsening during the day, eye itching and lacrimation, problem with concentration, slow reading
- Signs: Distance and near orthophoria, reduced PFV and NFV, low PRA and NRA, low binocular accommodation with +/- lenses, normal monocular accommodation facility

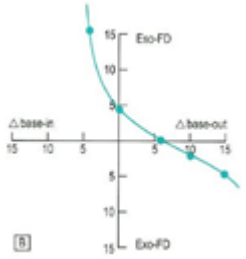
2 - Exophoria at distance – basic exophoria

- Normal AC/A means the same value of exophoria for distance and near
- Symptoms: Asthenopia during distance and near working, intermittent blurring or diplopia for far and near, symptoms are worsening during the day
- Signs: The same exophoria for far and near, reduced PFV for far and near, reduced distance and near vergence facility with prism BO, low NRA, low binocular accommodation facility with plus lenses, low MEM and FCC, exo-disparity, type III of exo-disparity curve



3 - Esophoria at distance – basic esophoria

- Patient has esophoria for far and near, high tonic vergence and normal AC/A
- Symptoms: Asthenopia for far and near, intermittent blurring and diplopia for far and near, symptoms are worsening during the day
- Signs: Distance and near esophoria, reduced NFV at far and near, reduced vergence facility at far and near with prism BI, low PRA, low binocular accommodation facility with minus lenses, high MEM and FCC, eso-fixation disparity, type II fixation disparity curve



Category 3: Binocular disorders with high AC/A

1. Ortophoria at distance – convergence excess
2. Esophoria at distance – convergence excess
3. Exophoria at distance – divergence excess

1 - Ortophoria at distance – convergence excess

- Patient has distance orthophoria and high AC/A ratio
- Symptoms: Asthenopia, intermittent blurring and diplopia, symptoms are worsening during the day, itching and burning, problems with concentration, slow reading and text understanding
- Signs: Near esophoria, reduced near NFV, reduced near vergence facility with prism base in, low PRA, fail binocular accommodation facility with minus lenses, high MEM, eso-fixation disparity for near

2 - Esophoria at distance – convergence excess

- Patient has low or intermediate distance esophoria (high tonic vergence) and high AC/A. Near esophoria is higher than distance esophoria
- Symptoms: Asthenopia, intermittent blurring and diplopia, worsening during the day, itching and burning, inability to concentrate, decrease of text understanding
- Signs: Near esophoria is higher than distance esophoria, reduced distance and near NFV, reduced distance and near vergence facility with prism BI, low PRA, low binocular accommodation facility with minus lenses, high MEM, eso fixation disparity at far and near

3 - Exophoria at distance – divergence excess

- Patient has low distance exophoria (low tonic vergence) and high AC/A ratio. Distance exophoria is greater than near exophoria
- Symptoms: Eyes are in exo position, uncomfortable in near, children try to close one eye
- Signs: Greater distance exophoria than near, high AC/A ratio, suppression for distance, normal NPC, limited NFV, adequate PFV, problems with fusion, normal near stereopsis

Category 4: Vertical anomalies

- Usually are classified right or left hyperphoria
- Symptoms: Blurry vision, headaches, asthenopia, diplopia, dizziness in car, problems with concentration during reading
- Signs: Anomaly head position, hyperphoria, reduced PFV and NFV, reduced vergence facility at distance and near with prism BI and BO, VFV is usually low or contrarily high

Category 5: Accommodative anomalies

1. Accommodation insufficiency
2. Ill-sustained accommodation
3. Accommodation excess
4. Inertia of accommodation

1 - Accommodation insufficiency

- Symptoms: Similar like in presbyopia, blurry vision at near and discomfort, fatigue, problems with near working concentration
- Signs: Low accommodation amplitude, low PRA, problem with mono and binocular accommodative facility with minus lenses, near esophoria, high MEM and FCC

2- Ill-sustained accommodation

- Symptoms: Similar like in accommodation insufficiency, blurry vision, discomfort in near working, disability to concentrate at near
- Signs: Normal accommodation amplitude in first measurement, in repeated measurements is accommodative amplitude decreasing, low PRA, low mono and binocular accommodation facility with minus lenses (decreasing in time), near esophoria, high MEM and FCC

3 - Accommodation excess

- Symptoms: Asthenopia and headache at near work, intermittent blurring while near gaze
- Signs: Changing visual acuity, low value of against the rule astigmatism, low MEM and FCC, low NRA, near and sometimes also distance esophoria, low mono and binocular accommodation facility with plus lenses

4 - Inertia of accommodation

- Symptoms: Problems with clear vision from distance to near and vice versa, asthenopia at near work, difficulties with concentration and intermittent blurring during near working
- Signs: Difficulties with mono and binocular accommodation facility with plus and minus lenses, low PRA and NRA

Category 6: Ocular motor anomalies

- According to Scheimann (2002) are ocular motor anomalies connected with fixation, saccades and pursuits
- Symptoms: Rapid head movements, words and row skipping, slow reading, problems with reading of tables, difficulties during sport activities
- Signs: DEM score and NSUCO test score are worse than 15th percentil

Accommodative and non-strabismic binocular vision disorders - table

TABLE 2.5 Common Accommodative and Nonstrabismic Binocular Vision Disorders: Summary of Diagnostic Findings

Condition	Cover Test	AC/A Ratio	NPC	Vergence Amplitude	Vergence Facility	Stereopsis	Accommodative Amplitude	Binocular Accommodative Facility	Monocular Accommodative Facility	NRA and PRA	Monocular Estimation Method
Accommodative insufficiency	No predictable pattern	Normal	Normal	BO blur at near may be low	Normal	Normal	Low	Fails −	Fails −	Low PRA	High
Ill-sustained accommodation	No predictable pattern	Normal	Normal	BO blur at near may be low	Normal	Normal	Normal	Fails −	Fails −	Low PRA	High
Accommodative excess	No predictable pattern	Normal	Normal	BI blur at near may be low	Normal	Normal	Normal	Fails +	Fails +	Low NRA	Low
Accommodative infacility	No predictable pattern	Normal	Normal	BO and BI blur at near may be low	Normal	Normal	Normal	Fails +/−	Fails +/−	Low NRA and PRA	Normal
Convergence insufficiency	Exo > N	Low	Receded	Low BO	Low BO	Normal	Normal	Fails +	Normal	Low NRA	Low
Convergence excess	Eso >N	High	Normal	Low BI	Low BI	Normal	Normal	Fails −	Normal	Low PRA	High
Fusional vergence dysfunction	Low eso or low exo	Normal	Normal	Low BO and BI	Low BO and BI	Normal	Normal	Fails +/−	Normal	Low NRA and PRA	Normal
Divergence insufficiency	Eso >D	Low	Normal	Low BI at D	Low BI at D	Normal	Normal	Normal	Normal	Normal	Normal
Divergence excess	Exo >D	High	Normal	Low BO at D Low BI at N	Low BO at D Low BI at N	Normal	Normal	Normal	Normal	Normal	Normal
Basic exophoria	Equal exo at D and N	Normal	Normal	Low BO at D and N	Low BO at D and N	Normal	Normal	Fails +	Normal	Low NRA	Low
Basic esophoria	Equal eso at D and N	Normal	Normal	Low BI at D and N	Low BI at D and N	Normal	Normal	Fails −	Normal	Low PRA	High

NPC, near point convergence; NRA, negative relative accommodation; PRA, positive relative accommodation; BO, base-out; BI, base-in; N, near; D, distance.

Cases analysis with systematical approach

- During analysis of patients we can use algorithm, which can be described by the scheme
- We know typical symptoms and signs which are typical for binocular vision disorders
- It is important to evaluate so called non-functional etiology, which is not directly relate to binocular vision
- We have typical anamnesis questions for evaluation symptoms and signs of patients

Symptoms and signs following binocular disorders

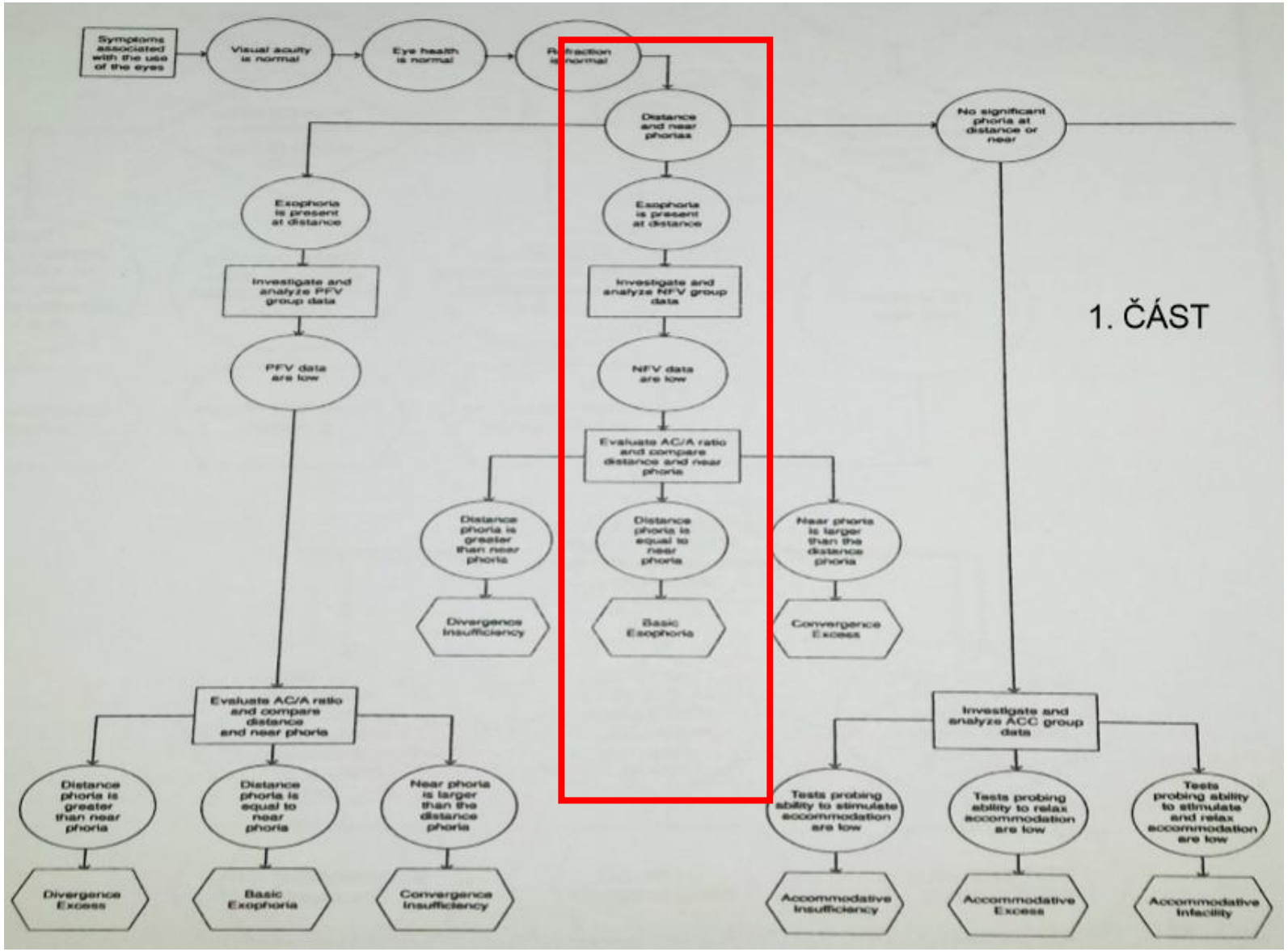
- Excessive blinking
- Eye pain and headache during near working
- Disability to concentrate for near working
- Intermittent diplopia
- Letters or row of letters skipping
- Sensitivity to light
- Blurry vision for far and near
- Low near distance
- One eye closing
- Slow reading
- Bad reading text understanding
- Head tilting

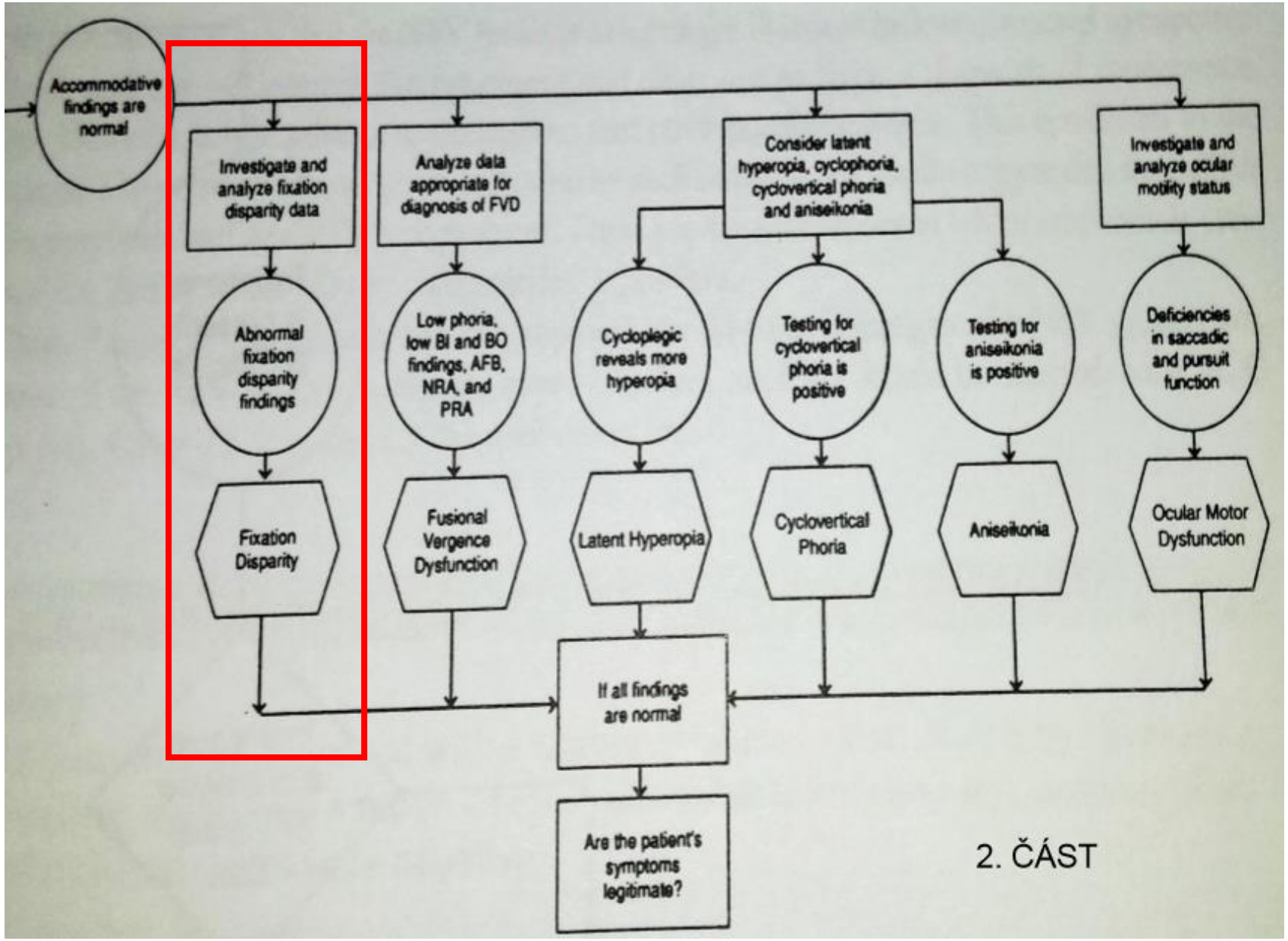
Non – functional etiology

- External eye evaluation (malformation)
- Pupillary reaction evaluation (direct, indirect)
- Swinging flashlight test
- Color vision
- Ophthalmoscopy
- Versions
- Cover test for distance, near and different gazing directions
- Visual field – confrontation test

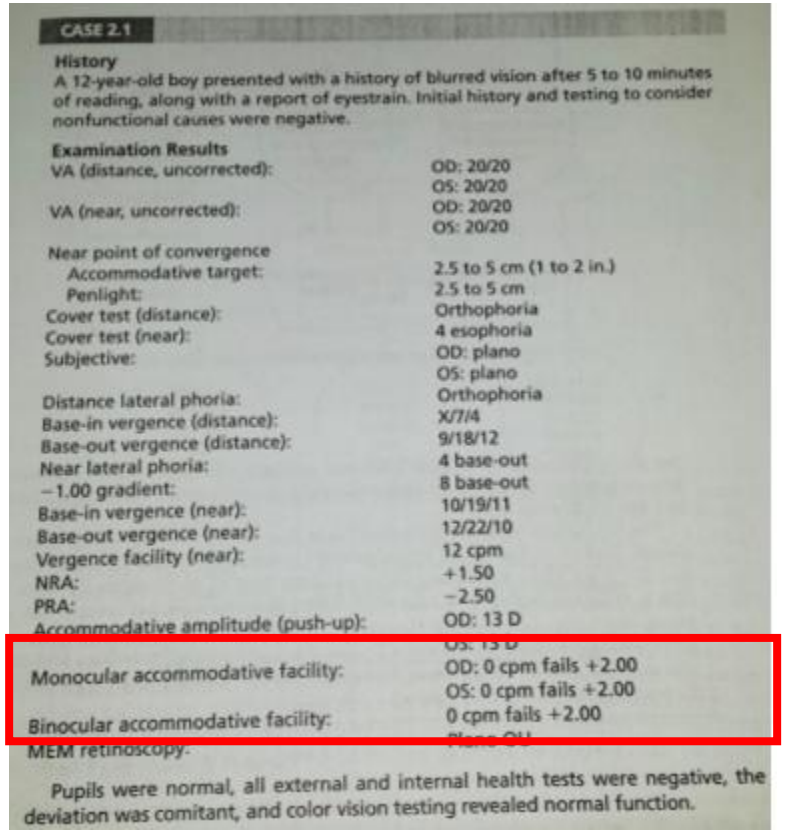
Questions from anamnesis

- When sings appears?
- Have you been sick recently?
- Have you taken some medical pills recently?
- Have you had change in your taste recently?
- Have you had some changes in sleeping recently?
- Have you changed your weight recently?
- Do you have swellings?
- Are problems worse morning or in the evening?
- Do you feel sick?
- Do you have headaches?
- Do you have weakness of muscles?


Symptoms associated with the use of the eyes
Visual acuity is normal
Eye health is normal
Distance and near phorias
No significant phoria at distance or near
Esophoria is present at distance
Investigate and analyze PFV group data
PFV data are low
Evaluate AC/A ratio and compare distance and near phoria
Distance phoria is greater than near phoria
Divergence Excess
Distance phoria is equal to near phoria
Basic Exophoria
Near phoria is larger than the distance phoria
Convergence Insufficiency
Esophoria is present at distance
Investigate and analyze NFV group data
NFV data are low
Evaluate AC/A ratio and compare distance and near phoria
Distance phoria is greater than near phoria
Divergence Insufficiency
Distance phoria is equal to near phoria
Basic Esophoria
Near phoria is larger than the distance phoria
Convergence Excess
Investigate and analyze ACC group data
Tests probing ability to stimulate accommodation are low
Accommodative Insufficiency
Tests probing ability to relax accommodation are low
Accommodative Excess
Tests probing ability to stimulate and relax accommodation are low
Accommodative Infacility
1. ČÁST


Accommodative findings are normal
Investigate and analyze fixation disparity data
Analyze data appropriate for diagnosis of FVD
Consider latent hyperopia, cyclophoria, cyclovertical phoria and aniseikonia
Investigate and analyze ocular motility status
Abnormal fixation disparity findings
Low phoria, low BI and BO findings, AFB, NRA, and PRA
Cycloplegic reveals more hyperopia
Testing for cyclovertical phoria is positive
Testing for aniseikonia is positive
Deficiencies in saccadic and pursuit function
Fixation Disparity
Fusional Vergence Dysfunction
Latent Hyperopia
Cyclovertical Phoria
Aniseikonia
Ocular Motor Dysfunction
If all findings are normal
Are the patient's symptoms legitimate?
2. ČÁST

Case 1



CASE 2.1

History
A 12-year-old boy presented with a history of blurred vision after 5 to 10 minutes of reading, along with a report of eyestrain. Initial history and testing to consider nonfunctional causes were negative.

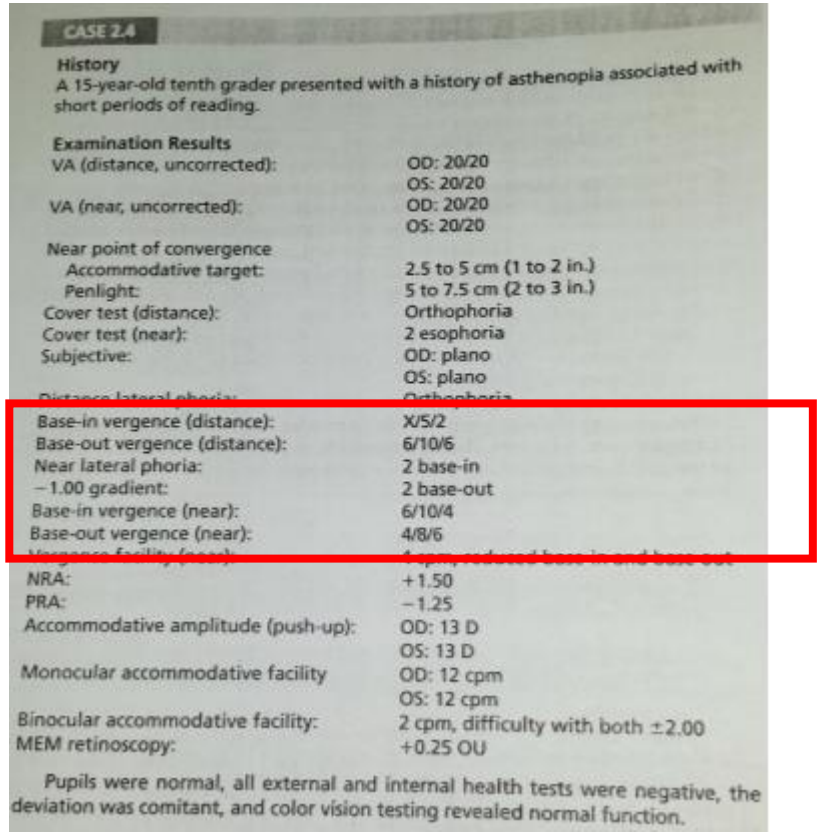
Examination Results

VA (distance, uncorrected):	OD: 20/20 OS: 20/20
VA (near, uncorrected):	OD: 20/20 OS: 20/20
Near point of convergence	
Accommodative target:	2.5 to 5 cm (1 to 2 in.)
Penlight:	2.5 to 5 cm
Cover test (distance):	Orthophoria
Cover test (near):	4 esophoria
Subjective:	OD: plano OS: plano
Distance lateral phoria:	Orthophoria
Base-in vergence (distance):	X/7/4
Base-out vergence (distance):	9/18/12
Near lateral phoria:	4 base-out
−1.00 gradient:	8 base-out
Base-in vergence (near):	10/19/11
Base-out vergence (near):	12/22/10
Vergence facility (near):	12 cpm
NRA:	+1.50
PRA:	−2.50
Accommodative amplitude (push-up):	OD: 13 D OS: 13 D
Monocular accommodative facility:	OD: 0 cpm fails +2.00 OS: 0 cpm fails +2.00
Binocular accommodative facility:	0 cpm fails +2.00
MEM retinoscopy:	Plano OU

Pupils were normal, all external and internal health tests were negative, the deviation was comitant, and color vision testing revealed normal function.

- Distance orthophoria
- Near esophoria
- Normal NFV and AC/A
- Disorder of the MAF and BAF shows probably on accommodation exces

Case 2



CASE 2.4

History
A 15-year-old tenth grader presented with a history of asthenopia associated with short periods of reading.

Examination Results

VA (distance, uncorrected):	OD: 20/20
	OS: 20/20
VA (near, uncorrected):	OD: 20/20
	OS: 20/20
Near point of convergence	
Accommodative target:	2.5 to 5 cm (1 to 2 in.)
Penlight:	5 to 7.5 cm (2 to 3 in.)
Cover test (distance):	Orthophoria
Cover test (near):	2 esophoria
Subjective:	OD: plano
	OS: plano
[illegible]	[illegible]
Base-in vergence (distance):	X/5/2
Base-out vergence (distance):	6/10/6
Near lateral phoria:	2 base-in
−1.00 gradient:	2 base-out
Base-in vergence (near):	6/10/4
Base-out vergence (near):	4/8/6
[illegible]	[illegible]
NRA:	+1.50
PRA:	−1.25
Accommodative amplitude (push-up):	OD: 13 D
	OS: 13 D
Monocular accommodative facility	OD: 12 cpm
	OS: 12 cpm
Binocular accommodative facility:	2 cpm, difficulty with both ±2.00
MEM retinoscopy:	+0.25 OU

Pupils were normal, all external and internal health tests were negative, the deviation was comitant, and color vision testing revealed normal function.

