

A new model of functional astigmatism

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ABSTRACT—Astigmatism is a refractive condition in which there is a variation of power in the different meridians of the eye. The cause of the condition has been subject to considerable discussion and debate over the years. Some consider it to be a structural anomaly following genetic and environmental patterns while others conceive of it as being functional in origin. To complement the more traditional view, this paper proposes a new and more encompassing model of functional astigmatism involving an interrelationship among the factors of eye position, head scan and head posture with implications that changing the elements within this triad can have a positive effect in reducing astigmatism.

KEY WORDS—astigmatism; with-the-rule; against-the-rule; oblique astigmatism; eye scan; head scan; head posture.

Astigmatism has been of interest since Thomas Young first discovered, measured and described the condition in himself in 1801.¹ Wharfedale Jones, in 1855, attributed it to a defect in the cornea.² It has since been found to be a condition that is quite prevalent.³ The enigma is whether it occurs. Is it mainly a structural anomaly following genetic or environmental trends or is it primarily func-

tional in nature, responding to use? Many have taken sides on this issue and have used clinical observations and research studies to substantiate their differing points of view.^{4,5,6,7,8,9,10,11,12,13,14} Interestingly, Emile Javal,¹⁵ one of the early and noted researchers in the area of astigmatism, observed over a century ago, that it was a common occurrence for astigmatism to decrease in strabismic patients after they had undergone either extraocular muscle surgery or stereoscopic exercises (orthoptic training).

My involvement in this area was sparked by the appearance of relatively rapid and unexpected astigmatic changes in individuals of varying ages whose refractive status had been stable for many years. It was also noted that many myopic and presbyopic individuals did not develop less with-the-rule (-cyl.×180) or more against-the-rule (-cyl.×90) astigmatism as recent research studies would lead one to expect.^{16,17,18,19} In addition, it was observed that many changes in astigmatism, often of low degree, appeared to be coincident with specific changes in work, study or TV habits.

This element of astigmatic

change was investigated over a period of many years. During this time, patients who demonstrated changes in their astigmatic status were questioned extensively and asked to demonstrate, often through the use of a visual imagery approach, how they performed their major visual tasks. This included determining how they sat, how they held their heads, and how they responded visually to secondary elements involved in their work that required looking up, down, or to the sides from what they were doing. (See Appendix for suggestions on using a visual imagery approach in order to determine how major visual tasks are performed.)

This long-term investigation revealed a distinct relationship between the development of functional astigmatism (or changes in existing astigmatic status) and persistent changes within an operational triad consisting of visual scan (eye movement free of accompanying head movement), head scan (eye movement yoked to head movement), and head posture (a combination of angle, rotation and tilt of the head in relation to gravity). (See Figures 1, 2, and 3.)

A subsequent research study on 45 patients revealed that altered



Figure 1: VISUAL SCAN—Eye movement free of accompanying head movement.



Figure 2: HEAD SCAN—Eye movement yoked to head movement.

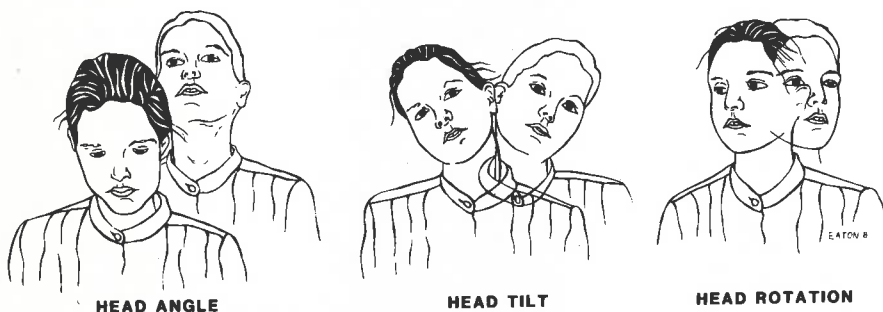


Figure 3: HEAD POSTURE—The major elements of head movement around the x, y, and z axes.

eye usage not only could trigger astigmatic changes but could do so in as short a period of time as four months. A second study, in turn, indicated that it was also possible to use refractive astigmatic data to predict the eye scan/head scan/head posture relationship.²⁰

A major implication of this investigation was that persistent limitation of eye movement on a meridional basis was seen to precipitate the development of astigmatism with the strongest power forming in the meridian of greatest "head scan," where eye and head movement tend to be yoked together. In other words, the visual system appears to become more myopic (or less hyperopic) in the

meridian in which the potential for the eyes to scan free of head movement is limited or restrained as compared to the meridian 90° away.