- Distance orthophoria
- 2 prism near esophoria
- PFV distance 6/10/6
- NFV distance X/5/2
- AC/A norm
- PFV near 4/8/6
- NFV near 6/10/4
- Low NFV and PFV shows fusion vergence disorder

III. General therapeutic attitude

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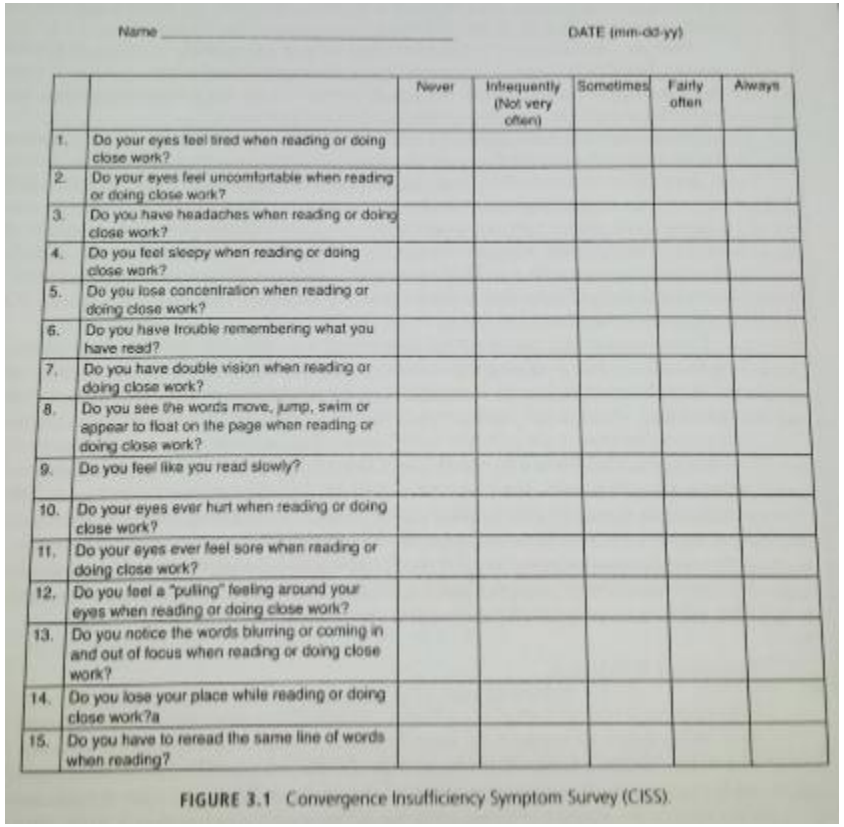
Difficulties definition and continuous therapy

- Questionnaires:
  - Convergence Insufficiency Symptom Survey (CISS)
  - College of Optometrists in Vision Development Quality of Life Outcomes Assessment (COVD-QOL)

Convergence Insufficiency Symptom Survey (CISS)



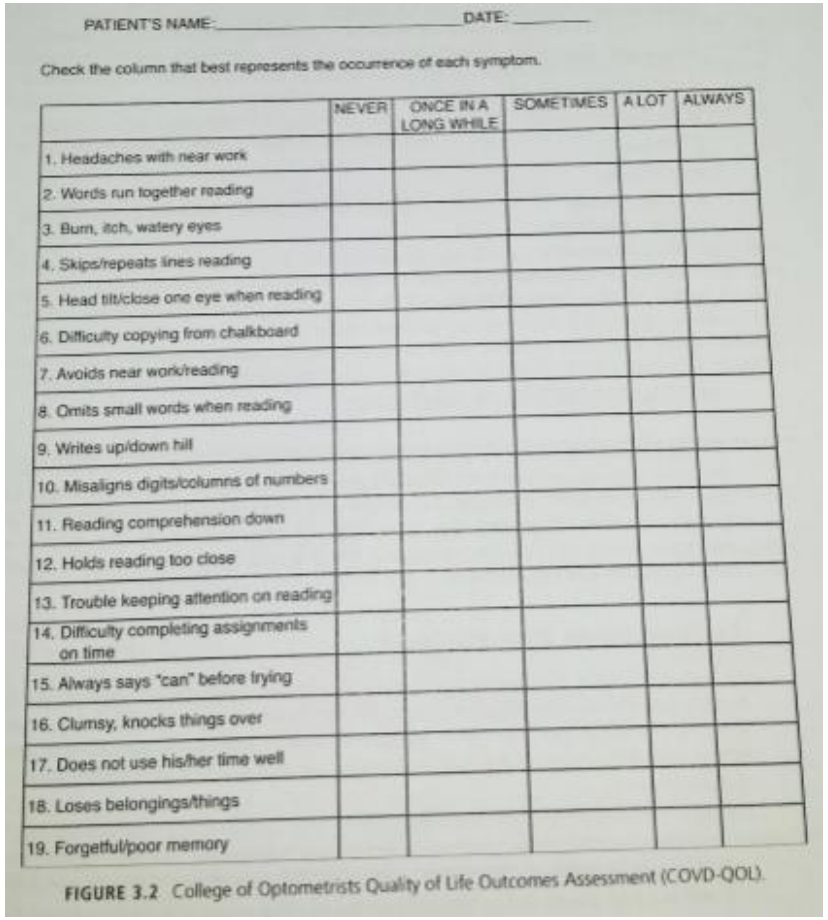
Name _____ DATE (mm-dd-yy)

		Never	Infrequently (Not very often)	Sometimes	Fairly often	Always
1.	Do your eyes feel tired when reading or doing close work?					
2.	Do your eyes feel uncomfortable when reading or doing close work?					
3.	Do you have headaches when reading or doing close work?					
4.	Do you feel sleepy when reading or doing close work?					
5.	Do you lose concentration when reading or doing close work?					
6.	Do you have trouble remembering what you have read?					
7.	Do you have double vision when reading or doing close work?					
8.	Do you see the words move, jump, swim or appear to float on the page when reading or doing close work?					
9.	Do you feel like you read slowly?					
10.	Do your eyes ever hurt when reading or doing close work?					
11.	Do your eyes ever feel sore when reading or doing close work?					
12.	Do you feel a "pulling" feeling around your eyes when reading or doing close work?					
13.	Do you notice the words blurring or coming in and out of focus when reading or doing close work?					
14.	Do you lose your place while reading or doing close work?a					
15.	Do you have to reread the same line of words when reading?					

FIGURE 3.1 Convergence Insufficiency Symptom Survey (CISS).

- Each answer has 0 to 4 points
- All answers with 0 points means without symptoms, 60 points means all symptoms
- The norm is less than 16 point for children bellow 17 years and below 21 points for older than 18 years

College of Optometrists in Vision Development Quality of Life Outcomes Assessment (COVD-QOL)



PATIENT'S NAME:_____ DATE: _____

Check the column that best represents the occurrence of each symptom.

	NEVER	ONCE IN A LONG WHILE	SOMETIMES	A LOT	ALWAYS
1. Headaches with near work					
2. Words run together reading					
3. Burn, itch, watery eyes					
4. Skips/repeats lines reading					
5. Head tilt/close one eye when reading					
6. Difficulty copying from chalkboard					
7. Avoids near work/reading					
8. Omits small words when reading					
9. Writes up/down hill					
10. Misaligns digits/columns of numbers					
11. Reading comprehension down					
12. Holds reading too close					
13. Trouble keeping attention on reading					
14. Difficulty completing assignments on time					
15. Always says "can" before trying					
16. Clumsy, knocks things over					
17. Does not use his/her time well					
18. Loses belongings/things					
19. Forgetful/poor memory					

FIGURE 3.2 College of Optometrists Quality of Life Outcomes Assessment (COVD-QOL).

- Scale from 0 to 4 points, maximum 76 points
- Score up to 20 points shows significant symptoms
- Questionnaire is possible to use before and after visual therapy

General therapeutic sequence in non-strabismic binocular anomalies

- Therapeutic sequence is influenced by AC/A and fusional vergence

1. Optical correction of refractive error
2. Using addition
3. Prism
4. Occlusion
5. Visual therapy
6. Surgery

1- Optical correction of refractive error – Refraction limits

- Significant refractive error which can cause symptoms is:
  - Hyperopia +1.5 D and more
  - Myopia -1 D and more
  - Astigmatism 1 D and more
  - Anisometropia 1 D and more sphere or cylinder

1- Optical correction of refractive error – Results of uncorrected refractive error

- Undercorrection or overcorrection can lead to:
  - Accommodative dysfunctions
  - High phoria or exhausting of the fusion reserve
  - Eye lateral disbalance disturb fusion
  - Decreased fusion makes the image blurry

1- Optical correction of refractive error – Cycloplegic refraction 1

- Usually we use objective and subjective refractive values
- In case of esophoria we expect latent hyperopia so we recommend cycloplegia
- For children over 3 years we use 1 gtt 0.5% of cyclopethanolate hydrochlorid with repetition every 5 minutes. After 40 minutes we are able to measure latent refraction

1- Optical correction of refractive error – Cycloplegic refraction 2

- In cycloplegia we reveal tonus of ciliary muscle
- After cycloplegic refraction we should finally subtract 0.75 D, i.e. less in plus lenses, and more in minus lenses

1- Optical correction of refractive error – Small refractive errors

- E.g. +0.25Dsph. Comb. -0.5Dcyl. Ax. 90
- So called small refractive errors can influenced patient’s comfort
- We should completely measure simple binocular vision and according the result we should decide pro or contra correction
- E.g. If the patient has small PFV with exophoria in near is recommended to correct such u error

1- Optical correction of refractive error – Anisometropia and aniseikonia

- Clinically significant is anisometropia 1 D
- Generally we try to correct anisometropia maximally (sharp image is important for the fusion)
- Some patient are sensitive for increasing of correction, so we should reduce this correction
- So called Knapp's law recommend use glasses for axial error and contacts for systemic error
- Increased anisometropia correction increases prism during peripheral gaze and disturb horizontal and vertical fusion vergence

2 – Using addition

- If we add plus lenses 1 D in patient with AC/A 12:1 we can decrease esophoria with 12 prism
- Contrarily in patient with far exophoria if we add minus lenses 1 D we can decrease exophoria
- AC/A value show us how many diopters we should add

2 – Using addition – add plus lenses

TABLE 3.2 Considerations for Prescribing Added Plus Lenses

Test	Consider the Use of Added Plus	Added Plus Not Indicated
AC/A ratio	High	Low
Refractive error	Hyperopia	Myopia
Near phoria	Esophoria	Exophoria
NRA/PRA	Low PRA	Low NRA
Base-out at near	Normal to high	Low
Monocular estimation method retinoscopy	High	Low
Amplitude of accommodation	Low	Normal
Accommodative facility testing	Fails minus	Fails plus

NRA, negative relative accommodation; PRA, positive relative accommodation.

2 – Using addition – add minus lenses

TABLE 3.3 Considerations for Prescribing Added Minus Lenses

Test	Consider the Use of Added Minus	Added Minus Not Indicated
AC/A ratio	High	Low
CA/C ratio	High	Low
Phoria	Exophoria	Esophoria
Base-in at near	Normal to high	Low
Amplitude of accommodation	Normal	Low
Accommodative facility	Fails plus	Fails minus
Testing		
Age	Younger than 6 yr	Age 9 yr or older

2 – Using addition – effect of plus lenses

TABLE 3.4 Example of the Effect of Plus Lenses on Test Results

***Given:* AC/A ratio = 8:1; if a +1.00 add is prescribed, it would be expected to lead to the following changes**

Test	Expected Change with +1.00
Near phoria	About 8 Δ less esophoria
Negative relative accommodation	Decrease of about 1.00 D
Positive relative accommodation	Increase of about 1.00 D
Base-out (near)	Decrease of about 8 Δ
Base-in (near)	Increase of about 8 Δ
Monocular estimation method retinoscopy	Decrease in +
Amplitude of accommodation	Increase of about 1.00 D
Accommodative facility testing	Better performance with −2.00

2 – Using addition – effect of minus lenses

TABLE 3.5 Example of the Effect of Minus Lenses on Test Results

Given: **AC/A ratio = 8/1; if a −1.00 add is prescribed, it would be expected to lead to the following changes**

Test	Expected Change with −1.00
Near phoria	About 8 Δ less exophoria
Negative relative accommodation	Increase of about 1.00 D
Positive relative accommodation	Decrease of about 1.00 D
Base-out (near)	Increase of about 8 Δ
Base-in (near)	Decrease of about 8 Δ
Monocular estimation method retinoscopy	Increase in +
Amplitude of accommodation	Decrease of about 1.00 D
Accommodative facility testing	Better performance with +2.00

2 – Using addition – when use the addition

- Plus lenses
  - Convergence excess
  - Basic esophoria
  - Accommodative insufficiency
  - Ill-sustained accommodation
- Minus lenses
  - High exophoria
  - Divergence exces

3 - Prism

- Bellow we mention situation when the prism can be used
  1. Horizontal relieving prism
  2. Vertical relieving prism
  3. Prism as the support for beginning of visual therapy
  4. Usage prism during the visual therapy
  5. Usage prism after visual therapy

3 – Prism: 1 – Horizontal relieving prism

- We use prism usually for decreasing fusion vergence or increasing of lower fusion vergence
- Prisms are effective in high tonic vergence or in esophoria for distance with normal or low AC/A
- Prism can be used during the visual therapy or without the visual therapy

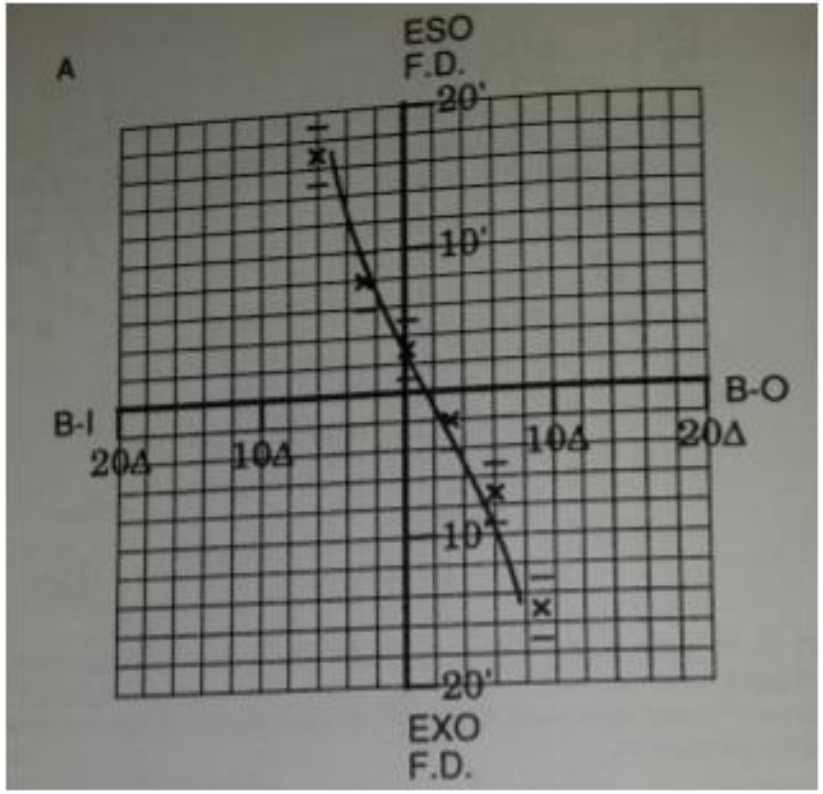
3 – Prism: 1 – Horizontal relieving prism - Results of studies

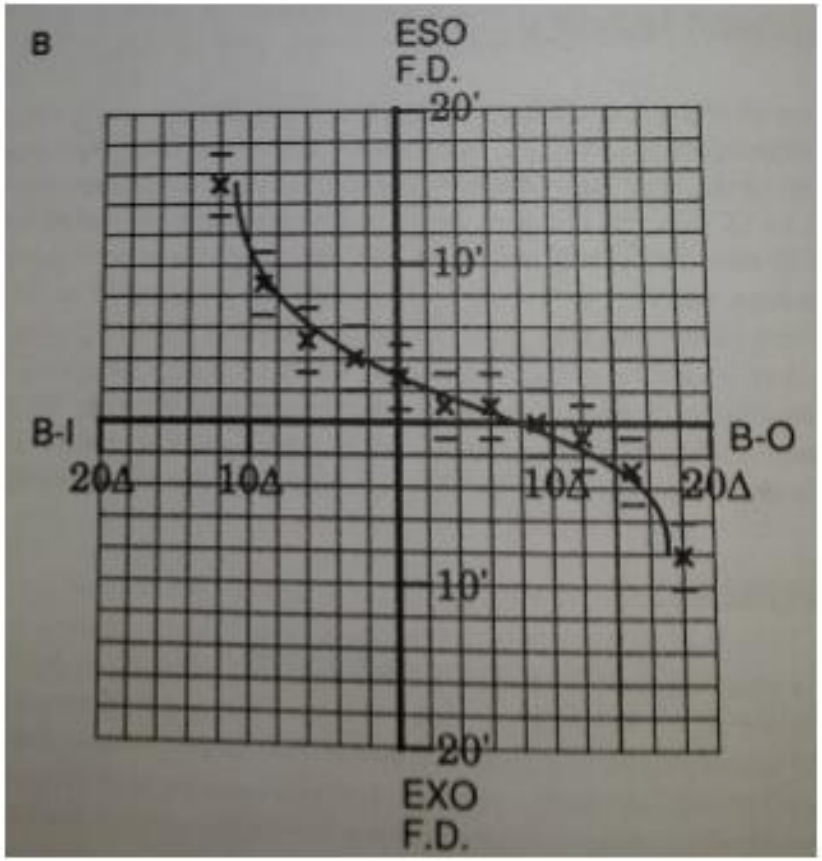
- Worrell ed al. (1971) found prism preference in low distance esophorie
- Stavis et al. (2002) identified asthenopic symptoms in patient with 2 weak wearing prism correction
- Scheiman et al. (2005) found difference between children with convergence insufficiency corrected with prism and with placebo
- O´Leary and Evans (2006) found in 58 patients with associated heterophoria from 0.5 to 2 prism no increasing of reading ability. Increasing was found in group with associated heterophoria form 2.5 to 3 prism

3 – Prism: 1 – Horizontal relieving prism - Fixation disparity analysis

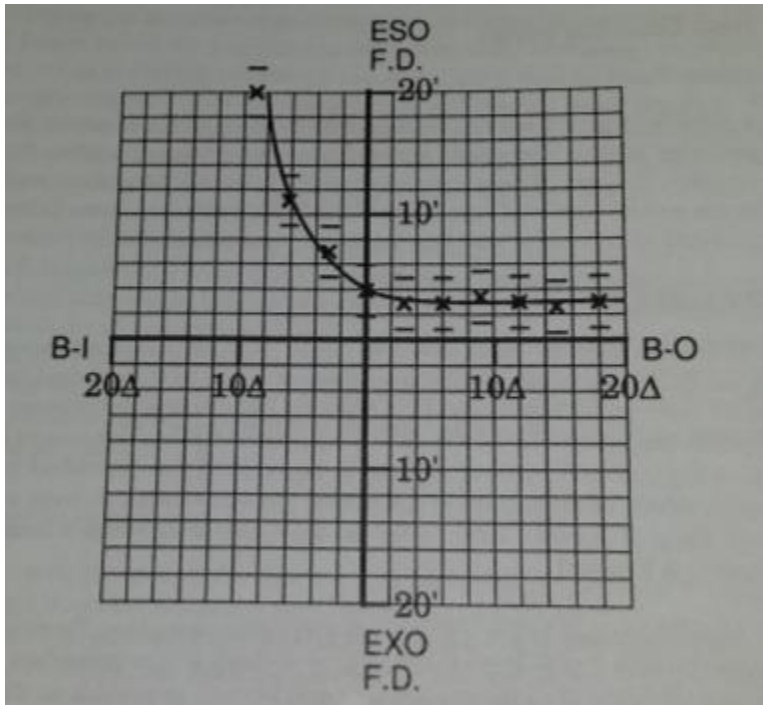
- This method is the most suitable for prescribing of relieving prism
- Prism value can be chosen according to
  - Amount of associated phoria
    - In case of steep fixation disparity curvature
  - Center of fixation disparity curve symmetry
    - In case of middle steep curve
  - Flat part of fixation disparity curve
    - We try to shift flat part of curve to axis ypsilon

Center of fixation disparity curve symmetry (in case of middle steep curve)





Flat part of fixation disparity curve - We try to shift flat part of curve to axis y



3 – Prism: 1 – Horizontal relieving prism - Sheard's criterion

- Sheard (1930) concluded that we need doubled value of opposite fusion vergence to eliminate the phoria
- We can you formula bellow:

Prism needed (P) $= \frac{2}{3}$ phoria $- \frac{1}{3}$ compensating fusional vergence.

For example, if a patient has 10 Δ of exophoria and the base-out to blur finding is 10 Δ, the amount of prism needed would be:

$$P = \frac{2}{3}(10) - \frac{1}{3}(10)$$

$$P = 6.67 - 3.33$$

$$P = 3.34\ \Delta$$

3 – Prism: 1 – Horizontal relieving prism - Percival's criterion

- This criterion is more effective in esophoria

According to Percival, the patient should be operating in the middle third of the vergence range. This is independent of the phoria and can be described by the following formula:

$$P = \frac{1}{3}G - \frac{2}{3}L$$

where

P = prism to be prescribed
G = greater of the two lateral limits (base-in or base-out)
L = lesser of the two lateral limits (base-in or base-out)

If P is a positive number, it represents the amount of prism to be prescribed. If it is zero or a negative number, prism is not required.

EXAMPLE 3.1

Phoria: 12 exophoria
Base-out vergence: 6/9/6
Base-in vergence: 18/24/21

$$P = \frac{1}{3}G - \frac{2}{3}L$$

$$P = \frac{1}{3}(18) - \frac{2}{3}(6)$$

$$P = 6 - 2$$
$$P = 4$$

4 Δ base-in would be required in this case because the deviation is exophoria.

3 – Prism: 1 – Horizontal relieving prism - Recommended application algorithm

- Primary we use prism in high distance tonic vergence (esophoria)
- In visual therapy if it is ineffective

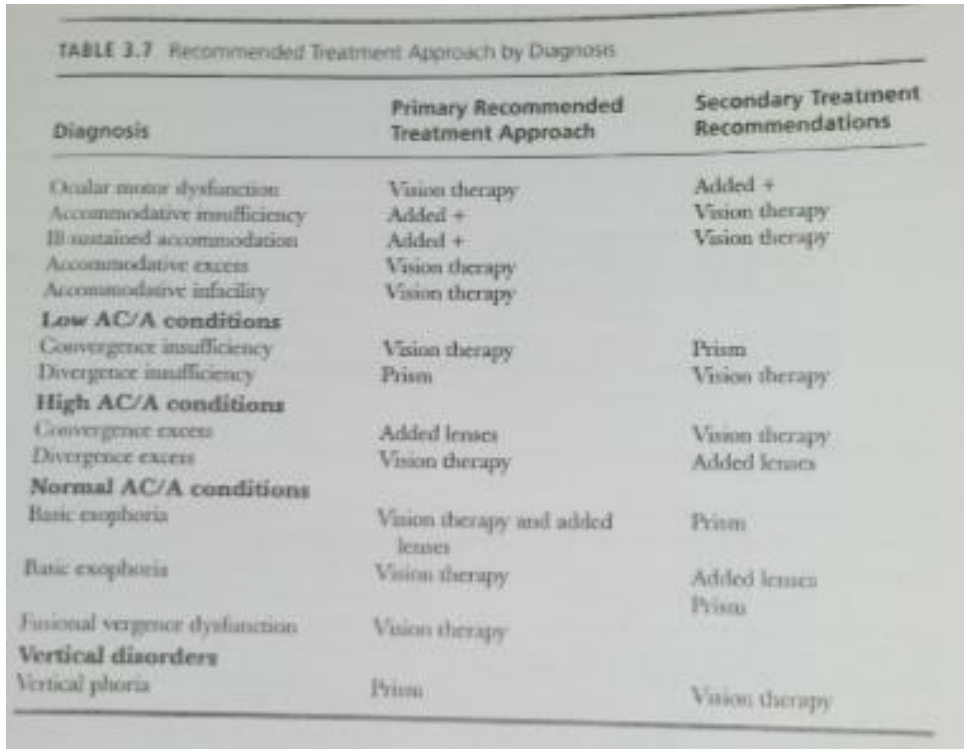


TABLE 3.7 Recommended Treatment Approach by Diagnosis

Diagnosis	Primary Recommended Treatment Approach	Secondary Treatment Recommendations
Ocular motor dysfunction	Vision therapy	Added +
Accommodative insufficiency	Added +	Vision therapy
Ill sustained accommodation	Added +	Vision therapy
Accommodative excess	Vision therapy	
Accommodative infacility	Vision therapy	
Low AC/A conditions		
Convergence insufficiency	Vision therapy	Prism
Divergence insufficiency	Prism	Vision therapy
High AC/A conditions		
Convergence excess	Added lenses	Vision therapy
Divergence excess	Vision therapy	Added lenses
Normal AC/A conditions		
Basic esophoria	Vision therapy and added lenses	Prism
Basic exophoria	Vision therapy	Added lenses Prism
Fusional vergence dysfunction	Vision therapy	
Vertical disorders		
Vertical phoria	Prism	Vision therapy

3 – Prism: 2 – Vertical relieving prism

- London and Wick (1987) found important effect of vertical prism on horizontal deviation
- Primary we should correct vertical deviation
- The most reliable method for measuring vertical prism is fixation disparity method or we can use Sheard's criterion

3 – Prism: 3 - Prism as the support for beginning of visual therapy

- Prism can be used as compensatory aid in high phoria or intermittent tropia during visual therapy
- For training we use prism base out in patient with low NFV

3 – Prism: 4 - Usage prism during the visual therapy

- If we have patient with bad compliance or visual therapy can not be used we can use prism

3 – Prism: 5 - Usage prism after visual therapy

- If the patient has problems with binocular vision after the visual therapy we can prescribe prismatic correction

4 - Occlusion

- This is typical therapy in strabismus – amblyopia, eccentric fixation, suppression with anomaly retinal correspondence
- We can use occlusion also in heterophoria with anisometropic amblyopia
- Studies shows effect of amblyopia therapy if is used 2 hours per day plus 1 hour of visual therapy in near (amblyopia less than 0.25)
- We can also use partial occlusion, e.g. in patients with high distance exotropia OD and low at near. On upper part of OD's visual field we put partial occlusion

5 – Visual therapy - usage

- Many patients with binocular disorders and disorders of accommodation are not preferred for spectacle lenses and prism therapy
- For spectacle lens and prism therapy are recommended patients with accommodative insufficiency, divergence insufficiency, convergence excess, basic esophoria or vertical phoria
- Visual therapy is recommended in patients with convergence insufficiency, divergence excess, fusion vergence dysfunction, basic exophoria, accommodative excess or insufficiency, or motor dysfunction

5 – Visual therapy – scientific background and effectiveness

- Visual therapy is effective in patients with accommodative, motor and non-strabismic binocular disorders
- Visual therapy reduces symptoms, increases accommodation amplitude and facility, eliminates accommodative spasm, improves near point of convergence, increases fusion vergence and facility, reduces suppression, increases stereopsis and exactness of the saccades and pursuits, improve fixation stability

5 – Visual therapy – when recommend the visual therapy?

1. Patient’s age and intelligence
2. Data analysis
3. Patient’s status definition and prognosis
4. Financial and economic view
5. Patient’s motivation
6. Relationship between symptoms and optometric findings
7. Time of particular therapy courses

5 – Visual therapy: 1 - Patient’s age and intelligence

- Visual therapy is not suitable for very young children
- Visual therapy needs patient’s concentration and attention
- Visual therapy is usually recommended from 6 years in patients with heterophoria and from 3 years for patient’s with strabismus and amblyopia.

5 – Visual therapy: 2 - Data analysis

- Very important is data analysis and their grouping
- Prisms are usable for patients with divergence insufficiency and vertical heterophoria. They also helps in esophoria or exophoria
- Spectacle lenses are suitable for accommodative disorders – accommodation insufficiency, excess, esophoria or divergence excess

5 – Visual therapy: 3 - Patient's status definition and prognosis

- Visual therapy solve all binocular disorders without divergence insufficiency
- Hoffman et al. (1973) showed success with visual therapy in 87 % of patients (n=80)
- Gallaway and Scheiman (1997) tested 83 patients with convergence excess. After visual therapy 84 % of patients had eliminated symptoms with increase of NFV
- Study form Wold et al. (1978) showed statistical important difference between saccades and pursuits in 100 patients before and after visual therapy

5 – Visual therapy: 4 - Financial and economic view

- Sometimes motivated and intelligent patients is not guarantee of non-problem therapy
- It depends also on financial possibilities of patient and their parents
- In some countries is possible to use some healthy insurance during the visual therapy

5 – Visual therapy: 5 - Patient’s motivation

- Patient’s motivation can increase but also decrease the prognosis during the visual therapy
- If there is bad motivation and cooperation with children we recommend to ask patient to motivate children at home before the therapy

5 – Visual therapy: 6 - Relationship between symptoms and optometric findings

- Generally the vision therapy is functional in non-strabismic, accommodative and motor disorders
- If we define precisely the problem, we can recommend specific solution
- E.g. Patient has headache with diplopia during reading. We found receded near point of convergence, near exophoria and reduced PFV
- On the other side there are no subjective symptoms (e.g. children with learning difficulties). Children have problems for example with accommodation avoiding reading and writing but have no symptoms

5 – Visual therapy: 7 - Time of particular therapy courses

- During the diagnosis we can reveal possible alternation to visual therapy, e.g. prism or spectacle correction
- If the alternative solution is quicker than visual therapy we can chose rather this solution
- Generally we can say that long-lasting visual therapy can be consider as the risk factor

6 – Surgery of the eye muscles

- Eye muscle surgery is not common solution of non-strabismic binocular disorders
- The conservative solution is usually unsuccessful if we measure phoria around 30 prism
- According Herman (1981) around 1 % from 1200 patients after orthoptics therapy after 10 years have still problems with vision and have to undergo surgery intervention

IV. Primary care of binocular vision, accommodation and monocular problems

- Page 118

IV. Primary care of binocular vision, accommodation and monocular problems - introduction

- Primary care in optometry means responsibility for visual and connected systemic disorder of the patient
- Optometrist should be educated not only in optometry but also in health care
- Table on the next page shows primary care in optometry and heterophoria

TABLE 4.1 Primary Care Heterophoria Examination and Treatment

Case history	High symptom scores on the CISS or VFS symptom questionnaires or complaints of eye strain, blurred vision, discomfort, double vision, loss of place, trouble sustaining, avoidance, and so forth, when symptoms are associated with visual tasks
Tonic vergence	Determine phoria magnitude and direction at distance with cover test or prism dissociation
AC/A ratio (calculated)	Determine whether AC/A ratio is high (more eso at near), normal (same distance and near), or low (more exo at near)

$$\text{Calculated AC/A} = \text{IPD(cm)} + \text{NFD(m)}\ (H_n - H_d)$$

	Low AC/A Ratio (<3Δ/D)			Normal AC/A Ratio (3 to 7Δ/D)			High AC/A Ratio (>7Δ/D)		
Distance phoria	Eso	Normal	Exo	Eso	Normal	Exo	Eso	Normal	Exo
Near phoria	Ortho	Exo	More Exo	Eso	Normal	Exo	More Eso	Eso	Ortho
Vergence assessment									
Base-out (distance)	y	y	**X**	y	y	**X**	y	y	**X**
Base-in (distance)	**X**	y	y	**X**	y	y	**X**	y	y
Supra and infra	Assess whether vertical phoria is seen on cover test OR whether symptoms exist (e.g., losing place when reading, getting on wrong line)								
Base-out (near)	z	**X**	**X**	y	y	**X**	y	y	z
Base-in (near)	z	y	y	**X**	y	y	**X**	**X**	z
NPC (amplitude)	y	**X**	**X**	**X**	**X**	**X**	**X**	**X**	y
Facility									
Near (12 BO/3 BI)	z	**X**	**X**	**X**	**X**	**X**	**X**	**X**	z
Associated phoria (lag)									
Horizontal	z	y	y	z	y	y	z	y	y
Vertical	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Comitance	y	y	y	y	y	y	y	y	y
Accommodation									
Amplitude (push-up)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Facility (scaled)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Lag (MEM)	**y**	**y**	**y**	**y**	**y**	**y**	**X**	**X**	**y**

Table continues on this page

low AC/A normal AC/A high AC/A

TABLE 4.1 *Continued*

Binocular status									
Stereopsis	y	y	y	y	y	y	y	y	y
Suppression	y	y	y	y	y	y	y	y	y
Treatment									
Best correction	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**
Added plus at near							+1.25	+1.25	+1.25
	+1.25 near addition if abnormal findings on accommodative testing								
Prism	**Prescribe BO prism equal to one third the distance phoria in esophoric patients**								
Horizontal	**BO**		Bl (b)	BO		Bl (b)	**BO**		Bl (b)
Vertical	**Prescribe vertical prism equal to associated phoria if symptoms exist (e.g., losing place when reading, getting on wrong line)**								
Home-based vision therapy	b	**A**	**A**	b	**A**	**A**	b	b	Refer for office based VT

CISS, Convergence Insufficiency Symptom Survey; VFS, Vision Function Scale; IPD, interpupillary distance (in cm); NFD, near fixation distance (in meters); H_p, near phoria, H_p, distance phoria (ins, +; exo, −); NPC, near point convergence; BO, base-out; Bl, base-in; MEM, monocular estimation method; VT, vision therapy.

Diagnosis: **X**, necessary diagnostic information; y, important at times; z, information that you may wish to gather.

Treatment: **A** or **bold**, necessary treatment; b, may be useful treatment.

IV. Primary care of binocular vision, accommodation and monocular problems – an overview

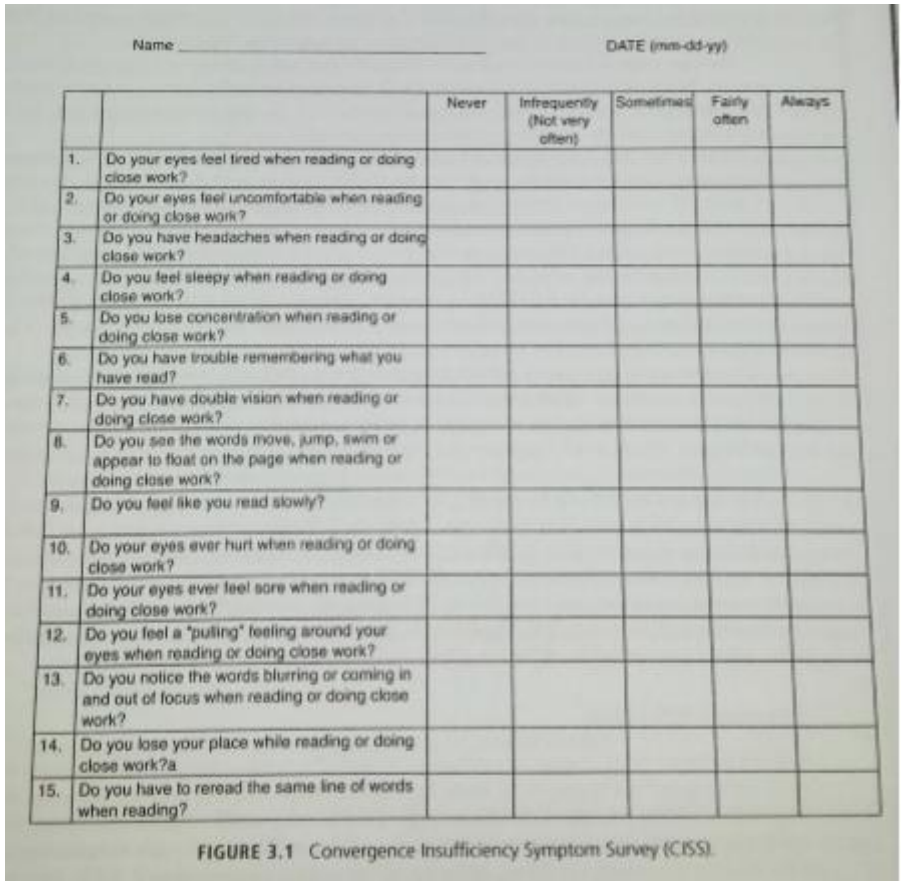
1. General diagnosis
2. Refractive error assessment
3. Non-strabismic binocular disorder assessment
4. Accommodative disorder assessment
5. Primary analysis of accommodative and non-strabismic disorder – an overview
6. General therapeutic guidelines – case histories

1 - General diagnosis

- For finding the diagnosis you can use some questionnaires, e.g. Convergence Insufficiency Symptom Survey (CISS), Vision Quality Scale (VQS). This questionnaires will help you chose binocular vision tests
- CISS questionnaire will help you define the value of symptoms in convergence insufficiency and intermittent exotropia

1 - General diagnosis – CISS questionnaire

- Use from 0 to 4 points, maximal count is 60 points which means totally symptomatic patient



Name _____ DATE (mm-dd-yy)

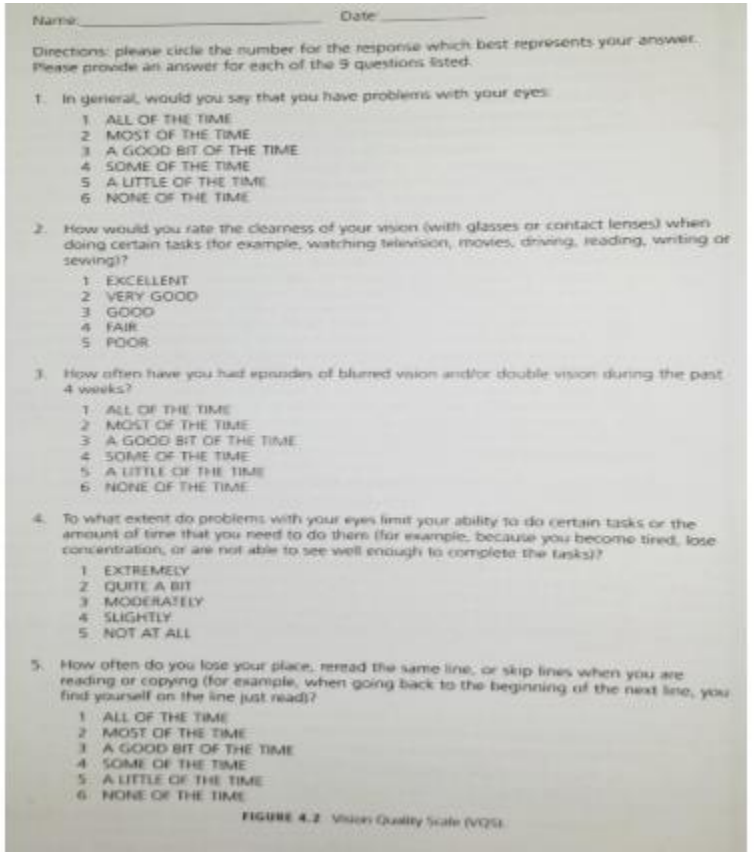
		Never	Infrequently (Not very often)	Sometimes	Fairly often	Always
1.	Do your eyes feel tired when reading or doing close work?					
2.	Do your eyes feel uncomfortable when reading or doing close work?					
3.	Do you have headaches when reading or doing close work?					
4.	Do you feel sleepy when reading or doing close work?					
5.	Do you lose concentration when reading or doing close work?					
6.	Do you have trouble remembering what you have read?					
7.	Do you have double vision when reading or doing close work?					
8.	Do you see the words move, jump, swim or appear to float on the page when reading or doing close work?					
9.	Do you feel like you read slowly?					
10.	Do your eyes ever hurt when reading or doing close work?					
11.	Do your eyes ever feel sore when reading or doing close work?					
12.	Do you feel a "pulling" feeling around your eyes when reading or doing close work?					
13.	Do you notice the words blurring or coming in and out of focus when reading or doing close work?					
14.	Do you lose your place while reading or doing close work?a					
15.	Do you have to reread the same line of words when reading?					

FIGURE 3.1 Convergence Insufficiency Symptom Survey (CISS).

1 - General diagnosis – Vision Function Scale (VFS)

- VSF is general tool for assessment of quality of binocular vision developed by McKeon (1997)
- This tool measures vision in patients with intermittent exotropia
- This questionnaire distinguishes patients with and without asthenopia
- Patient chooses one answer from 6 possible answers (from 0 to 6 points). These points are after that converted into percents
- Result lower than 71 % in patient older 8 years means symptomatic patient

1 - General diagnosis – Vision Function Scale (VFS) - Questionnaire



Name:_____ Date:_____

Directions: please circle the number for the response which best represents your answer. Please provide an answer for each of the 9 questions listed.

1. In general, would you say that you have problems with your eyes:
   1 ALL OF THE TIME
   2 MOST OF THE TIME
   3 A GOOD BIT OF THE TIME
   4 SOME OF THE TIME
   5 A LITTLE OF THE TIME
   6 NONE OF THE TIME

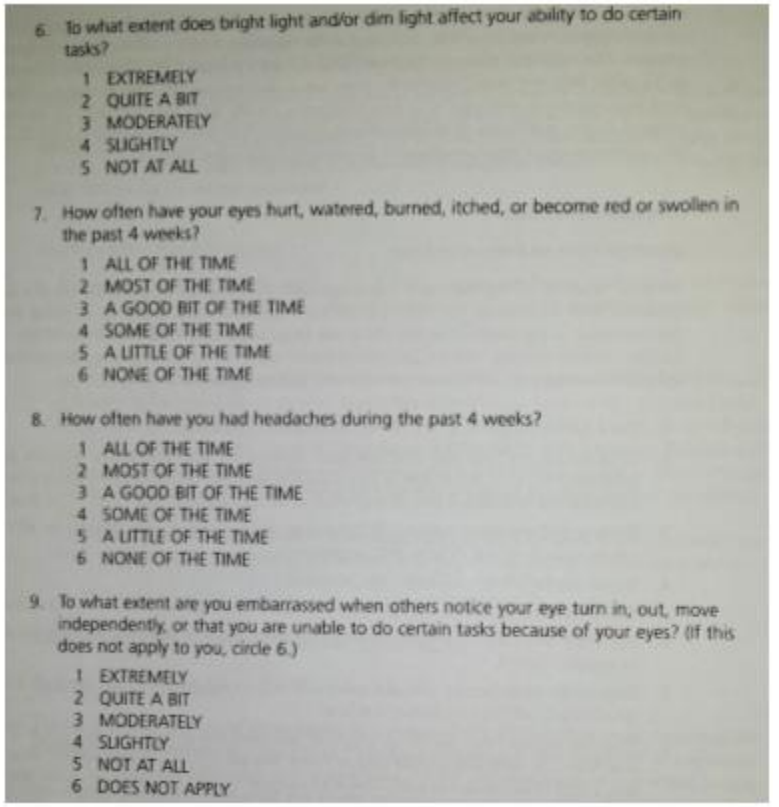
2. How would you rate the clearness of your vision (with glasses or contact lenses) when doing certain tasks (for example, watching television, movies, driving, reading, writing or sewing)?
   1 EXCELLENT
   2 VERY GOOD
   3 GOOD
   4 FAIR
   5 POOR

3. How often have you had episodes of blurred vision and/or double vision during the past 4 weeks?
   1 ALL OF THE TIME
   2 MOST OF THE TIME
   3 A GOOD BIT OF THE TIME
   4 SOME OF THE TIME
   5 A LITTLE OF THE TIME
   6 NONE OF THE TIME

4. To what extent do problems with your eyes limit your ability to do certain tasks or the amount of time that you need to do them (for example, because you become tired, lose concentration, or are not able to see well enough to complete the tasks)?
   1 EXTREMELY
   2 QUITE A BIT
   3 MODERATELY
   4 SLIGHTLY
   5 NOT AT ALL

5. How often do you lose your place, reread the same line, or skip lines when you are reading or copying (for example, when going back to the beginning of the next line, you find yourself on the line just read)?
   1 ALL OF THE TIME
   2 MOST OF THE TIME
   3 A GOOD BIT OF THE TIME
   4 SOME OF THE TIME
   5 A LITTLE OF THE TIME
   6 NONE OF THE TIME

FIGURE 4.2 Vision Quality Scale (VQS).



6. To what extent does bright light and/or dim light affect your ability to do certain tasks?
   1 EXTREMELY
   2 QUITE A BIT
   3 MODERATELY
   4 SLIGHTLY
   5 NOT AT ALL

7. How often have your eyes hurt, watered, burned, itched, or become red or swollen in the past 4 weeks?
   1 ALL OF THE TIME
   2 MOST OF THE TIME
   3 A GOOD BIT OF THE TIME
   4 SOME OF THE TIME
   5 A LITTLE OF THE TIME
   6 NONE OF THE TIME

8. How often have you had headaches during the past 4 weeks?
   1 ALL OF THE TIME
   2 MOST OF THE TIME
   3 A GOOD BIT OF THE TIME
   4 SOME OF THE TIME
   5 A LITTLE OF THE TIME
   6 NONE OF THE TIME

9. To what extent are you embarrassed when others notice your eye turn in, out, move independently, or that you are unable to do certain tasks because of your eyes? (If this does not apply to you, circle 6.)
   1 EXTREMELY
   2 QUITE A BIT
   3 MODERATELY
   4 SLIGHTLY
   5 NOT AT ALL
   6 DOES NOT APPLY

2 - Refractive error assessment

- Recommended procedure:
  - Use optotype’s row 0.6
  - Patient has covered OD, add +0.25 D on OS, if it not decreases visus use it. You can do the same procedure on other eye
  - Use JCC
  - Use vertical dissociating prism and add 0.25 D on better seeing eye. The goal is release the accommodation
  - Remove dissociating prism and add minus until patient see 1.0
  - Do the stereo test
  - Test visual acuity. If it is not better than 1.0 you can use minus lenses

3 - Non-strabismic binocular disorder assessment

- The phoria value and direction assessment
- AC/A calculation
- Vergence evaluation
- Near point of convergence
- Fixation disparity

3 - Non-strabismic binocular disorder assessment - The phoria value and direction assessment

- Cover test is an objective method to reveal the value and direction of phoria
- We expect 1 prism distance exophoria (tonic vergence) with SD 1 prism and 3 prism near exophoria with SD 3 prism

3 - Non-strabismic binocular disorder assessment - AC/A calculation

- AC/A value often influences the chose of therapeutic method, e.g. near esophoria with high AC/A ratio enables successfully use plus addition
- Expected values of AC/A are 6:1 with SD 2 prism

$$AC/A = IPD(cm) + NFD(m)\,(H_n - H_f)$$

where

IPD = interpupillary distance in centimeters
NFD = near fixation distance in meters
H_n = near phoria (eso is plus and exo is minus)
H_f = far phoria (eso is plus and exo is minus)

Example: IPD = 60 mm, the patient is 2 exophoric at distance and 10 exophoric at near (40 cm).

$$AC/A = 6 + 0.4(-10 + 2)$$
$$= 6 + 0.4(-8) = 6 + (-3.2)$$
$$= 2.8$$

3 - Non-strabismic binocular disorder assessment - Vergence evaluation

- Gall et al. (1998) recommends to use 3 prism BI and 12 prism BO to distinguish symptomatic patients
- As a fixation target we usually use vertical column of letters size 0.6

3 - Non-strabismic binocular disorder assessment - Near point of convergence

- We determine convergence amplitude
- It is recommended to examine twice. Ones with accommodative target and ones with light point with red filter in front of one eye

3 - Non-strabismic binocular disorder assessment – Fixation disparity

- The main advantage of this test is performing under real conditions (association test, fusion)
- This method is very suitable for vertical phoria measurement

4 - Accommodative disorder assessment - overview

- Accommodative amplitude determination (Hofstetter's rule)
- Accommodative facility determination
- Monocular estimation method (MEM)

TABLE 4.3 Table of Expected Findings: Accommodative Testing

Test	Expected Finding	Standard Deviation
Amplitude of accommodation		
Push-up test (minimum expected)	$15 - \frac{1}{4}$ age	±2 D
Binocular accommodative facility		
Children (±2.00 flippers, calling out numbers or letters on accommodative rock cards)		
8–12 yr old	5.0 cpm	±2.5 cpm
Age 13 to adult (Use lens power based on amplitude scaled testing)	10.0 cpm	±5.0 cpm
Test distance = 45% of amplitude; lens power range = 30% of amplitude		
Monocular estimation method (MEM) retinoscopy	+0.50 D	±0.25 D

4 - Accommodative disorder assessment – Accommodation amplitude

- We usually use push-up method
- We can use in front of both eyes minus 4 D which make measurement more exact
- Patient has to read letters until it is clear
- Disadvantage: There is not subjective equal letters size. Letters with size 0.6 pro 40 cm will be bigger if they are read from 10 cm (accommodation overestimation)

4 - Accommodative disorder assessment – Accommodation facility

- Yothers et al. (2002) recommends 2 diopters flipper form 40 cm to distinguish symptomatic patients
- We usually do this test binocularly (BAF). If it is not possible we can do it monocularly
- It is recommended to use binocular polarized test to control suppression (each eye sees different part of the test)

4 - Accommodative disorder assessment – Accommodation facility - Table

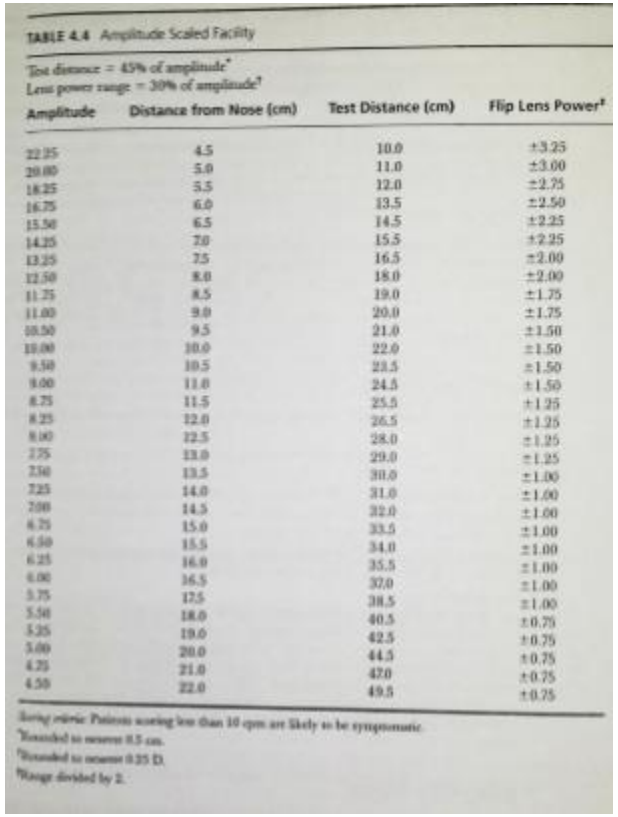


TABLE 4.4 Amplitude Scaled Facility

Test distance = 45% of amplitude*
Lens power range = 30% of amplitude†

Amplitude	Distance from Nose (cm)	Test Distance (cm)	Flip Lens Power‡
22.25	4.5	10.0	±3.25
20.00	5.0	11.0	±3.00
18.25	5.5	12.0	±2.75
16.75	6.0	13.5	±2.50
15.50	6.5	14.5	±2.25
14.25	7.0	15.5	±2.25
13.25	7.5	16.5	±2.00
12.50	8.0	18.0	±2.00
11.75	8.5	19.0	±1.75
11.00	9.0	20.0	±1.75
10.50	9.5	21.0	±1.50
10.00	10.0	22.0	±1.50
9.50	10.5	23.5	±1.50
9.00	11.0	24.5	±1.50
8.75	11.5	25.5	±1.25
8.25	12.0	26.5	±1.25
8.00	12.5	28.0	±1.25
7.75	13.0	29.0	±1.25
7.50	13.5	30.0	±1.00
7.25	14.0	31.0	±1.00
7.00	14.5	32.0	±1.00
6.75	15.0	33.5	±1.00
6.50	15.5	34.0	±1.00
6.25	16.0	35.5	±1.00
6.00	16.5	37.0	±1.00
5.75	17.5	38.5	±1.00
5.50	18.0	40.5	±0.75
5.25	19.0	42.5	±0.75
5.00	20.0	44.5	±0.75
4.75	21.0	47.0	±0.75
4.50	22.0	49.5	±0.75

[illegible] Patients scoring less than 10 cpm are likely to be symptomatic.
*Rounded to nearest 0.5 cm.
†Rounded to nearest 0.25 D.
‡Range divided by 2.

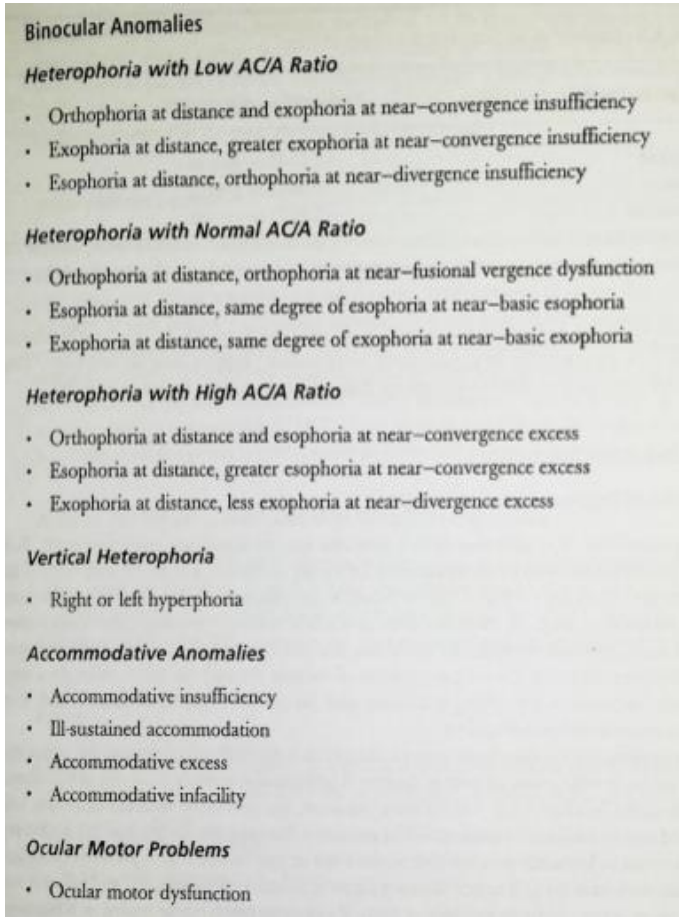
- Recommended test distance:
  - 145 % of accommodation amplitude in cm
- Recommended flipper power:
  - 30 % of accommodation amplitude in diopters

4 - Accommodative disorder assessment – MEM

- It is recommended to do it according the horizontal axis
- We usually do it binocularly
- We use normal room light
- With MEM we can also verify the value of estimated addition
- Expected values are from +0.25 to +0.5 D with SD 0.25 D. MEM values 0, minus values and plus values more than +0.75 are suspicious

5 - Primary analysis of accommodative and non-strabismic disorder – an overview

- It is recommended to use classification according to Duan improved by Wick (1987)
- We can distinguish 15 accommodative, motor and binocular disorders



Binocular Anomalies

Heterophoria with Low AC/A Ratio

- Orthophoria at distance and exophoria at near–convergence insufficiency
- Exophoria at distance, greater exophoria at near–convergence insufficiency
- Esophoria at distance, orthophoria at near–divergence insufficiency

Heterophoria with Normal AC/A Ratio

- Orthophoria at distance, orthophoria at near–fusional vergence dysfunction
- Esophoria at distance, same degree of esophoria at near–basic esophoria
- Exophoria at distance, same degree of exophoria at near–basic exophoria

Heterophoria with High AC/A Ratio

- Orthophoria at distance and esophoria at near–convergence excess
- Esophoria at distance, greater esophoria at near–convergence excess
- Exophoria at distance, less exophoria at near–divergence excess

Vertical Heterophoria

- Right or left hyperphoria

Accommodative Anomalies

- Accommodative insufficiency
- Ill-sustained accommodation
- Accommodative excess
- Accommodative infacility

Ocular Motor Problems

- Ocular motor dysfunction

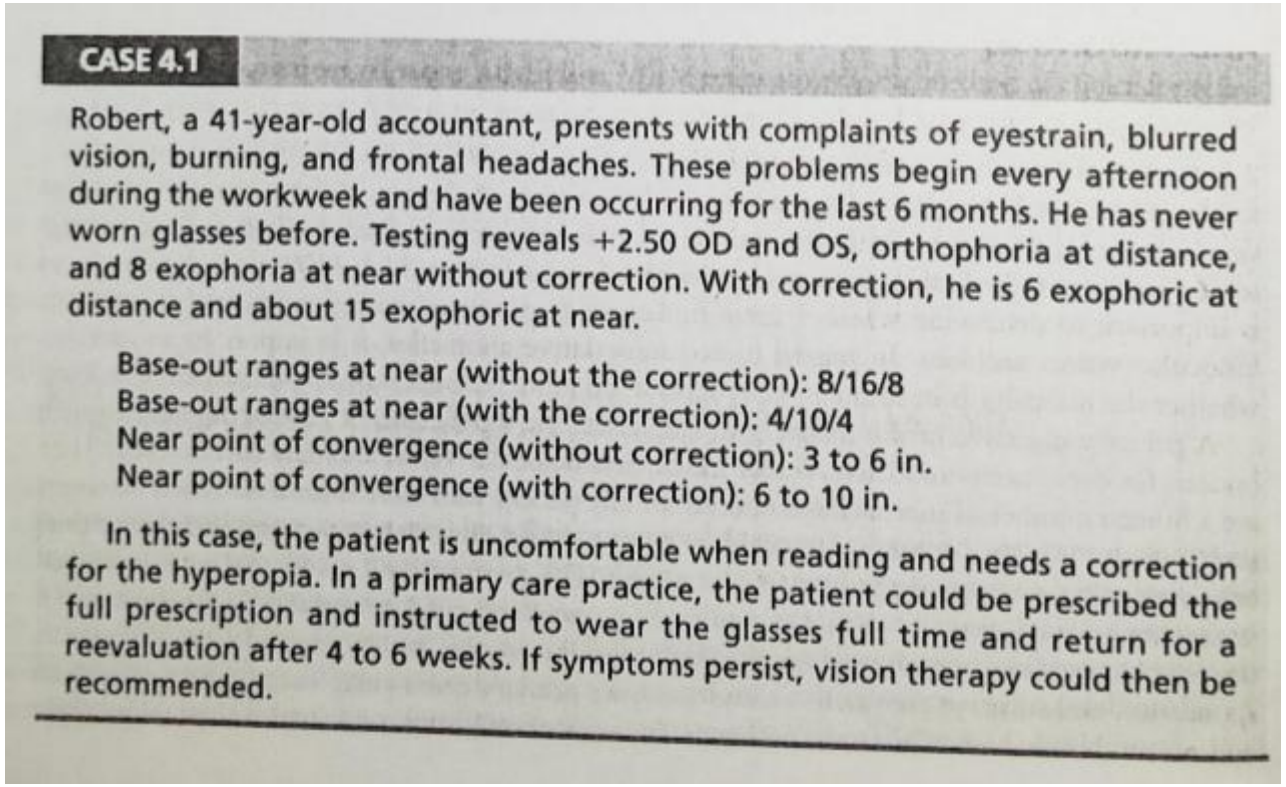
6 - General therapeutic guidelines – case histories

- At first we need to identify near and far phoria and AC/A ratio
- At the base of these results we distinguish accommodative, motor and binocular disorder
- Possible cases and their solution:
    1. Refractive error correction
    2. Prism
    3. Fixation disparity and vertical prism
    4. Passive therapy: occlusion and atropine
    5. Visual therapy
    6. Accommodative disorders

6 - General therapeutic guidelines: 1 – Refractive error correction

- At first we recommend adequate correction of refractive error to stabilize binocular vision
- We recommend to patient to use adequate correction of refractive error at least for 4 – 6 weeks
- It is possible that problem disappear with adequate correction. If it is not we recommend further solution
- For revealing of eye symptoms we distinguish significantly this refractive errors:
  - Hyperopia 1.5 D and more
  - Myopia 1 D and more
  - Astigmatism 1 D and more
  - Anisometropia 1 D and more on sphere or cylinder

6 - General therapeutic guidelines: 1 – Refractive error correction – Case history 1



CASE 4.1

Robert, a 41-year-old accountant, presents with complaints of eyestrain, blurred vision, burning, and frontal headaches. These problems begin every afternoon during the workweek and have been occurring for the last 6 months. He has never worn glasses before. Testing reveals +2.50 OD and OS, orthophoria at distance, and 8 exophoria at near without correction. With correction, he is 6 exophoric at distance and about 15 exophoric at near.

Base-out ranges at near (without the correction): 8/16/8
Base-out ranges at near (with the correction): 4/10/4
Near point of convergence (without correction): 3 to 6 in.
Near point of convergence (with correction): 6 to 10 in.

In this case, the patient is uncomfortable when reading and needs a correction for the hyperopia. In a primary care practice, the patient could be prescribed the full prescription and instructed to wear the glasses full time and return for a reevaluation after 4 to 6 weeks. If symptoms persist, vision therapy could then be recommended.

Prescription of full correction for hyperop

6 - General therapeutic guidelines: 1 – Refractive error correction – Add minus or plus

- We use it in patients with accommodative and binocular disorders
- The effect of influence of binocular vision is dependent on AC/A
- Mostly addition helps in convergence excess (we use add to decrease of near esophoria)
- If the AC/A ration is small we have to use prism
- Often we can also use so called E-lines bifocal lenses for correction of accommodative strabismus

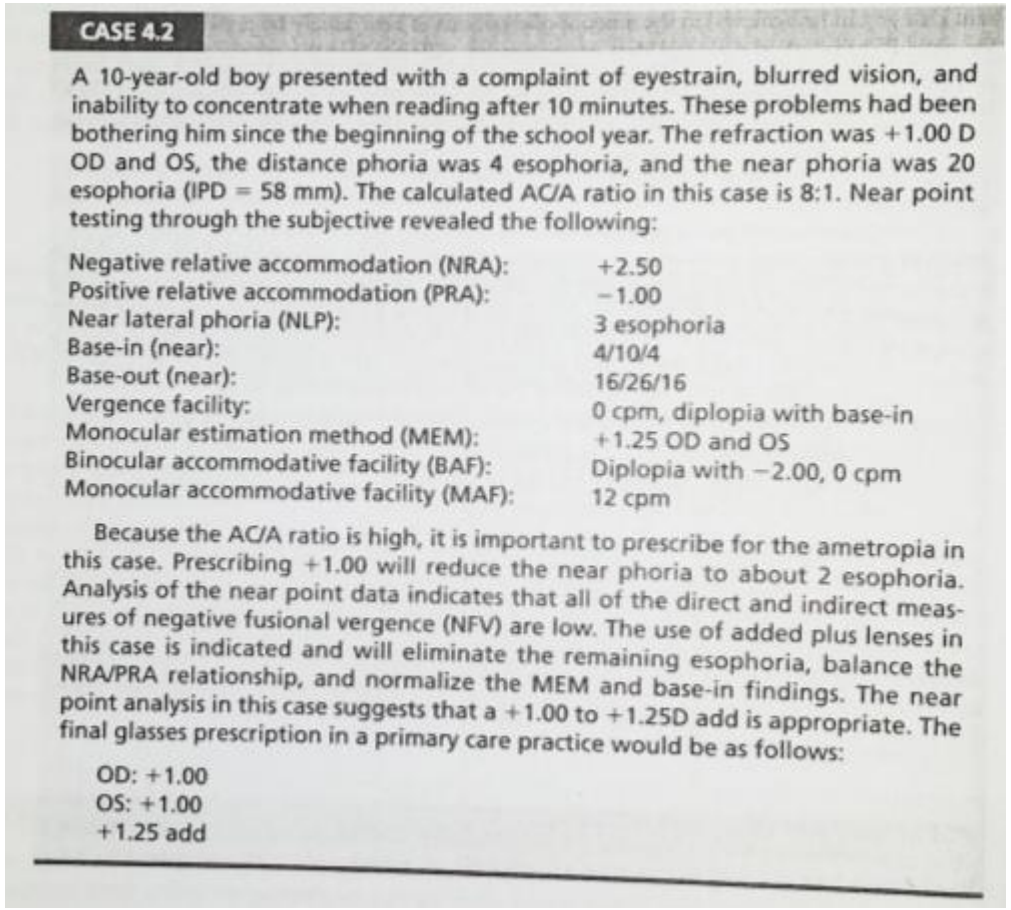
6 - General therapeutic guidelines: 1 – Refractive error correction – Effect of +1.25 near addition

TABLE 4.6 Effect of a +1.25 Near Addition in Patients with Various Calculated AC/A Ratios

Distance Phoria	Near Phoria	Calculated AC/A Ratio (60 cm pupillary distance; 40 cm working distance)	Predicted Near Phoria with 1.25 Add
Ortho	5 eso	8/1	5 exo
Ortho	10 eso	10/1	2.5 exo
Ortho	15 eso	12/1	Ortho

6 - General therapeutic guidelines: 1 – Refractive error correction – Case history 2

Prescribing +1 D addition



CASE 4.2

A 10-year-old boy presented with a complaint of eyestrain, blurred vision, and inability to concentrate when reading after 10 minutes. These problems had been bothering him since the beginning of the school year. The refraction was +1.00 D OD and OS, the distance phoria was 4 esophoria, and the near phoria was 20 esophoria (IPD = 58 mm). The calculated AC/A ratio in this case is 8:1. Near point testing through the subjective revealed the following:

Negative relative accommodation (NRA):	+2.50
Positive relative accommodation (PRA):	−1.00
Near lateral phoria (NLP):	3 esophoria
Base-in (near):	4/10/4
Base-out (near):	16/26/16
Vergence facility:	0 cpm, diplopia with base-in
Monocular estimation method (MEM):	+1.25 OD and OS
Binocular accommodative facility (BAF):	Diplopia with −2.00, 0 cpm
Monocular accommodative facility (MAF):	12 cpm

Because the AC/A ratio is high, it is important to prescribe for the ametropia in this case. Prescribing +1.00 will reduce the near phoria to about 2 esophoria. Analysis of the near point data indicates that all of the direct and indirect measures of negative fusional vergence (NFV) are low. The use of added plus lenses in this case is indicated and will eliminate the remaining esophoria, balance the NRA/PRA relationship, and normalize the MEM and base-in findings. The near point analysis in this case suggests that a +1.00 to +1.25D add is appropriate. The final glasses prescription in a primary care practice would be as follows:

OD: +1.00
OS: +1.00
+1.25 add

6 - General therapeutic guidelines: 1 – Refractive error correction - Depth of vision and lag of accommodation

- We know the difference between accommodation stimulus and accommodation response
- Probably due to depth of vision can be accommodation response lower than accommodation stimulus
- E.g. emetrop usually accommodate 1.25 D on 40 cm which we can test with the MEM

6 - General therapeutic guidelines: 1 – Refractive error correction – Add of minus lenses

- We can use minus lenses in exophoria
- This influences accommodation with change of convergence accommodation to convergence ratio (CA/A)
- Patient maintains fusion thanks to fusion vergence
-

6 - General therapeutic guidelines: 1 – Refractive error correction – Ineffectiveness of adding of minus lenses

- E.g. in convergence insufficiency with distance orthophoria and near exophoria in patients with low AC/A ratio
- Using of minus lenses is ineffective in this case

6 - General therapeutic guidelines: 2 - Prism

- The most effective is using the prism in patients with divergence insufficiency, basic esophoria, vertical heterophoria
- Further we can use prism to decrease convergence insufficiency and basic exophoria values

6 - General therapeutic guidelines: 2 – Prism – Table of recommended prism using

TABLE 4.7 Recommended Primary Care Treatment Approach by Diagnosis

Diagnosis	Primary Treatment	Secondary Treatment
Ocular motor dysfunction	Vision therapy	Added plus
Accommodative dysfunction		
Accommodative insufficiency	Added plus	Vision therapy
Ill-sustained accommodation	Added plus	Vision therapy
Accommodative excess	Vision therapy	Added plus
Accommodative infacility	Vision therapy	
Low AC/A conditions		
Convergence insufficiency	Vision therapy	Base-in prism
Divergence insufficiency	Base-out prism	Vision therapy
High AC/A conditions		
Convergence excess	Added lenses	Vision therapy
Divergence excess	Vision therapy	Added lenses (− distance; + near)
Normal AC/A conditions		
Basic esophoria	Base-out prism	Vision therapy, added plus
Basic exophoria	Vision therapy	Added minus, base-in prism
Fusional vergence dysfunction	Vision therapy	
Vertical disorders		
Vertical phoria	Vertical prism	Vision therapy

6 - General therapeutic guidelines: 2 – Prism – Case history

CASE 4.3

A 21-year-old man presents with a complaint of intermittent diplopia that is more bothersome when he looks at a distance. The problem has been present for several years. The refraction is +0.50 D OD and OS, the distance phoria is 10 esophoria, and the near phoria is ortho. The calculated AC/A ratio in this case is 2:1.

Prescribing for the ametropia in this case would have virtually no effect on the distance esophoria, reducing it from 10 esophoria to 9 esophoria. Of course, added plus lenses at distance for divergence insufficiency cannot even be considered because it would cause distance vision blur. In a primary care practice, the full-plus distance correction with 3 base-out prism (one third the distance phoria) can be prescribed; if the patient remains symptomatic, he should be referred for vision therapy.

Full distance correction with prism

6 - General therapeutic guidelines: 2 – Prism – Prism application

- We can prescribe prism monocularly if the prism is 1.25 D and lower
- If we use prism more than 1.25 D we should divide this value in front of both eyes
- It is recommended to use lenses made from CR-39 or higher refractive index with Abbe's value consideration
- We usually recommend antireflex in lenses with high base value

6 - General therapeutic guidelines: 3 – Fixation disparity and vertical prism

- According London and Wick (1987) it was found that vertical values of fixation disparity reduction has positive effect on horizontal values of FD

6 - General therapeutic guidelines: 3 – Fixation disparity and vertical prism – Vertical FD measuring

- Associated phoria can be measured with Mallett test
- Patient watches nonius line and during eye opening and closing we look for vertical prism correction which set the test in zero position

6 - General therapeutic guidelines: 3 – Fixation disparity and vertical prism – Case history 1st part

CASE 4.4 PRESCRIBING VERTICAL PRISM BASED ON ASSOCIATED PHORIA

A 17-year-old boy complained of slow reading, loss of place while reading, reading the same line when going back to the beginning of a line, and headaches after approximately 30 minutes of reading (eyelid/brow area). He stated that blinking cleared the near blur. The current spectacle prescription was essentially the same as the refractive findings:

OD: − 1.50 diopter sphere (DS)	20/15
OS: − 1.75 DS	20/15

All further testing was performed through the habitual spectacle lenses. Cover test and Maddox rod testing revealed 2 Δ of left hyperphoria in all fields of gaze at distance and near. The associated phoria findings were 1.75 Δ left hyper-associated phoria at distance and near. There were no changes in associated phoria response as the patient shifted vision into lateral gaze. Accommodative findings were normal (lag = 0.75 D, amplitude = 14 D, binocular facility = 6 cpm with ±2.00 D flippers at near).

6 - General therapeutic guidelines: 3 – Fixation disparity and vertical prism – Case history 2nd part

Based on the examination findings, the habitual spectacle correction was judged to be adequate, as were accommodative and fusional abilities. The myopic correction alone and then with the addition of 1.75 Δ base-down before the left eye were placed into a trial frame and the patient was allowed to read for 10 to 15 minutes under both conditions. He expressed a feeling of less eyestrain and more accurate eye movements (easier returning to the next line of letters) with the additional prism, which was then prescribed. With the new prescription, the patient reported a decrease in the frequency of losing his place while reading, and he experienced no symptoms while reading.

6 - General therapeutic guidelines: 4 – Passive therapy: occlusion and atropine

- Occlusion is usually used in amblyopia, eccentric fixation and suppression with ARC
- Passive therapy with occlusion or atropine is used for heterophoria with anisometropic amblyopia

6 - General therapeutic guidelines: 4 – Passive therapy: occlusion and atropine – Recommended treatment of anisometropic amblyopia

1. Full correction of refractive error
2. Use add or prism for alignment of fixation axis of both eyes
3. Passive therapy – better eye occlusion or atropine for 2-6 hours twice a week
4. Active visual therapy leading to binocular functions improving

6 - General therapeutic guidelines: 4 – Passive therapy: occlusion and atropine – Table of management of anisometropic amblyopia

TABLE 4.8 Sequential Management of Anisometropic Amblyopia

1. Full refractive correction
2. Improve alignment of the visual axes when needed
   a. Added lenses if:
      1) High AC/A ratio
      2) Inaccurate or insufficient accommodation
   b. Prism if:
      1) Esophoric at distance (base-out)
      2) Hyperphoric (base-down)
3. Direct occlusion (part-time, 2 to 6 hr/d)
   or
   Atropine penalization of the better-seeing eye (1 gtt twice weekly)
4. Vision therapy
   a. Monocular–maximize monocular acuity
   b. Binocular–improve binocular function

6 - General therapeutic guidelines: 4 – Passive therapy: occlusion and atropine – Case history

CASE 4.5 REFRACTIVE CORRECTION ALONE

A 12-year-old girl presented with the chief complaint of blurred vision when looking from reading books to the chalkboard. She also complained of irregular headaches and felt that the left eye bothered her more than the right. Her parents reported that she had received a visual examination 2 years previously, but did not wear the prescription. External and internal ocular health was within normal limits. Visual acuity (VA) and refraction with cycloplegia was as follows:

OD: +0.50	20/20 – 1
OS: +4.25 – 2.00 × 005	20/60 – 1
OU 20/20	

There was a comitant 5 Δ esophoria at 6 m, and 8 Δ esophoria at 40 cm. Stereopsis was 100 seconds at 40 cm with Randot circles. There was no suppression. Fixation was central with both eyes.

The cycloplegic refractive finding less 0.50 D was prescribed. The patient was instructed to return for reevaluation in 1 month, but she did not return until 3 months later. She had noticed diplopia for the first 2 days while wearing the new glasses, but now wore them full time without complaint.

Aided VA

OD: 20/15 – 2
OS: 20/20
OU: 20/15

Eye alignment was 2 Δ esophoria at 6 m and 4 Δ esophoria at 40 cm. Stereopsis was 20 seconds at 40 cm with random dot circles.

6 - General therapeutic guidelines: 4 – Passive therapy: occlusion and atropine - Basics

- With occlusion or atropine penalization we try to activate visual pathway of the worse eye
- It the refractive error correction is ineffective we use occlusion for 2-6 hours a day
- If there is no improvement after 3 month it is recommended to start with other therapy

6 - General therapeutic guidelines: 4 – Passive therapy: occlusion and atropine - Occlusion

- In patients with intermediate amblyopia (better than 0.1) we start with occlusion 2 hour per day
- In patients with heavy amblyopia (worse than 0.1) we use 6 hours per day occlusion
- Patient should be checked every 6 weeks
- If the visual acuity increases with one row we can continue in the same procedure
- If the visual acuity increases less than one row we extend twice occlusion time

6 - General therapeutic guidelines: 4 – Passive therapy: occlusion and atropine - Atropine

- Atropine is used already for 100 years. It has huge tradition in optometry and ophthalmology
- Treatment of anisometropic amblyopia is slow
- Studies showed that is better to use 1% atropine twice a week than daily

6 - General therapeutic guidelines: 5 – Visual therapy

- Visual therapy is useful for patients with binocular, accommodative and motor disorders who are not sensitive for spectacle lenses and prism application
- Visual therapy can be managed ambulatory (periodically visiting the professional) or at home
- Some researches showed that home based visual therapy has the same effect as placebo
- If the home based visual therapy is ineffective after 4 weeks it recommended to change it on ambulatory visual therapy

6 - General therapeutic guidelines: 6 – Accommodative disorders

- If we have symptomatic patient with distance and near orthophoria and normal AC/A ration the problem can be accommodative, motor, vergence, fixation disparity, latent hyperopia, cyclophoria or aniseikonia
- It is recommended to examine accommodative amplitude, facility and lag (MEM)

6 - General therapeutic guidelines: 6 – Accommodative disorders – Guidelines

- At first we have to check latent hyperopia
- Low astigmatism or anisometropia can cause asthenopia
- If we use plus lenses we can help patient with accommodation insufficiency or ill-sustained accommodation
- If the patient has problems with releasing of accommodation or with the change of accommodation adding of lenses is ineffective

V. Visual therapy techniques

- Scheiman page 147

V. Visual therapy techniques - overview

1. Basic concept introduction (instruments, procedures, guidelines)
2. Fusion vergence methods
3. Voluntary convergence methods
4. Anti-suppression methods
5. Accommodative techniques
6. Motor techniques

1 - Basic concept introduction – Types of instrument

- We can distinguish “instrument training” and “free space training”
- Scheiman recommends to resolve:
  1. Anaglyph and polarized filters
  2. Lenses, prisms and mirrors
  3. Septum and apertures
  4. Paper, pencil and tasks
  5. Stereoscopes
  6. Afterimages, entoptic phenomenon and electrophysiological methods

1 - Basic concept introduction – Types of instrument: 1 - Anaglyph and polarized filters

- Anaglyph and polarized filters divide image of both eyes. We use it in heterophoria
- Advantages: We can use different stimulus – accommodative and non-accommodative, we can use it in patient with slight suppression, it simulates normal visual conditions
- Disadvantages: Young patients are hardly concentrated, instruments are expensive, linear polarization is direction dependend

1 - Basic concept introduction – Types of instrument: 2 - Lenses, prisms and mirrors

- Lenses change accommodative and vergence demands. Can be used with polarized and anaglyph techniques
- Lenses can be used for training of accommodation, vergence, eye motor and anti-suppression exercises
- Advantages: Lenses are very effective for accommodation and vergence training
- Disadvantages: Young patient lose quickly their concentration. We can use different fixation targets

1 - Basic concept introduction – Types of instrument: 3 - Septum and apertures

- Septum is mechanical barrier which divide both eyes image, e.g. Remy's separator
- Aperture is hole which enables to patient see part of the object with one eye and the other part with the second eye
- Advantages: It is used for treatment of mild and intermediate suppression
- Disadvantages: Examination depends on head position. Often is not possible to adapt vergence in zero position

1 - Basic concept introduction – Types of instrument: 4 - Paper, pencil and tasks

- We can use printed test for training of vergence, accommodation and exact eye movements
- Advantages: This is cheep technique. Patient has different targets for mild and intermediate suppression. Usually we use these test for training of suppression or convergence
- Disadvantages: Sometimes is difficult to attract young patients to these tests

1 - Basic concept introduction – Types of instrument: 5 - Stereoscopes

- Stereoscope divides physical space into two divided areas of each eye vision
- The space is usually divided with mechanical barrier, tube, mirror or prisms
- This technique can be used in patients with experiences of image separation form other instruments
- Advantages: We can train 3 level of simple binocular vision. It can be used in patients with deep suppression
- Disadvantages: The sense is unreal, instrumental. Instruments are expensive

1 - Basic concept introduction – Types of instrument: 6 - Afterimages, entoptic phenomenon and electrophysiological methods

- We use it for treatment of amblyopia, eccentric fixation, ARC, strabismus or nystagmus
- E.g. Haidinger’s brushes, Hering-Bielschowski’s afterimages
- Afterimages can be used for training of motor function of the eye

1 - Basic concept introduction – Basic procedures

- Before the visual therapy (VT) is recommend to consider these need:
  - Define the difficulty level which is adequate for proper patient
  - Be careful for frustration
  - You should define the goals and give the reward to patient
  - Patient should see improvement during exercises
  - Make patient sure that improvement will come in his visual system
  - Define and tell particular targets in VT to patient
  - Use techniques with feed back, e.g. diplopia, stereo vision, blurry vision etc.

1 - Basic concept introduction – Basic procedures – Feed back mechanisms in VT

- Diplopia
- Blurry vision
- Suppression
- Binocular luster (combination of two color objects in stereo vision generates binocular luster)
- Sense of moving
- Sense of flowing
- SILO (small in, large out)
- Localization
- Parallax
- Upper terms will be explained in separate slides

1 - Basic concept introduction – Basic procedures – Feed back mechanisms in VT - SILO

- Small in, large out
- Patient can see this in change of vergence or vertex distance of spectacle lenses
- In convergence object seems to be near and small = SI effect
- In divergence object seems to be far and large = LO effect
- If we use plus lens eye image is increased in size, if we use minus lens image is degreased in size

1 - Basic concept introduction – Basic procedures – Feed back mechanisms in VT – SILO - Picture

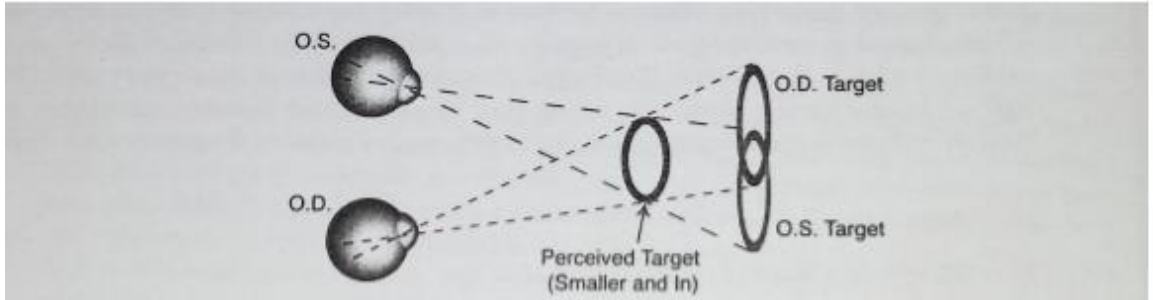


FIGURE 5.6 Geometric explanation for the "small in, large out" phenomenon. The illustration demonstrates that the fused target would appear to be smaller and closer than either of the real targets during a base-out fusion technique.

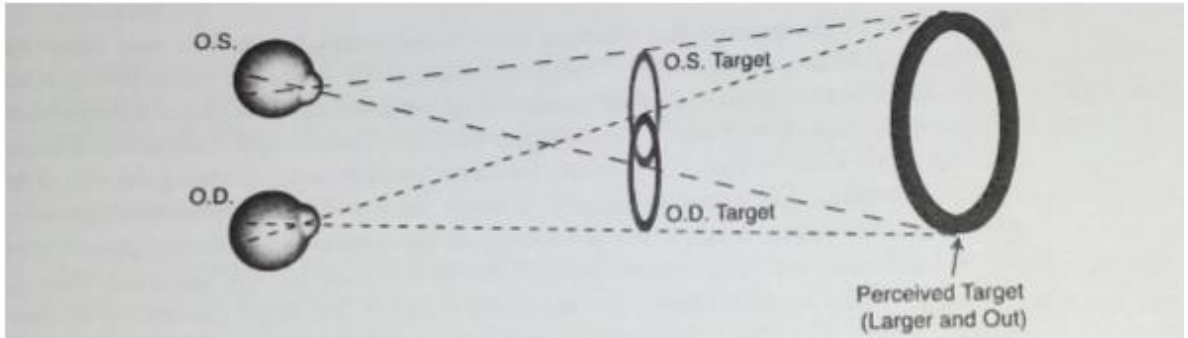


FIGURE 5.7 Geometric explanation for the "small in, large out" phenomenon. The illustration demonstrates that the fused target would appear to be larger and farther away during a base-in fusion technique.

1 - Basic concept introduction – Basic procedures – Feed back mechanisms in VT – Localization

- Patient shows where are positioned fused objects
- Feed back is based on physiologic diplopia principle

1 - Basic concept introduction – Basic procedures – Feed back mechanisms in VT – Parallax

- Thanks to parallax we can define the direction of object movement
- In convergence fused object moves into same direction as the patient’s head
- In divergence is it opposite

1 - Basic concept introduction – Main procedures

- For increasing the fusion reserves we can use these procedures:
  - The accommodation is stopped in certain level and we change vergence demands
  - Vergence is stopped in certain level and we change accommodative demands

1 - Basic concept introduction – Main procedures - The accommodation is stopped in certain level and we change vergence demands

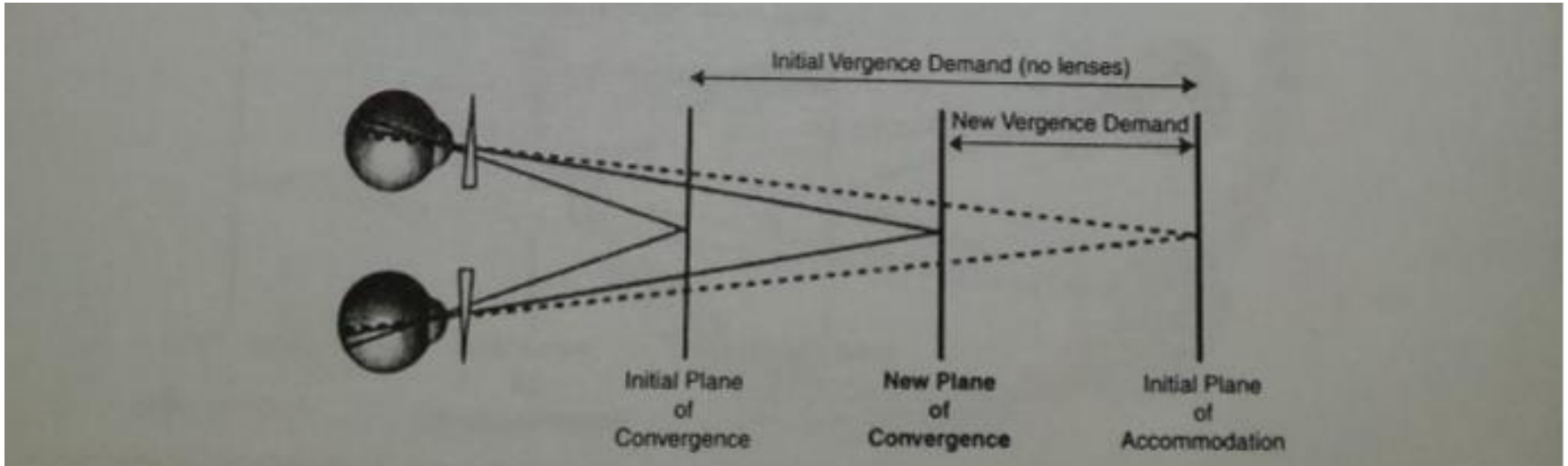


FIGURE 5.15 Effect on the plane of vergence when base-in prism is added during convergence therapy.

Making easier

1 - Basic concept introduction – Main procedures - Vergence is stopped in certain level and we change accommodative demands

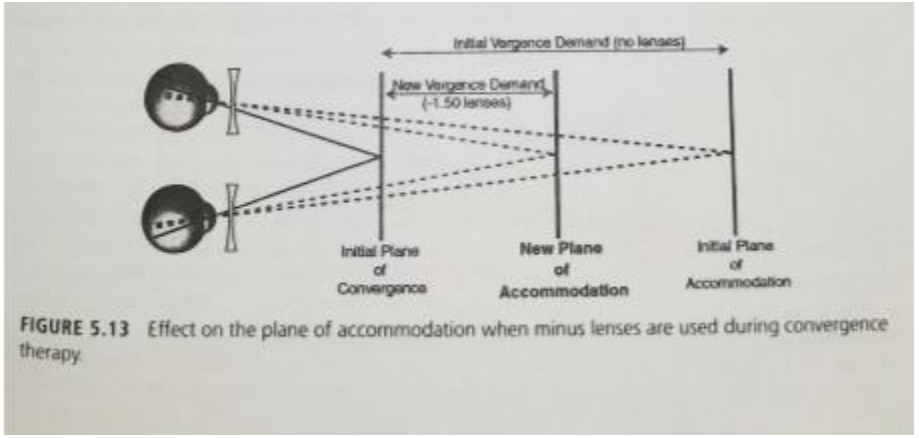


FIGURE 5.13 Effect on the plane of accommodation when minus lenses are used during convergence therapy.

Making easier

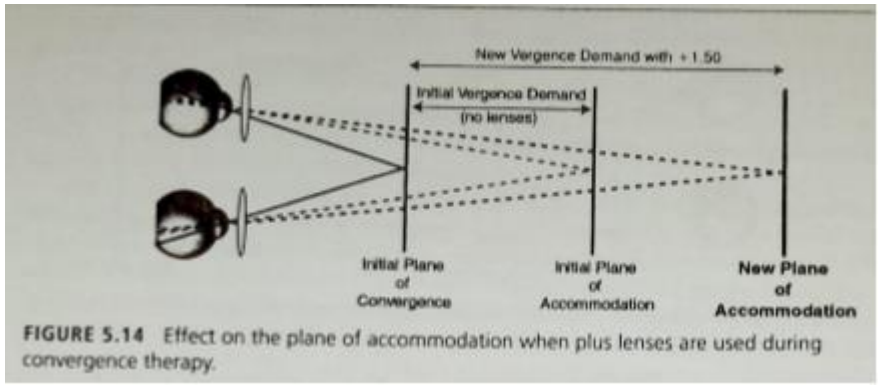


FIGURE 5.14 Effect on the plane of accommodation when plus lenses are used during convergence therapy.

Making harder

1 - Basic concept introduction – Specific procedures – Binocular and accommodative

- Before VT starting you should start with ametropia correction, prism correction or occlusion therapy
- Before vergence therapy you should solve suppression and amblyopia
- Before starting VT you should test visual system functions, e.g. in convergence insufficiency we test convergence
- You should start with therapy which is suitable for patient
- Use test blurring
- During training we should control PFV, NFV, PRA, NRA (usually one is increasing and the second decreasing)
- We start with amplitude and then accommodation facility
- We try to equal amplitude and accommodation facility of both eyes

1 - Basic concept introduction – Specific procedures – Motor therapy

OCULAR MOTILITY THERAPY: SPECIFIC GUIDELINES

- Emphasize accuracy first and then speed of either the saccadic or pursuit eye movement.
- For saccades, go from gross (large) to fine (small) eye movements. For pursuits, the sequence is the opposite—from fine (small) to gross (large) eye movements.
- Begin motility therapy monocularly and continue until both eyes are approximately equal in ability. Once monocular skills are equal, accurate, and fast, begin binocular ocular motility activities.
- Eliminate head movements during both pursuit and saccadic eye movements that can reasonably be accomplished without head movement.
- Increase the complexity of the task to develop more reflexive, automated pursuits and saccades.

1 - Basic concept introduction – Specific procedures – Anti-suppression therapy

- Adapt the training method. Patient should suppress as little as possible. You can do this to minimize suppression:
  - Change light
  - Change contrast
  - Move with object
  - Flash with light

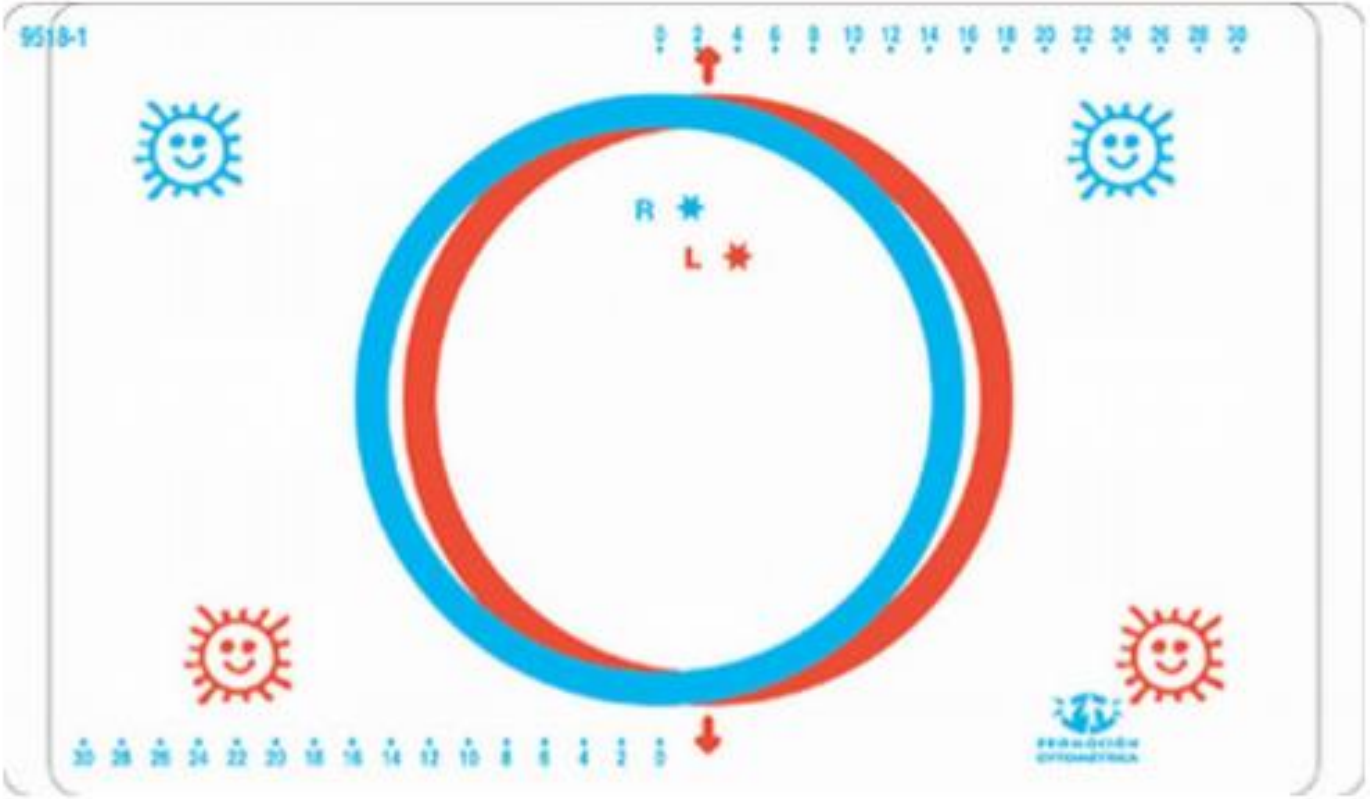
2 - Fusion vergence methods

1. Anaglyphs and polarizators (Tranaglyph, Vectogram, PC training)
2. Lenses, prisms, mirrors (Loose prism)
3. Septum and apertures (Aperture rule)
4. Paper, pencil, tasks (Free fusion pictures)
5. Stereoscope

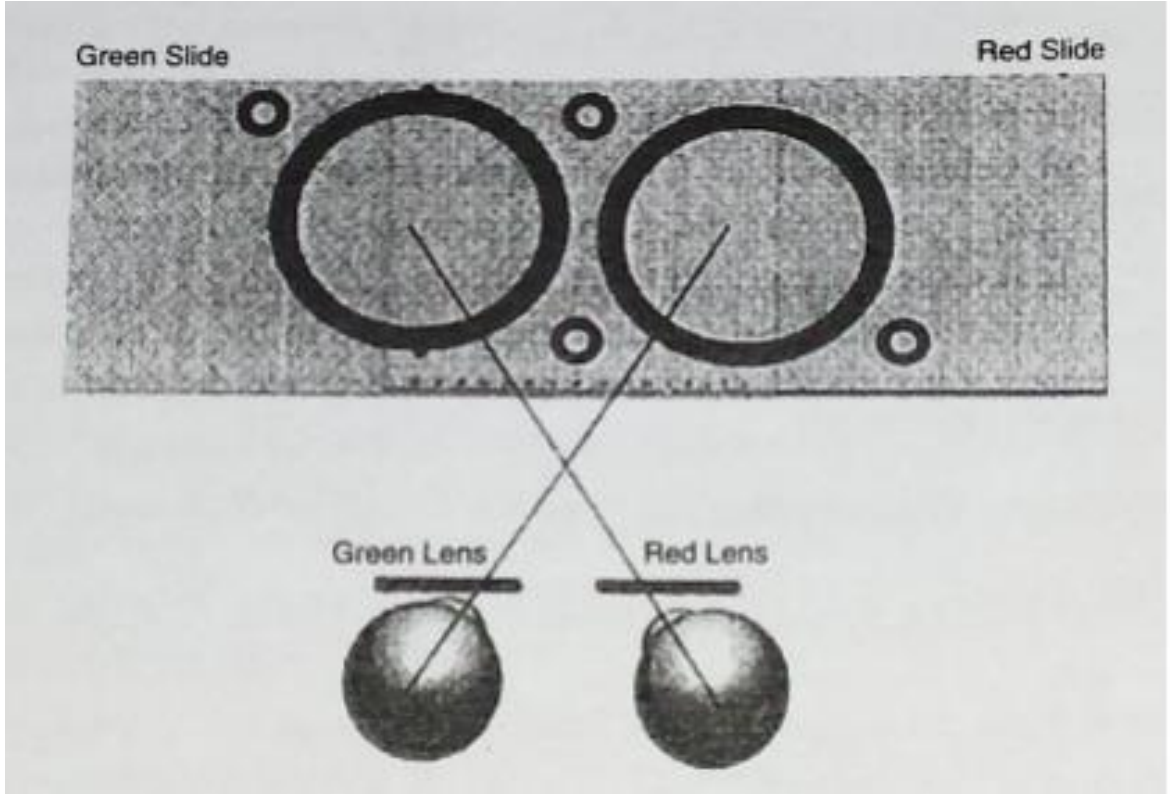
2 - Fusion vergence methods: 1 - Anaglyphs and polarizators – Variable tranaglyph

- Goals: Increasing of NFV and PFV, decreasing latency of fusional vergence answer and increasing of its velocity
- Equipment: Variable tranaglyph, red-green glasses, pointer
- Procedure: Tranaglyph has red and green part. Moving both parts nasally we stimulate convergence and temporally we stimulate divergence

2 - Fusion vergence methods: 1 - Anaglyphs and polarizators – Variable tranaglyph - Picture



2 - Fusion vergence methods: 1 - Anaglyphs and polarizators – Variable tranaglyph - Principle



2 - Fusion vergence methods: 1 - Anaglyphs and polarizators – Variable tranaglyph – Recommended guidelines

TABLE 6.1 Recommended Procedures for Anaglyph and Polaroid Vision Therapy Techniques

Step 1

a. The patient wears appropriate filters.
b. Establish patient's ability to fuse.

Step 2

a. Create small amount of base-out/base-in vergence demand and establish presence of appreciation of SILO response, clarity, parallax, float, localization, and absence of suppression.

Step 3

a. Patient maintains fusion as targets are separated in 3 Δ increments base-out or base-in.
b. Use localization procedure to establish awareness of looking close and far.
c. Have patient break fusion, look away and look back or cover and uncover an eye, and then regain fusion for 10 seconds. Repeat this three times.
d. Increase target separation by 3 Δ and repeat steps 3a–3c.

SILO, "small in, large out."

2 - Fusion vergence methods: 1 - Anaglyphs and polarizators – Variable tranaglyph – Other possible training

TABLE 6.2 *Other Recommended Therapy Procedures for Binocular Vision Therapy Techniques*

Phasic/step vergence therapy

1. Change fixation from the target to another point in space.
2. Cover, uncover, and regain fusion.
3. Use loose prism or flip prism to change demand.
4. Use flip lenses to change demand.
5. Use two different targets with varying demand.
6. Use Polaroid or anaglyph flip lenses designed to alternate between divergence and convergence demand.
7. Use flip lenses to create a binocular accommodative demand.
8. Change fixation distance and move to distance of most difficulty.

2 - Fusion vergence methods: 1 - Anaglyphs and polarizators – Variable tranaglyph – Change of training difficulties

TABLE 6.3 Procedures for Increasing and Decreasing Vergence Demand with Binocular Vision Therapy Procedures

Decreasing the level of difficulty of the task

Convergence	**Divergence**
• Minus lenses	• Plus lenses
• Base-in prism	• Base-out prism
• Increase working distance	• Increase working distance

Increasing the level of difficulty of the task

Convergence	**Divergence**
• Plus lenses	• Minus lenses
• Base-out prism	• Base-in prism
• Decrease the work distance	• Decrease the work distance

2 - Fusion vergence methods: 1 - Anaglyphs and polarizators – Variable tranaglyph – Target values

- During exercises we try to reach 20-25 prism BO (PFV) and 10-15 prism BI (NFV)
- For vergence facility we try to reach 20-25 prism BO and 10-15 prism BI in 15 cpm

2 - Fusion vergence methods: 1 - Anaglyphs and polarizators – Non-variable tranaglyph

- The goals are same like in variable version
- Patient should reach simple binocular vision

2 - Fusion vergence methods: 1 - Anaglyphs and polarizators – PC training

- With help of PC programs we can train accommodation, fusion vergence, saccades and pursuits
- Advantages: It is standardized method, interpreted by the software. Can be mixed with the traditional methods
- For example: Computer Orthoptics VTS3 Liquid Crystal System, Computer Aided Vision Therapy

2 - Fusion vergence methods - Lenses, prisms, mirrors – Flipper and loose prism

- Goals: Prisms are used for increasing or decreasing exercise difficulty
- Equipment: Loose prism, prismatic flipper, fixation target (tranaglyph, vectogram, Lifesaver card etc.)
- Procedure: For example during convergence training if we use prism BI we increase exercise difficulty

2 - Fusion vergence methods - Lenses, prisms, mirrors – Flipper and loose prism - Picture

2 - Fusion vergence methods - Septum and apertures - Introduction

- Goals: Increasing of NFV and PFV, decreasing of latency of FV and increase of velocity of FV
- Equipment: E.g. Bernell Aperture Rule trainer and card, flip lens, flip prism, pointer
- Procedure: We use chiastopic fusion (visual axis are crossed in comparison with fixation level) and orthoptic fusion. Training is more difficult like with tranaglyphs. We use pictures with disparity 2.5-30 prism

2 - Fusion vergence methods - Septum and apertures - Picture

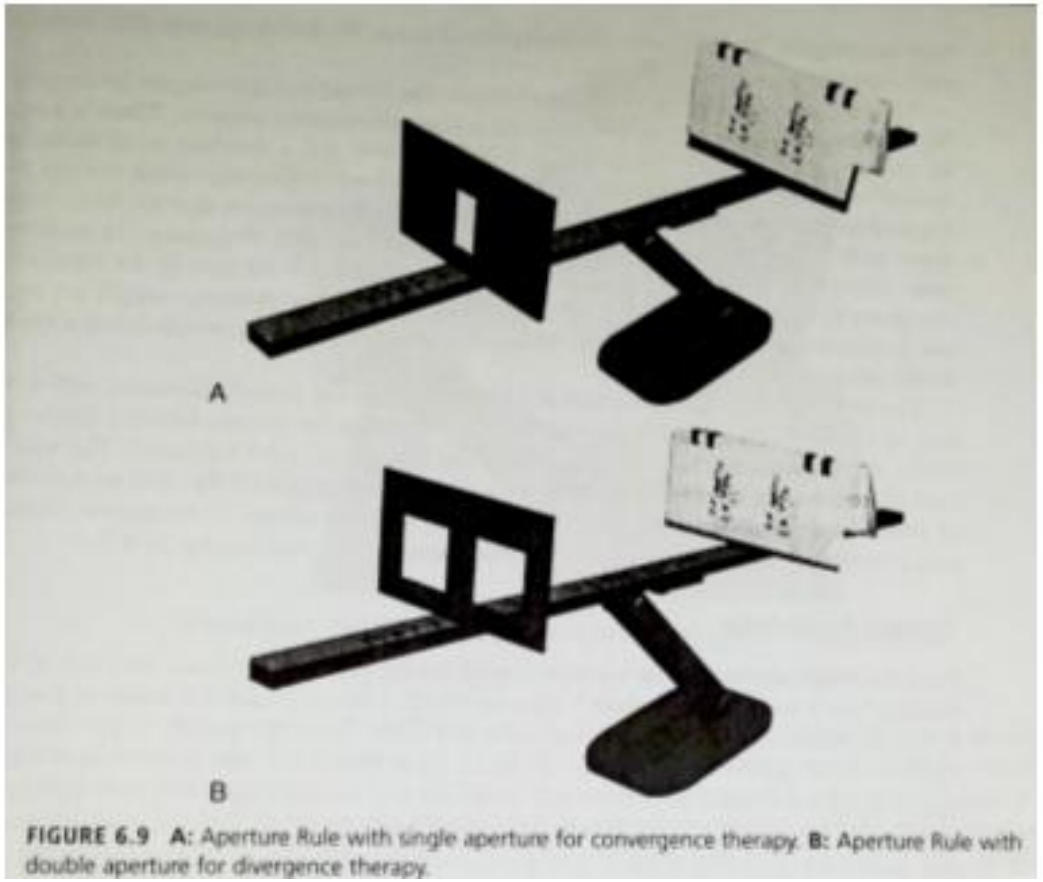
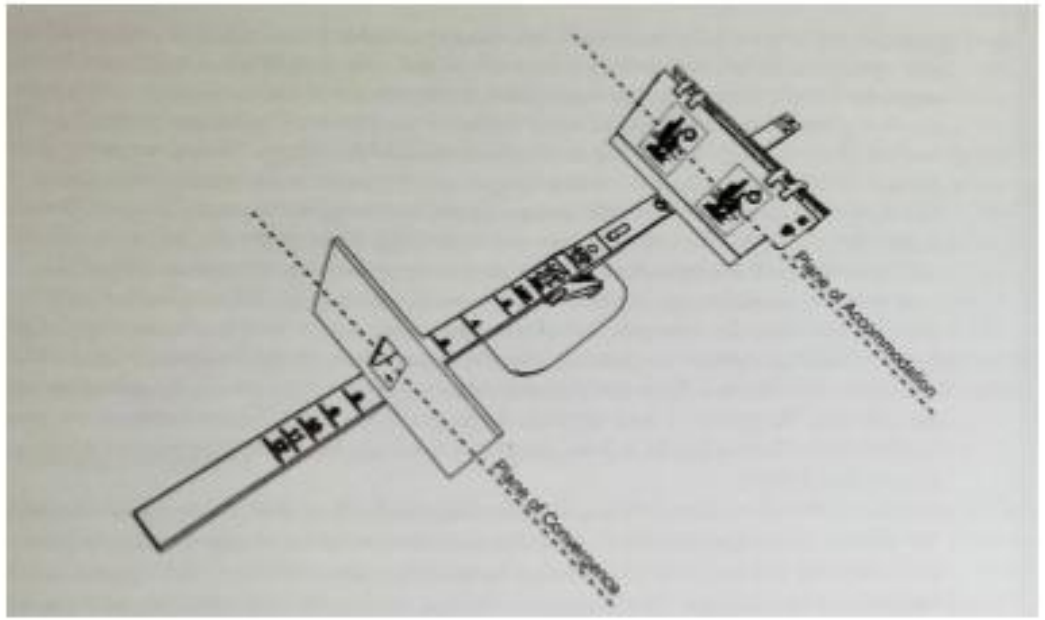


FIGURE 6.9 **A:** Aperture Rule with single aperture for convergence therapy. **B:** Aperture Rule with double aperture for divergence therapy.



2 - Fusion vergence methods - Septum and apertures – Types of cards

- We use different card types for fusion and stereopsis
- Examination is usually done from 40 cm, where 1 mm means 0.25 prism
- Disparity 1 cm changes vergence demand with 2.5 prism, 12 cm refers to 30 prism

2 - Fusion vergence methods - Septum and apertures – General guidelines

- Aperture is moved to patient as close as possible
- Insert picture with small disparity
- Patient should fuse the pictures
- If patient can not fuse the picture we can use additional lenses or prism
- In case of convergence therapy is level of accommodation in place of picture and level of convergence in place of aperture
- If the fusion is not possible we use pointer which is inserted behind the aperture
- We continue in training until patient is able to fuse all cards (12 for convergence and 6 for divergence)

2 - Fusion vergence methods - Septum and apertures – Modified Remy's separator - Introduction

- Goals: Increasing NFV and PFV, decreasing latency of FV, increase velocity of FV
- Equipment: Paper septum, Lifesaver card, Free Space Fusion card, stereogram
- Procedure: We use it for divergence therapy (mechanical aperture), if objects are separated 4 cm in 40 cm divergence demand is 10 prism BI

2 - Fusion vergence methods - Septum and apertures – Modified Remy's separator - Picture

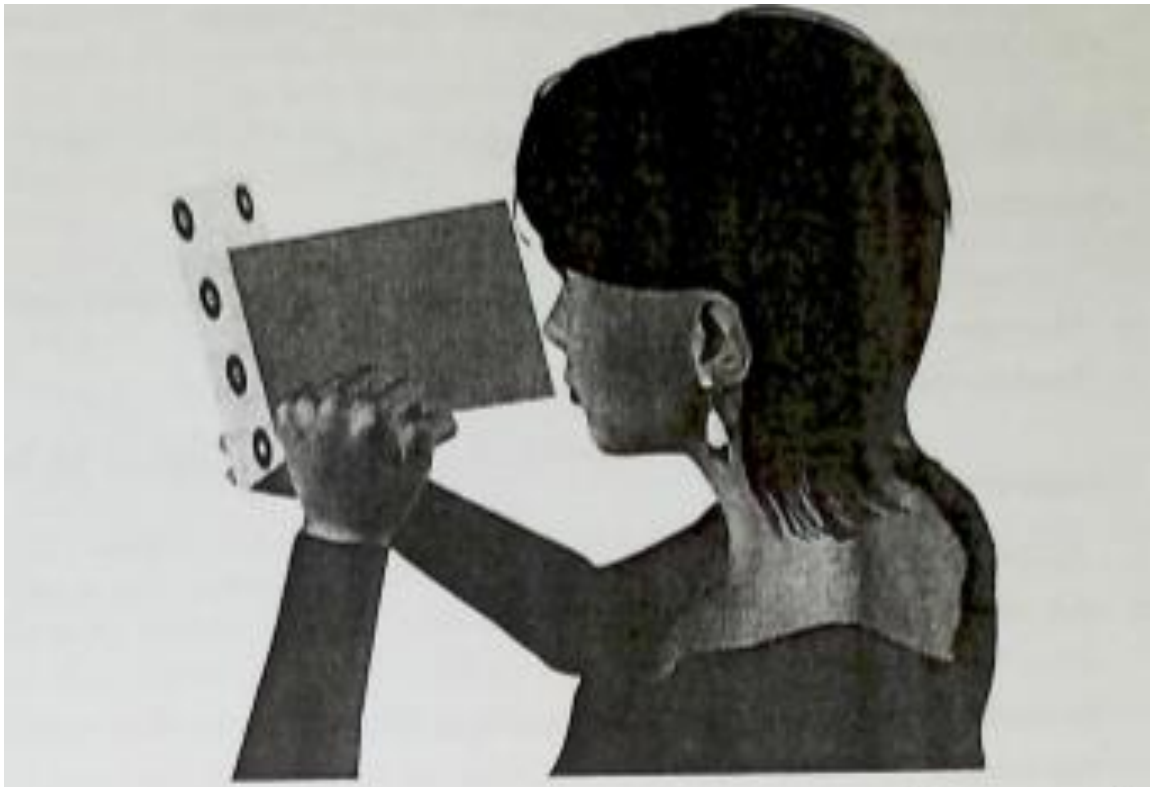


FIGURE 6.14 Modified Remy separator using a septum and Lifesaver card.

2 - Fusion vergence methods - Septum and apertures – Modified Remy's separator – Recommended procedure

- Main goal is divergence training
- This procedure is more difficult than in tranaglyph or vectogram
- Patient tries to keep fusion for 10 seconds and then looks to infinity and then back to fusion
- Divergence fusion difficulty we can increase with increase of fixating objects separation. We can use plus lenses or BO prism
- We can finish procedure if the patient is able to fuse 15 prism BI (we train exo deviation of eyes)

2 - Fusion vergence methods - Paper, pencil, tasks – Eccentric circles and Free Space Fusion Cards (FSFC)

- Goals: Increase NFV and PFV, decrease FV latency, increase FV velocity
- Equipment: E.g. Keystone opaque/transparent Eccentric Circles, Bernel opaque/transparent FSFC, flip lenses, flip prism, pointer
- Procedure: It is free-space chiastopic and orthoptic technique. Prism, lenses and glasses are obligatory. Patient tries to fuse pictures in front of and behind the fixation level

2 - Fusion vergence methods - Paper, pencil, tasks – Eccentric circles and Free Space Fusion Cards (FSFC) - Picture

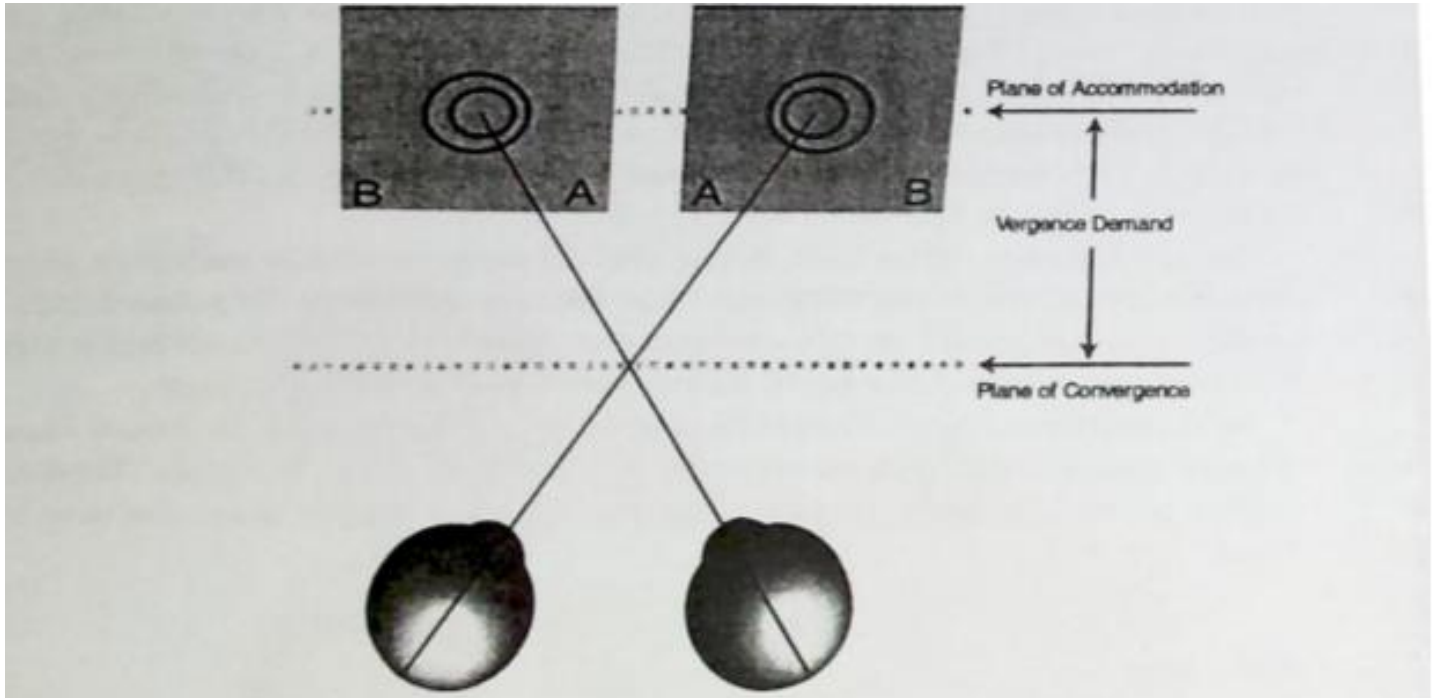


FIGURE 6.15 Eccentric Circles setup for convergence therapy, illustrating planes of accommodation and vergence.

2 - Fusion vergence methods - Paper, pencil, tasks – Eccentric circles and Free Space Fusion Cards (FSFC) – Basic technique with eccentric circles

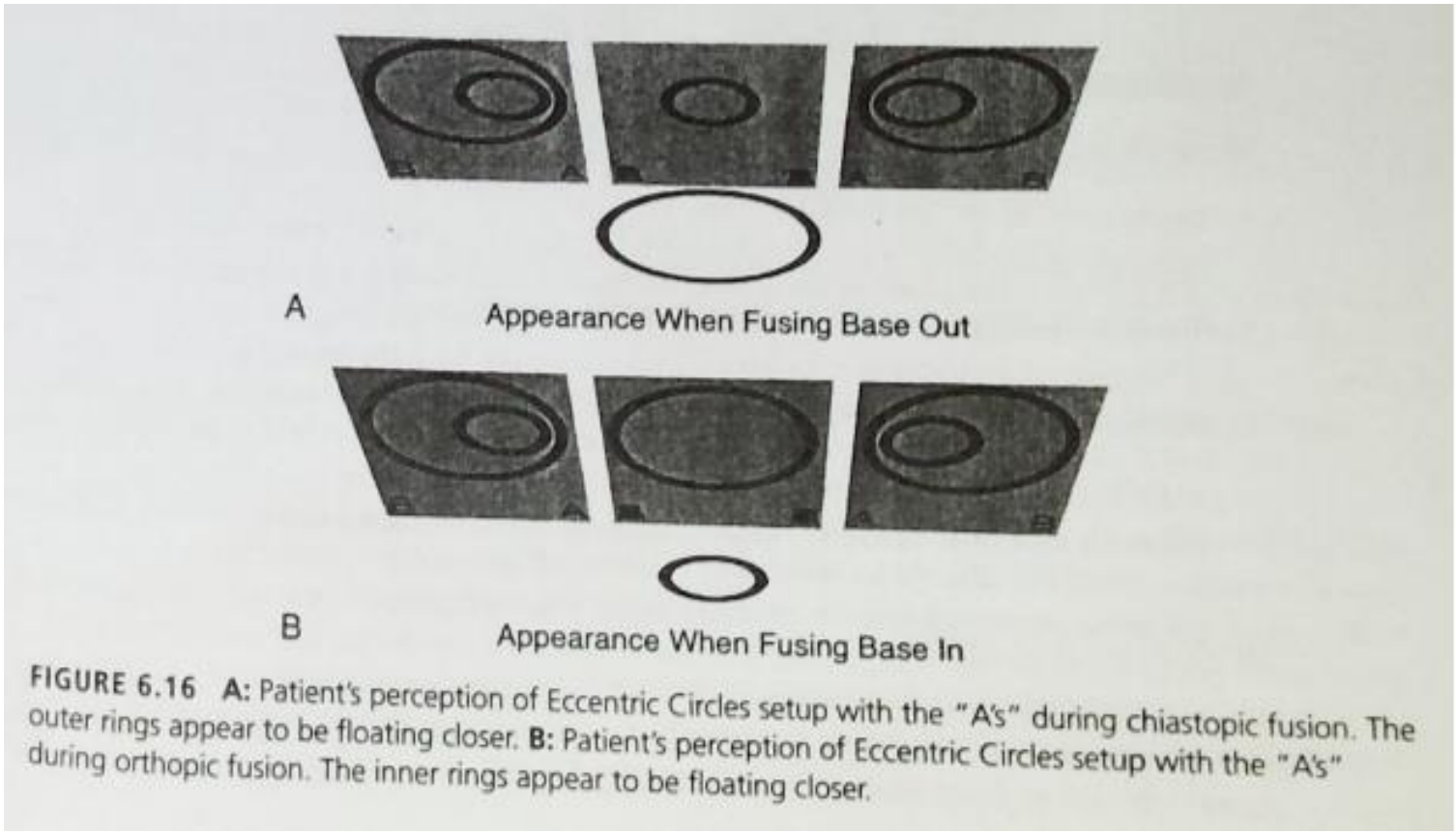


FIGURE 6.16 **A:** Patient's perception of Eccentric Circles setup with the "A's" during chiastopic fusion. The outer rings appear to be floating closer. **B:** Patient's perception of Eccentric Circles setup with the "A's" during orthopic fusion. The inner rings appear to be floating closer.

2 - Fusion vergence methods - Paper, pencil, tasks – Eccentric circles and Free Space Fusion Cards (FSFC) – Training guidelines

- Training is performing with the non-transparent cards. Patient tries to maintain fusion for 10 seconds. After that he look in infinity and back to fuse pictures
- We can train convergence in different fixation direction
- Further we can train velocity and quality of fusion with frequency 20 cpm
- For divergence training we use transparent cards
- If the patient has problems with divergence we can use pencil behind the test
- Training can be stopped if the patient has separation 12 cm in chiastopic fusion and 6 cm in orthoptic fusion

2 - Fusion vergence methods - Paper, pencil, tasks – Eccentric circles and Free Space Fusion Cards (FSFC) – Lifesaver card

- Principal of training is similar like with FSFC

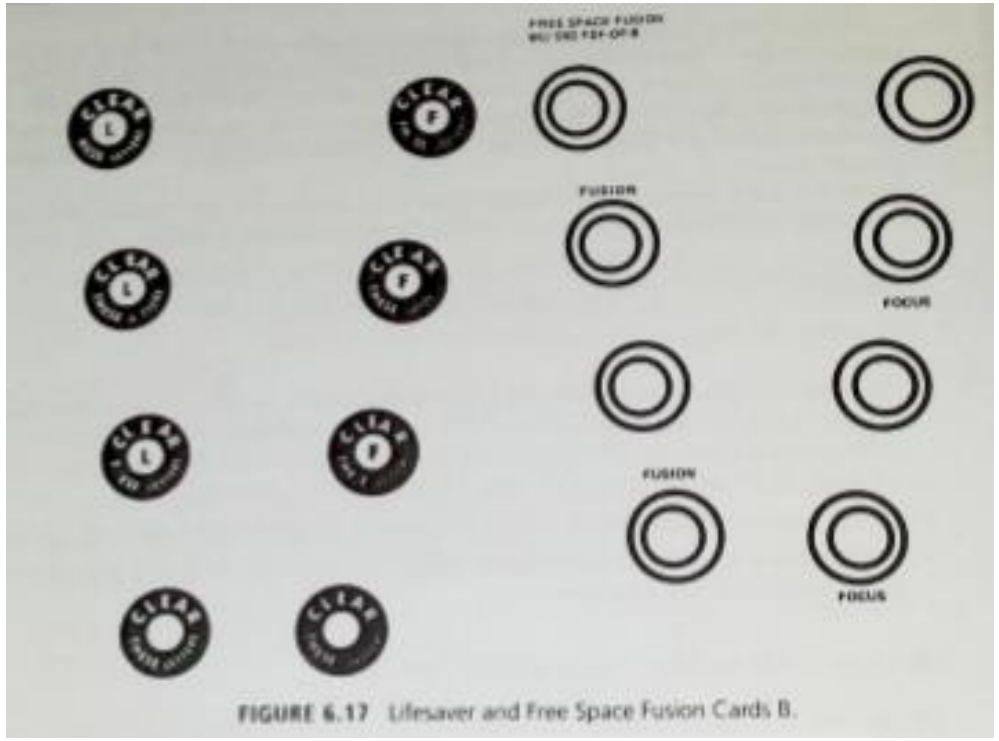


FIGURE 6.17 Lifesaver and Free Space Fusion Cards B.

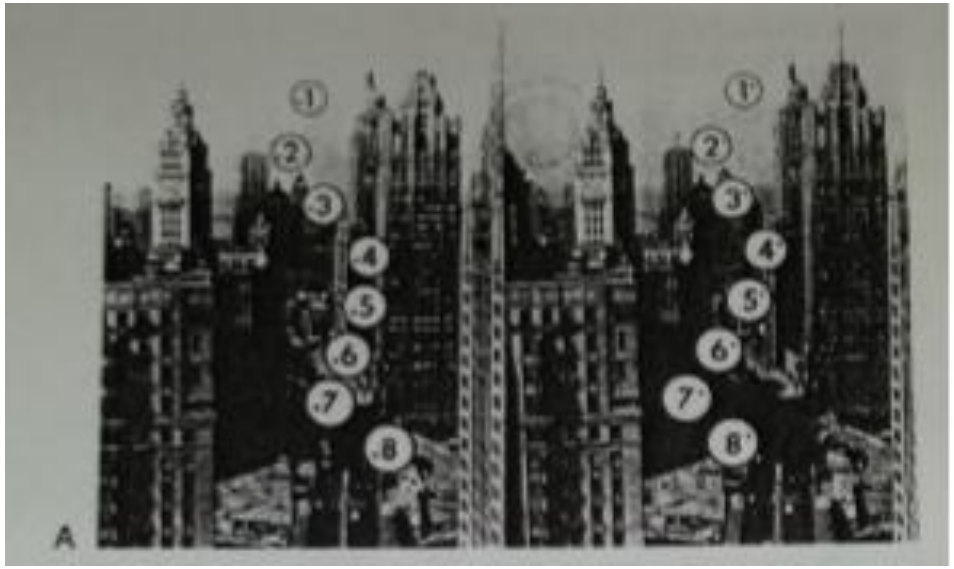
2 - Fusion vergence methods - Stereoscope

- Goals: Increase NFV and PFV, decrease FV latency, increase FV velocity
- Equipment: Keystone stereoscope, Bernell-O-Scope, stereoscopic cards, flip lenses, flip prism, pointer
- Procedure: Brewster's type of stereoscope contains oculars with plus 5 D lenses. This lenses are separated 95 mm so they induce BO prism. Pictures are in 20 cm distance

2 - Fusion vergence methods – Stereoscope – Test cards/pictures

- In the stereoscope we can use different types of pictures:
  - Convergence and divergence pictures
  - Pictures for coordination eye-hand
  - Accommodative therapy pictures
  - Anti-suppression pictures
  - Pictures for superposition, fusion and stereopsis

2 - Fusion vergence methods – Stereoscope – Picture examples



2 - Fusion vergence methods – Stereoscope – Bernell-O-Scope

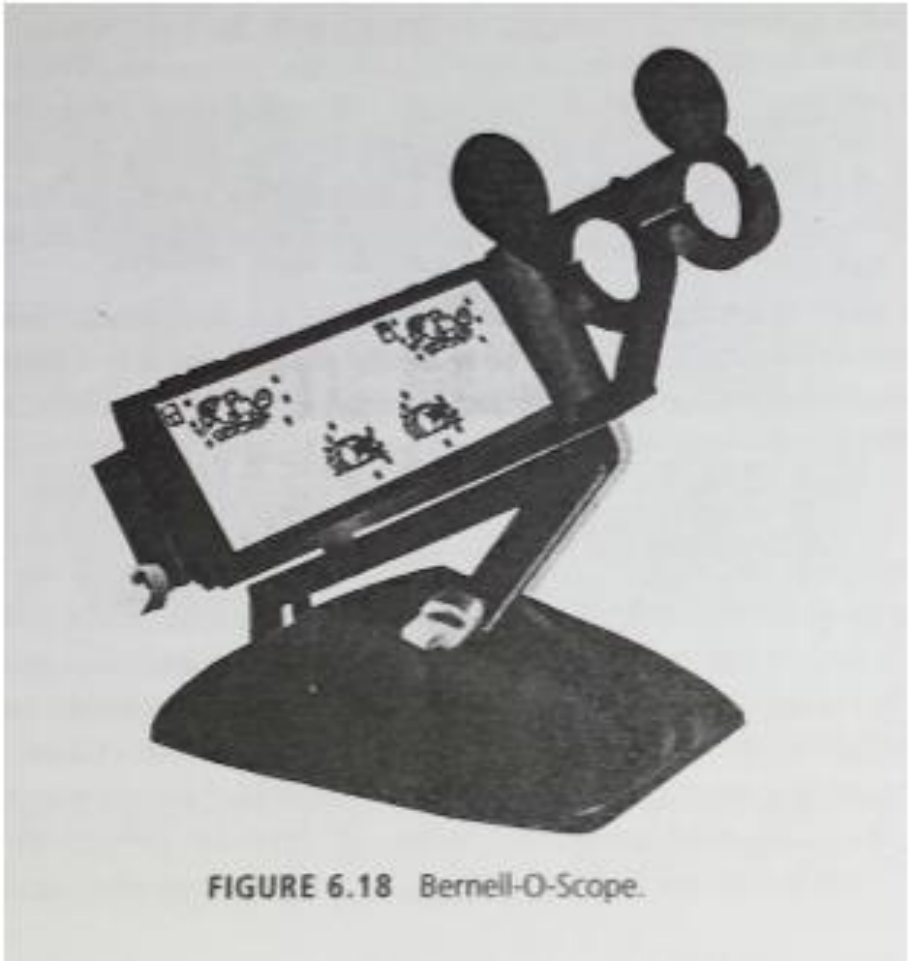


FIGURE 6.18 Bernell-O-Scope.

2 - Fusion vergence methods – Stereoscope – Calculation of accommodation

ACCOMMODATIVE DEMAND

Because the power of the stereoscope lenses is known and the distance of the target from the lens plane is known, one can easily calculate the accommodative demand, using the following formula:

$$A = (1/TD) - P$$

where

A = accommodation (D)
TD = distance between target and lens plane (m)
P = power of stereoscope lenses (D)

EXAMPLE 6.1

You are working with a stereoscope with +5.00 D lenses and a 95 mm lens separation. If you place the stereoscopic card at 20 cm, what is the accommodative demand?

Answer

$$A = (1/TD) - P$$
$$A = (1/0.2) - 5$$
$$A = 5 - 5 = 0$$

At a working distance of 20 cm, there is no accommodative demand. This is the distance setting for this particular stereoscope.

EXAMPLE 6.2

If the target is now moved to a working distance of 13 cm, what is the accommodative demand?

Answer

$$A = (1/TD) - P$$
$$A = (1/0.13) - 5 = 7.6 - 5 = 2.6 \text{ D}$$

At a working distance of 13 cm, the accommodative demand is about 2.6 D.

2 - Fusion vergence methods – Stereoscope – Calculation of convergence

CONVERGENCE DEMAND

Flax (14) presented a formula that is applicable to any Brewster-type stereoscope and permits rapid calculation of the vergence demand in a manner simple enough for routine clinical application. The formula is also independent of the patient's interpupillary separation.

$$C = (P \times LS) - (TS/TD)$$

where

C = vergence demand in prism diopters

P = power of stereoscope lenses

LS = separation of optical centers of stereoscope lenses (cm)

TD = distance of stereogram from stereoscope lenses (m)

TS = separation of corresponding points of the stereogram (cm)

Plus values represent a convergence demand, and minus values a divergence demand. One of the reasons this formula is simple to use is because part of the equation, $(P \times LS)$, becomes a constant value when using a specific instrument with a fixed lens separation. Thus, as long as you use the same instrument, this part of the equation is a given.

EXAMPLE 6.3

You are working with a stereoscope with +5.00 D lenses and a 95 mm lens separation. What is the vergence demand for a 60 mm target set at 20 cm?

Answer

$$C = (P \times LS) - (TS/TD)$$
$$C = (5 \times 9.5) - (6.0/0.2) = 47.5 - 30 = 17.5 \text{ base-out}$$

EXAMPLE 6.4

If you use the same stereoscope as in Example 6.3 and the same card, now set at a working distance of 13 cm, what is the vergence demand?

Answer

$$C = (P \times LS) - (TS/TD)$$
$$C = 47.5 - (6.0/0.13) = 47.5 - 46.0 = 1.5 \text{ base-out}$$

2 - Fusion vergence methods – Stereoscope – Exercises

- It depends on type of card/picture
- The most important thing is to fuse pictures and maintain fusion for 10 seconds
- Further we can change cards distance (changing accommodation) or cards separation (changing vergence)

2 - Fusion vergence methods – Stereoscope – Cheiroscope

- Cheiroscope can be used for analysis of simple binocular vision
- We use special pictures for cheiroscope for exophoria (separation is 77-80 mm) and for esophoria (separation is less than 77 mm)
- We can also measure vertical phoria on cheiroscope
- Patient with suppression will draw with interruptions

2 - Fusion vergence methods – Stereoscope – Cheiroscope - Pictures

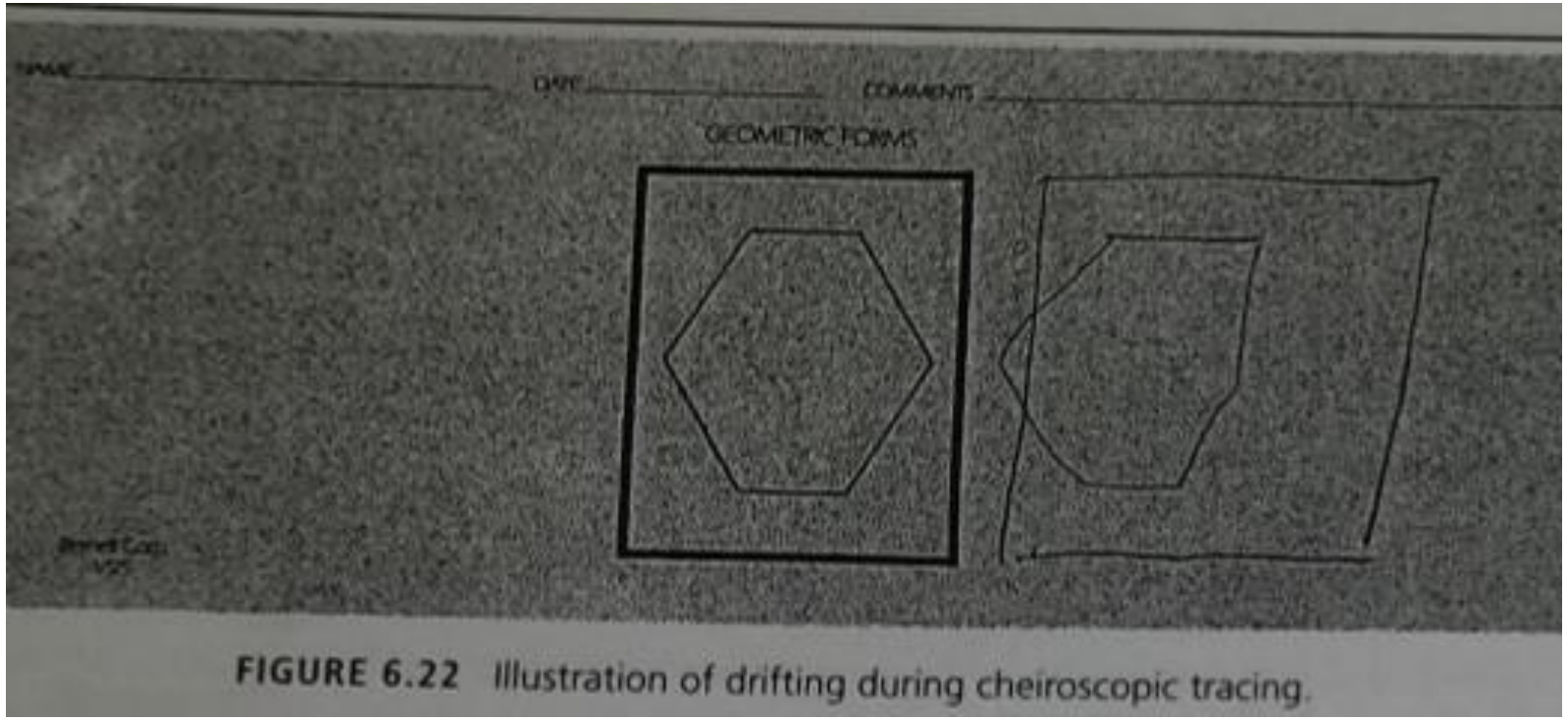


FIGURE 6.22 Illustration of drifting during cheiroscopic tracing.

3 - Voluntary convergence methods

- Brock string
- Barrel cards

3 - Voluntary convergence methods – Brock string

- Goals: We try to built sense of object going far away, voluntary convergence ability and normalize near point of convergence
- Equipment: Brock string, flip lens, flip prism, pencil
- Procedures: Brock string contains 3 color beads. We use it usually in convergence insufficiency, in esophoria to train the proper convergence

3 - Voluntary convergence methods – Brock string – Therapy 1

- Step 1: We need 2 beads, patient change fixation of anterior and posterior bead. If patient focus first bead the rear one is doubled
- Step 2: Patient tries to converge more close beads
- Step 3: Patient should eliminate sense of the string and concentrate on convergence

3 - Voluntary convergence methods – Brock string – Therapy 1 - Picture

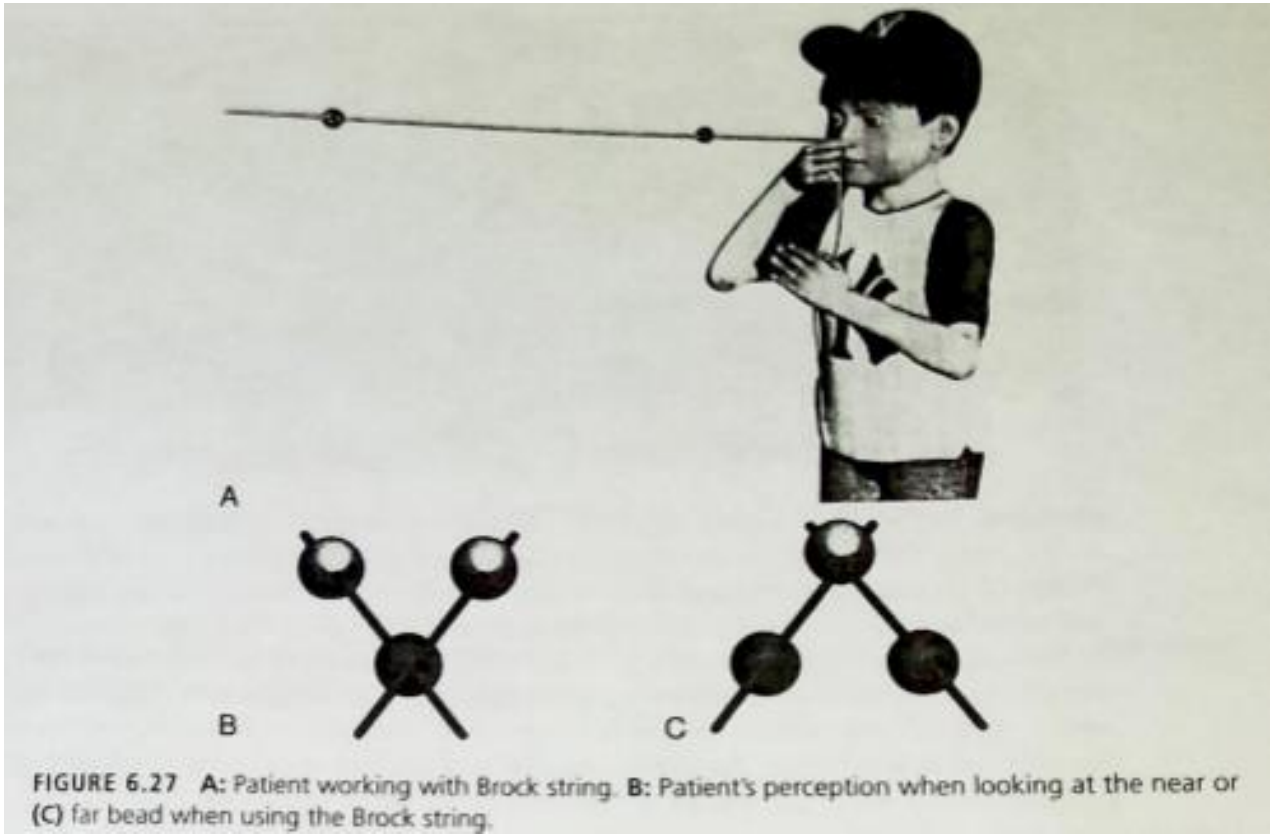


FIGURE 6.27 **A:** Patient working with Brock string. **B:** Patient's perception when looking at the near or **(C)** far bead when using the Brock string.

3 - Voluntary convergence methods – Brock string – Therapy 2

- We can train also saccades with Brock string
- But we need 3 strings
- We can also train pursuits

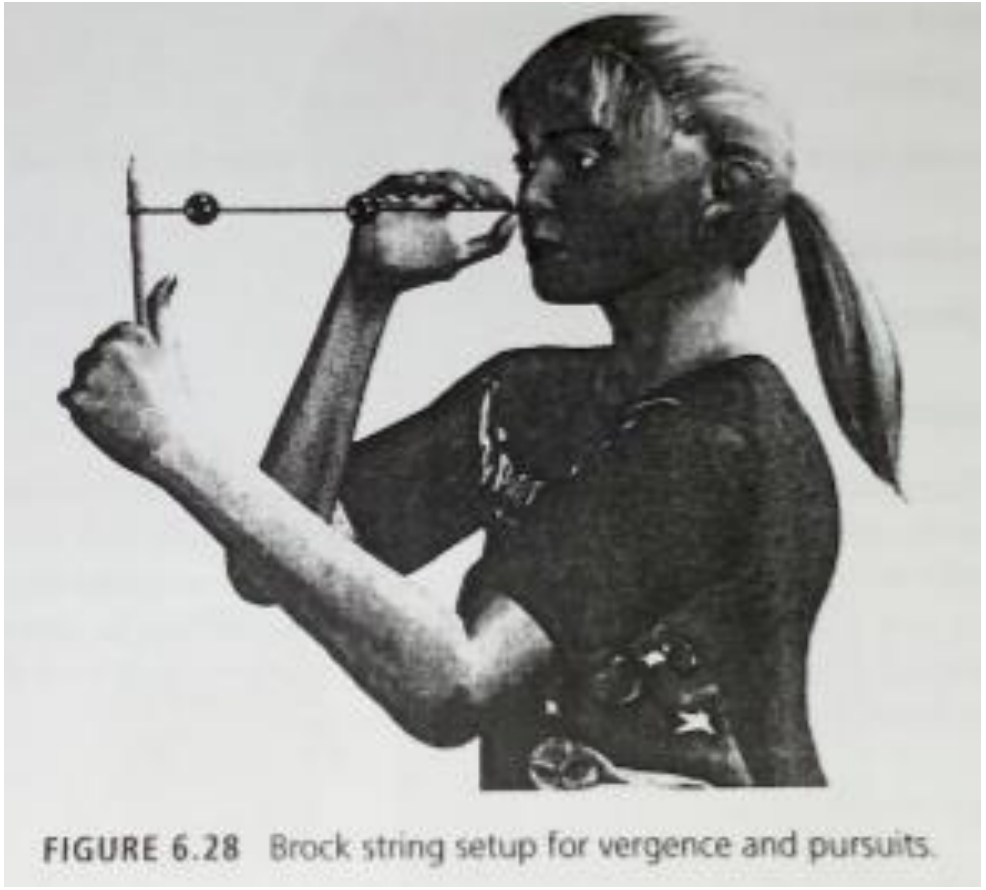


FIGURE 6.28 Brock string setup for vergence and pursuits.

3 - Voluntary convergence methods – Brock string – Therapy 3

- We can change level of difficulty – decrease:
  - Minus lenses
  - BI prism
  - Bead far from the nose
- We can change level of difficulty – increase:
  - Plus lenses
  - BO prism
  - Bead closer to the nose

3 - Voluntary convergence methods – Brock string – Therapy ending

- Successful convergence in distance 2.5 cm from the nose
- Sense of normal convergence and divergence
- Ability to voluntary convergence
- Adequate vergence value

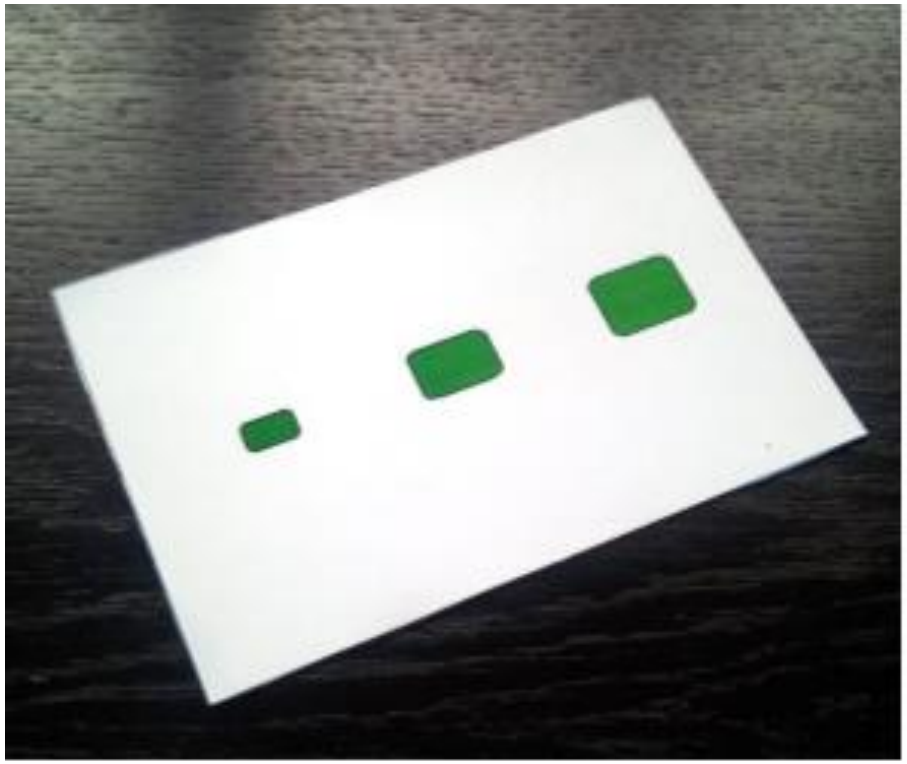
3 - Voluntary convergence methods – Barrel card - Introduction

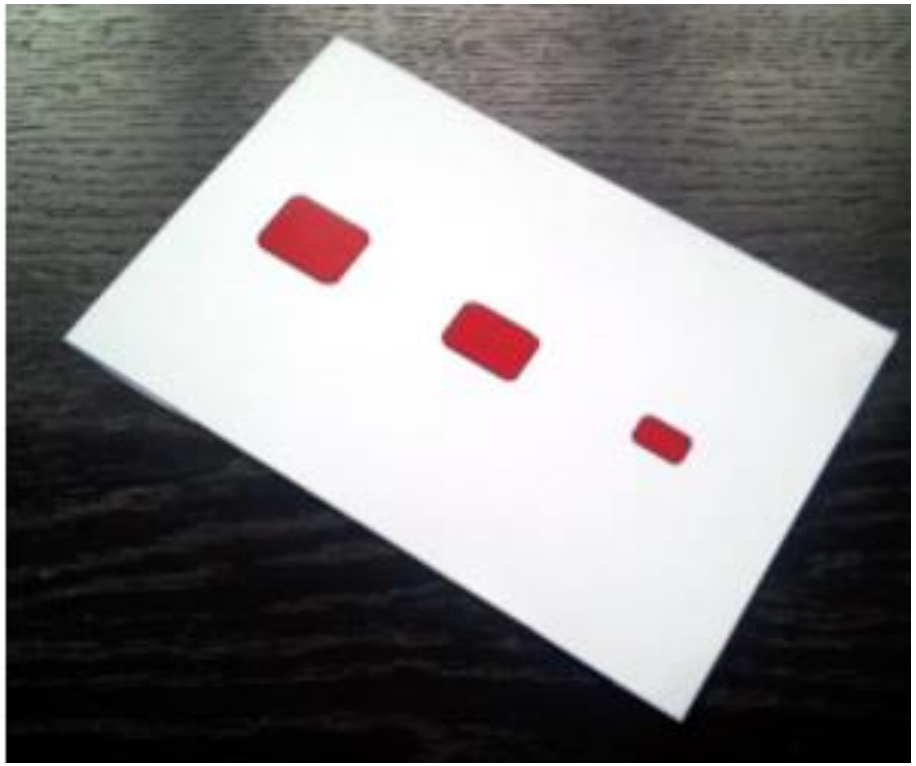
- Goals: Built the sense of approaching and receding object, built the ability to use voluntary convergence, near point normalization
- Equipment: Barrel card
- Procedure: Red barrel on the left side and green on the right side. This test is recommended for patients with convergence insufficiency. We use it after Brock string training

3 - Voluntary convergence methods – Barrel card – Picture 1

https://www.youtube.com/watch?v=HtzEHSie-90

3 - Voluntary convergence methods – Barrel card – Picture 2





3 - Voluntary convergence methods – Barrel card – Procedure and its finalizing

- Barrel card is placed on the nose
- Patient tries to converge and fuse the most distant barrel at least for 10 seconds
- After that patient has to fixate middle barrel
- Finally patient tries to fixate and fuse the smallest and closest barrel
- Finishing: Patient is able to converge at distance 2.5 cm from nose with adequate convergence and divergence

4 - Anti-suppression methods

1. Bar reader
2. TV trainer
3. Red-green glasses with the light
4. Vertical dissociating prism
5. Training of superposition with mirror (mirror superimposition)

4 - Anti-suppression methods: 1 – Bar reader

- Goals: We use it for suppression control during BAF therapy and fusion facility training
- Equipment: Red-green or polarized overlay, red-green or polarized glasses, flip lens, flip prism or loose prism
- Procedures: Patient tries to red over the dissociating overlay. One eye can see part of the text and the second eye can see other part of the text

4 - Anti-suppression methods: 1 – Bar reader – Picture 1

4 - Anti-suppression methods: 1 – Bar reader – Procedure

- Text reading can be followed by BAF training, image skipping with prism (saccades training) and vergence facility training

4 - Anti-suppression methods: 2 - TV trainer

- Goal: We try to decrease depth and frequency of suppression
- Equipment: TV trainer overlay, red-green glasses, TV (monitor)
- Procedure: TV trainer overlay is stick on the monitor. Patient wears glasses. If there is the suppression part of the monitor is black
- Change of difficulty: We can change monitor distance, use lenses or prism
- Other goals: We develop stabile simple binocular vision

4 - Anti-suppression methods: 3 - Red-green glasses with the light

- Goals: With R-G glasses and point light we try to decrease depth and frequency of suppression. This therapy is not suitable for patients with ARC
- Equipment: R-G glasses, point light, 6 prism
- Description: Patient wears R-G glasses with prism BD on dominant eye, watching point light, we can change light intensity, its position, we can move with light and flash with it

4 - Anti-suppression methods: 3 - Red-green glasses with the light – Procedure and its finishing

- Patient wears R-G glasses, leading eye has 6 prism BD, patient watches point light
- If patient do not see doubled the point light we try to change light intensity of the point light, or surrounding light or we move with the point light in space
- Finishing: Patient should see two point lights with prism without R-G glasses in normal light conditions

4 - Anti-suppression methods: 4 - Vertical dissociating prism

- Goal: Vertical prism makes diplopia, it is suitable for patient with heavy suppression, e.g. in anisometropia, heterophoria or intermittent strabismus, can interfere with vergence therapy which can decrease effect of this therapy
- Equipment: Light point, isolated optotype letter, 6-8 prism
- Procedure: We start with low room light and low point light, if the suppression is worse in near we start from distance
- Finishing: Patient should see two standard light of the point light in normal room light

4 - Anti-suppression methods: 4 - Vertical dissociating prism – Further procedures and finishing

- Training can be combined with training of saccades and pursuits, convergence and divergence training
- In patients with heterophoria we can observe change of horizontal object position
- Finishing: Therapy can be finished if patient is able to see with diplopia (with vertical prism) in normal light room condition

4 - Anti-suppression methods: 5 - Training of superposition with mirror

- Goal: Superimpose the images and protection against suppression
- Equipment: Small mirror, different fixation objects
- Procedure: Patient holds small mirror before right eye in angle 45 degrees and try to superimpose left eye image with the right eye image

4 - Anti-suppression methods: 5 - Training of superposition with mirror - Picture

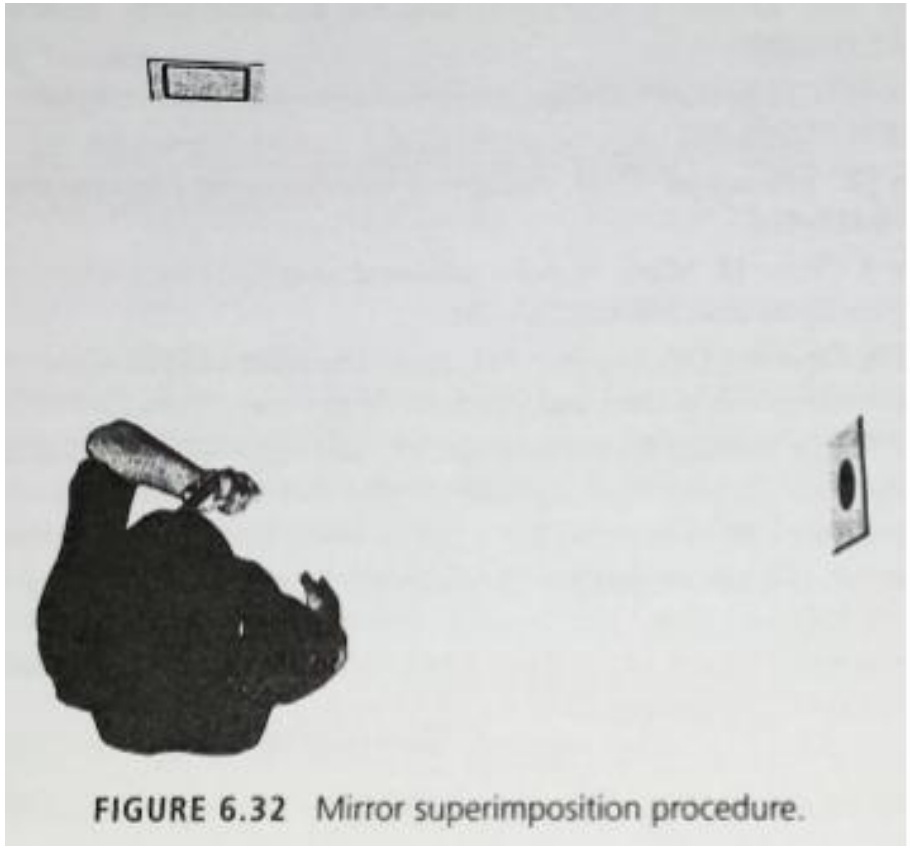


FIGURE 6.32 Mirror superimposition procedure.

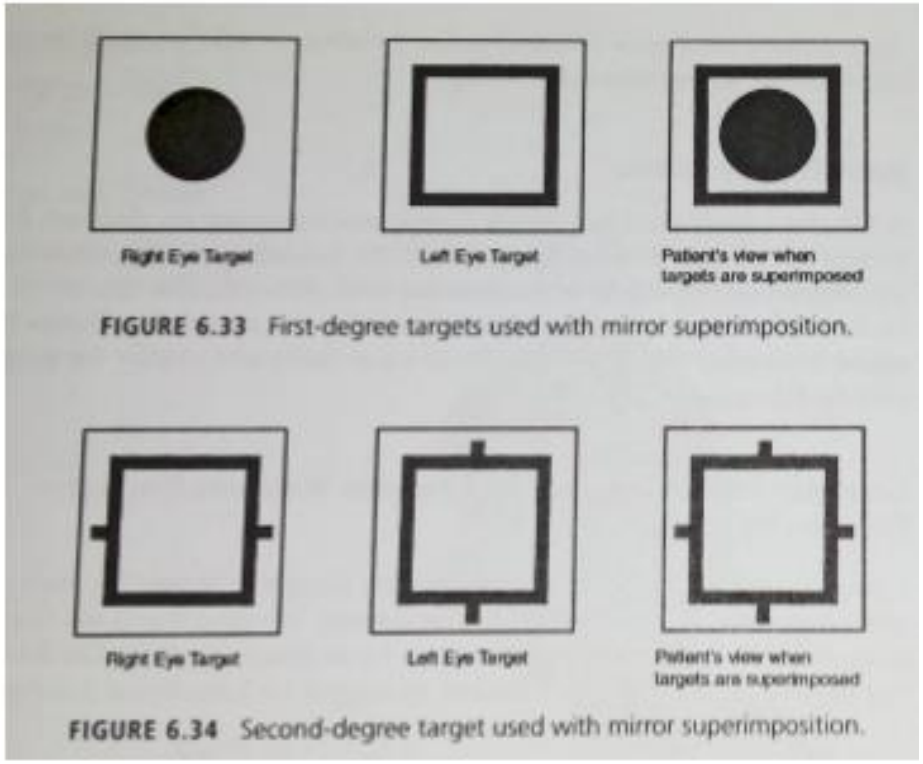


FIGURE 6.33 First-degree targets used with mirror superimposition.

FIGURE 6.34 Second-degree target used with mirror superimposition.

4 - Anti-suppression methods: 5 - Training of superposition with mirror - Procedure and finishing

- We train at first with pictures for superposition and next for the fusion
- During the training we decrease the size of the pictures
- Finishing: Procedure can be finished if patient can see both pictures.

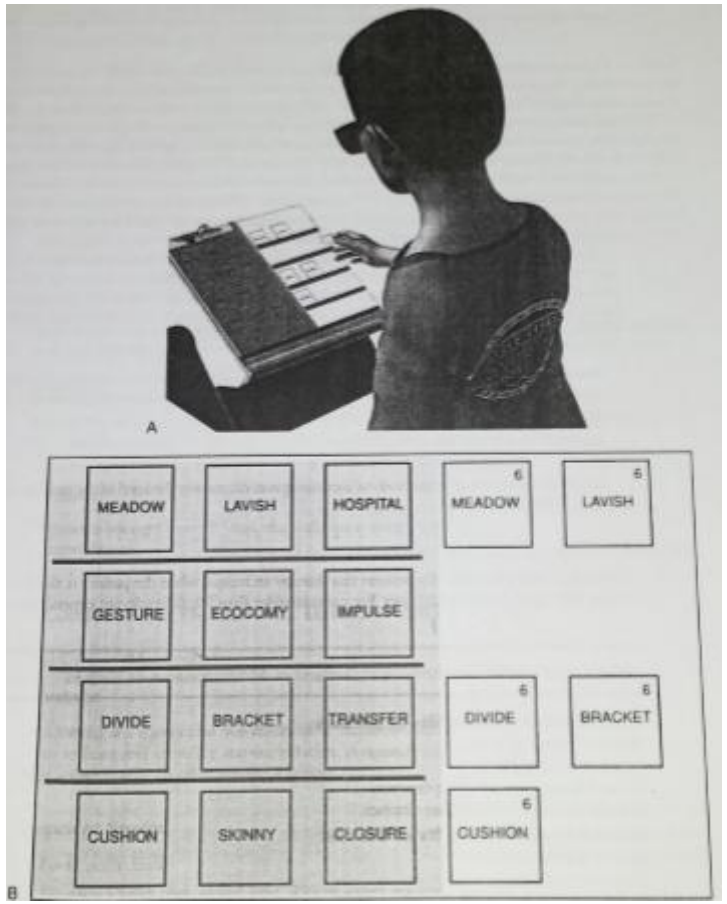
5 - Accommodative techniques

1. Anaglyph and polarized techniques (Red-red rock)
2. Lenses, prism and mirror (Lens sorting, Loose lens rock – mono and bino, binocular accommodative facility - BAF)
3. Paper, pencil and tasks (Hart's chart)

5 - Accommodative techniques: 1 - Anaglyph and polarized techniques - Red-red rock - Introduction

- Goals: Anaglyph training for improvement of accommodative amplitude and facility
- Equipment: R-G glasses, cheiroscope with R-G overlay, trial lenses
- Procedure: Patient observe letters on the plane. Left side is covered with red overlay. With R-G glasses right eye can see right side, left eye can see black word/letters on the right side. Patient has to look for same words on both sides

5 - Accommodative techniques: 1 - Anaglyph and polarized techniques - Red-red rock - Picture



5 - Accommodative techniques: 1 - Anaglyph and polarized techniques - Red-red rock – Important factors

TABLE 7.1 Important Factors to Emphasize When Performing Accommodative Therapy

The feeling of stimulating and relaxing accommodation.
The ability to clear the target as quickly as possible when changing lenses.
The patient, not the therapist, should hold and manipulate the lenses.
Changes must occur within the patient's own visual system.
Equalize the performance in the two eyes.
The awareness of diplopia during biocular techniques.

5 - Accommodative techniques: 1 - Anaglyph and polarized techniques - Red-red rock – Procedure and finish

- During the exercise we use lenses from +2.5 to -6 D
- In the first phase we do it without time limit, further we reduce time
- Finish: Patient 20 years old should be able to see clearly with lenses +2.5 to -6 D. In older patients we use lenses only up to half of their accommodation amplitude

5 - Accommodative techniques: 1 - Anaglyph and polarized techniques - Red-red rock – Accommodative demand modification

TABLE 7.2 Procedures to Modify the Level of Demand of Accommodative Techniques

Decreasing the level of difficulty of the task
Decrease power of lenses.
Increase size of print.
For plus lenses, decrease the working distance.
For minus lenses, increase the working distance.
Increasing the level of difficulty of the task
Increase power of lenses.
Decrease size of print.
For plus lenses, increase the working distance (this is limited to reciprocal of lens power).
For minus lenses, decrease the working distance.

5 - Accommodative techniques: 2 - Lenses, prism and mirror – Lens sorting

- Goals: Patient should be aware of accommodation stimulation and relaxation and can effectively use it
- Equipment: Uncut single lenses, accommodation optotype (0.2-0.6), occlusion
- Procedure: In older patient we use minus lenses with power equal to half of patient's accommodation amplitude. Patient looks through lenses and tries to clear optotype and sorts the lenses

5 - Accommodative techniques: 2 - Lenses, prism and mirror – Lens sorting - Questions

- Patient tries to sort spectacle lenses
- We can ask questions:
  - Which lens makes object larger/smaller
  - Which lens is more difficult to accommodate
  - Which lens object move closer/farther
- Patient should be aware of effort for accommodation and des-accommodation

5 - Accommodative techniques: 2 - Lenses, prism and mirror – Lens sorting – Change of difficulty and finish

- Decreasing patient’s effort: In patients with accommodation excess we starting with minus lenses. In patients with accommodation insufficiency with use only plus lenses
- Increasing patient’s effort: Lenses differs only with 0.25 D, patient has time limit for sorting
- Finish: We can stop procedure if patient is able to distinguish lenses with 0.5 D

5 - Accommodative techniques: 2 - Lenses, prism and mirror – Loose lens rock (monocular)

- Goals: Renewing of normal accommodative amplitude and facility
- Equipment: Optotype with different letter size (0.2-0.6), uncut spectacle lenses from -6 to +2.5 D in 0.25 D steps
- Procedure: Firstly patient tries to make clear text with increasing power of lens. Secondary patient tries to accommodate alternatively over plus and minus lenses

5 - Accommodative techniques: 2 - Lenses, prism and mirror – Loose lens rock (monocular) - Picture

https://www.youtube.com/watch?v=6VGWoVh69f0

5 - Accommodative techniques: 2 - Lenses, prism and mirror – Loose lens rock (monocular) – Exercise finishing

- In patients up to 20 years we try to stabilize accommodation through +2.5 D to -6 D with frequency 20 cpm
- In older patients we use strongest minus equal half of the patient's accommodation amplitude

5 - Accommodative techniques: 2 - Lenses, prism and mirror – Loose lens rock (binocular)

- Goal: Renewing of the accommodation amplitude and facility during suppression elimination
- Equipment: Reading text (0.2-0.6), uncut lenses from -6 to 2.5 D, 6 prism vertically
- Procedure: Patient wears 6 prism vertically and reads. We use +2.5 to -6 D. Secondary we use binocularly +/- 0.5 D to +2/-4 D with frequency 20 cpm
- Finishing: Patient should accommodate from +2.5 to -6 D with frequency 20 cpm

5 - Accommodative techniques: 2 - Lenses, prism and mirror – BAF

- Goals: Patient tries to decrease latency and increase velocity of accommodation
- Equipment: Flip lenses from +/-0.5 to +/-2.5 D, reading text, polarized or R-G overlays, polarized or R-G glasses, vectogram or anaglyph
- Procedure: Patient uses R-G glasses and overlay. Patient use flip lenses and tries to see clear the text. We start with +/-0.5 D. Secondary we can use tranaglyph as the fixation target
- Finishing: We try to reach accommodation and des-accommodation with lens +/-2.5 D and frequency 20 cpm without suppression

5 - Accommodative techniques: 2 - Lenses, prism and mirror – BAF - Picture

https://www.youtube.com/watch?v=1htUxVcuZwA

5 - Accommodative techniques: 3 - Paper, pencil and tasks – Hart chart (monocularly)

- Goals: Renewing of normal accommodation amplitude and facility – range and velocity
- Equipment: Large and small Hart chart, occlusion
- Procedure (3 levels):
  1. Patient hold HC in 40 cm before eye, reads first row and then looks at large HC
  2. Patient moves small HC closer. When it is blurry then patient look at large HC in 5 m
  3. Patient moves small HC to distance 2.5 cm from nose

5 - Accommodative techniques: 3 - Paper, pencil and tasks – Hart chart (monocularly) - Picture

5 - Accommodative techniques: 3 - Paper, pencil and tasks – Hart chart (monocularly) - Finish

- Patients younger 20 years ends therapy when clear small HC in 8 cm from nose and large in 3 m
- Older patients have small HC in distance which refers to their accommodation amplitude

6 - Motor techniques

1. Lenses, prism and mirrors (Loose prism jumps)
2. Paper, pencil and tasks (Hart chart, letter or symbol tracking, visual tracking, rotator, flashlight tag)
3. Afterimages

6 - Motor techniques: 1 - Lenses, prism and mirrors – Loose prism jumps

- Goal: We try to make saccades more exact and rapid, done monocularly
- Equipment: Loose prism 12, 10, 8, 6, 5-1 and 0.5 prism, different fixation targets
- Procedure: One eye is covered, we introduce prism in front of uncovered eye, this eye has to refixate making saccadic motion. We start with larger saccades (higher prism) and larger objects. We use prism base in all direction
- Finish: Patient is able quickly and exactly make the saccadic motion for far and near

6 - Motor techniques: 2 - Paper, pencil and tasks – Hart chart

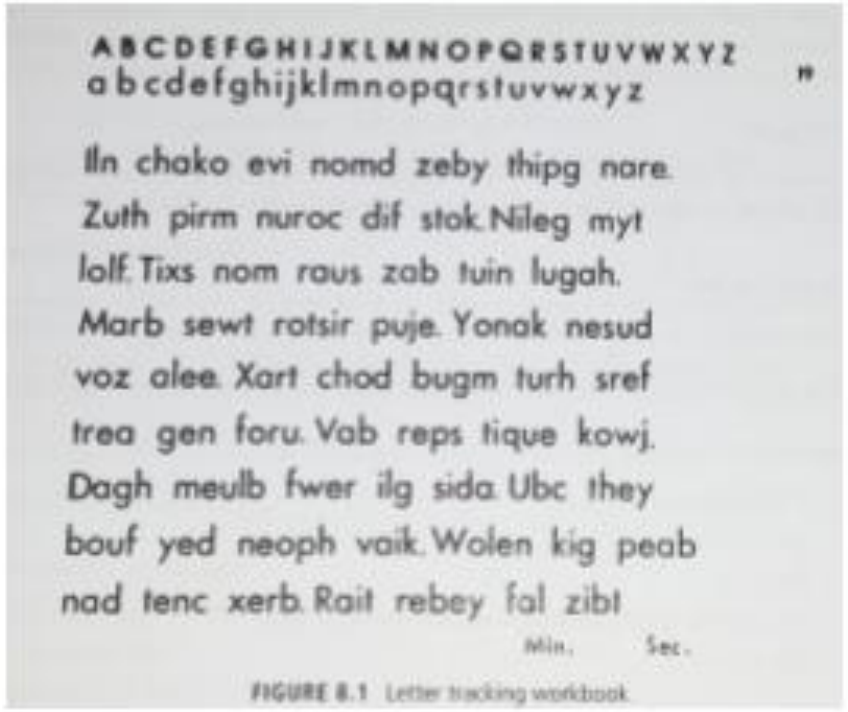
- Goals: Increasing of velocity and exactness of the saccades with HC
- Equipment: Occlusion, large distance Hart chart
- Procedure: HC is placed in 3 m distance. Patient has covered one eye. Patient has to read 1st letter from 2nd row etc.
- Finishing: Patient should exactly read letters in HC which are surrounded by other letter

6 - Motor techniques: 2 - Paper, pencil and tasks – Hart chart - Picture

6 - Motor techniques: 2 - Paper, pencil and tasks – Letter or symbol tracking

- Goals: If patient connect letters or symbols it will increase his exactness and velocity of saccadic eye movements (monocularly)
- Equipment: Letters and symbols, occlusion, transparent plastic foil
- Procedure: In letters patient connect letters according to alphabet, in symbols according to task
- Finish: We try to equal test time for both eyes

6 - Motor techniques: 2 - Paper, pencil and tasks – Letter or symbol tracking - Picture



ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz

Iln chako evi nomd zeby thipg nare.
Zuth pirm nuroc dif stok. Nileg myt
lolf. Tixs nom raus zab tuin lugah.
Marb sewt rotsir puje. Yonak nesud
voz alee. Xart chod bugm turh sref
trea gen foru. Vab reps tique kowj.
Dagh meulb fwer ilg sida. Ubc they
bouf yed neoph vaik. Wolen kig peab
nad tenc xerb. Rait rebey fal zibt

Min. Sec.

FIGURE 8.1 Letter tracking workbook.

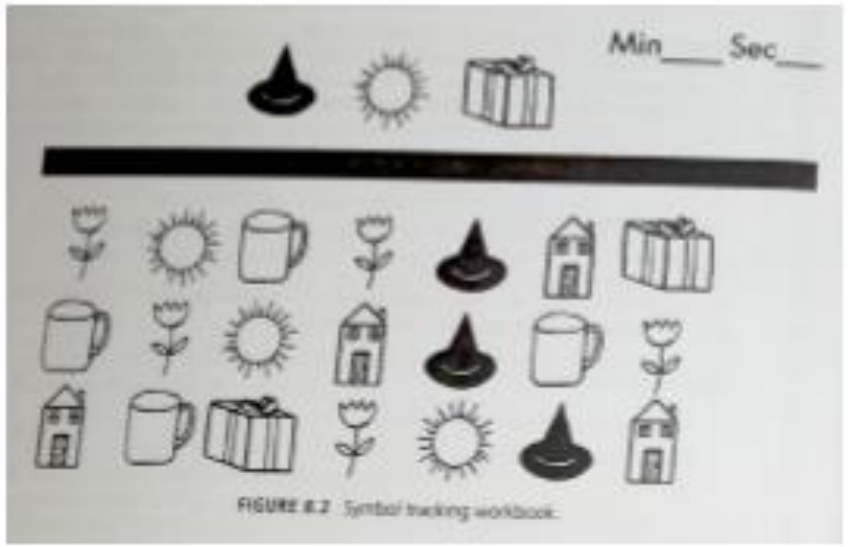


FIGURE 8.2 Symbol tracking workbook.

6 - Motor techniques: 2 - Paper, pencil and tasks – Visual tracking

- Goals: Improving of exactness and velocity of the pursuits
- Equipment: Visual tracking workbooks, plastic transparent foil, occlusion
- Procedure: Cover one eye, with uncover eye we connect letter A with number. Patient should define the numbers
- Finish: For every exercise we have normative time. We training as long as we reach normative time

6 - Motor techniques: 2 - Paper, pencil and tasks – Visual tracking - Picture

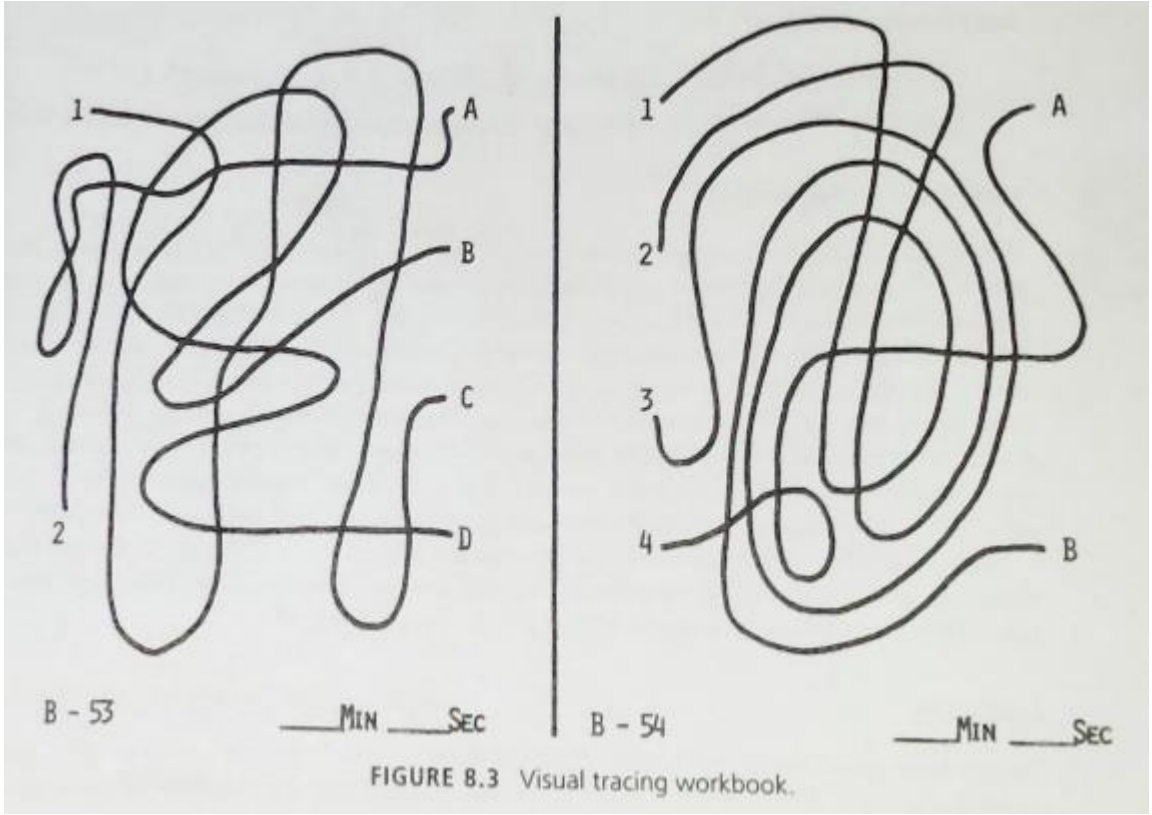


FIGURE 8.3 Visual tracing workbook.

6 - Motor techniques: 2 - Paper, pencil and tasks – Rotator

- Goal: Improvement of pursuits velocity
- Equipment: Rotating Pegboard, automatic rotating instrument, occlusion
- Procedure: Patient has to insert objects in holes of rotating instrument

6 - Motor techniques: 2 - Paper, pencil and tasks – Rotator - Picture

6 - Motor techniques: 2 - Paper, pencil and tasks – Flashing tag

- Goal: Increase of quality and velocity of pursuits
- Equipment: Two light sources, occlusion
- Procedure: We project light on the wall and patient tries to superimpose this spot light (simultaneously)

6 - Motor techniques: 3 - Afterimages

- Goals: We try to improve exactness of saccades and pursuits with the feed back for patient
- Equipment: Camera with the flash
- Procedure: We form narrow slit on the camera’s flash, one eye is covered, we produce patient’s afterimage, after that patient has to blink or we switch the light on and off. Patient should se afterimages everywhere he looks
- Finish: This method can be combined with Hart chart or automatic rotary instrument

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