The key relationships are as follows:

Key Elements

1. With-the-Rule (-cyl.×180) astigmatism appears to relate to a greater observed preference for visual scanning (free of head movement) in the horizontal meridian.
2. Against-the-Rule (-cyl.×90) astigmatism appears to relate to a greater observed preference for visual scanning in the vertical meridian.

3. The overall magnitude of astigmatism appears to relate to the degree of difference in the visual scanning status between the predominantly visual (or eye) scanning meridian and the predominantly head scanning meridian. Less astigmatism indicates less of an operational difference between meridians. Little or no astigmatism appears to develop when the eye scan—head scan preferences (whatever they may be) are approximately equal in all meridians.
4. Astigmatic Anisometropia is a condition in which there is a difference in astigmatism between the two eyes. This appears to develop as a result of a persistent mismatch between the structural midline of the head and the operational visual midline as represented by an imaginary line bisecting the angle formed by the lines of sight as they fixate on a target. (See Figure 4.) This kind of mismatch can be elicited by working off to the side without fully rotating the head, keeping work directly ahead while rotating the head to one side, or a combination of the two. In any case, it was found that the eye

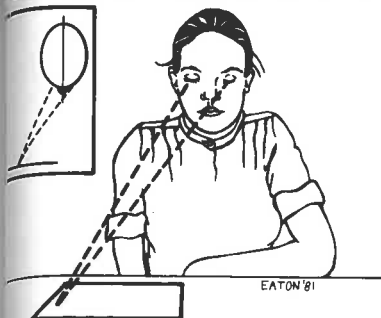


Figure 4: A mismatch between the structural midline of the head and the operational visual midline.



not yoked to head movement.

l magnitude of astigmatism appears to relate to the difference in the visual axis between the pre-visual (or eye) scanning meridian and the predominant scanning meridian. The eye that is consistently closest to being directly in line with and perpendicular to the task appears to develop less astigmatism. The closer that eye is to true perpendicularity with the task, the closer it will be to having little or no astigmatism. (See Figure 5.)

Oblique Astigmatism—Astigmatism is usually considered to be oblique when the principal meridians lie between the 30th and 60th or the 120th to 150th meridian.²¹ Since this author has always been impressed with the fact that so many astigmatic eyes measure exactly 90° or 180°, for the purposes of this paper axes that are not exactly vertical or horizontal will be considered to be oblique. Parallel Oblique Astigmatism is a condition in which the axes of astigmatism are the same in each eye, both being oblique. This appears to be due to a consistent obliquity in visual scanning that is related to either an

angled positioning of the task, an angled position of the head, or some combination of both. It is specifically caused by a mismatch between the geometry of the head position (a right or left tilt of the head) and the corresponding geometry (or placement) of the task.

Astigmatism of -cyl.×25, for example, would indicate that the consistent line of scan of the predominantly visual scanning meridian is 25° from the "horizontal" plane of the eyes (a plane at the level of the two eyes). (See Figure 6.)

If, however, the tilt of the head and the tilt of the task are similar so that the "horizontal" plane of the eyes and the visual scanning meridian are coincident, the resulting astigmatism will tend to be with-the-rule (-cyl.×180) rather than oblique. (See Figure 7.)

Similarly, if the preferred visual scanning meridian is perpendicular to the "horizontal" plane of the eyes (regardless of head tilt) the resulting astigmatism will tend to be against-the-rule (-cyl.×90). (See Figure 8.)

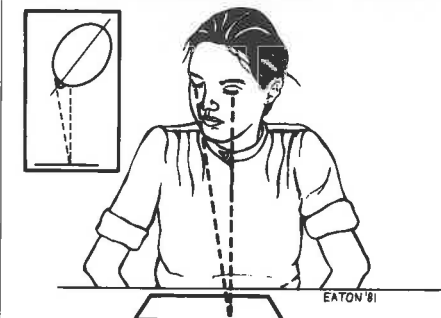


Figure 5: The eye closest to being directly in line with and perpendicular to the task develops less astigmatism.

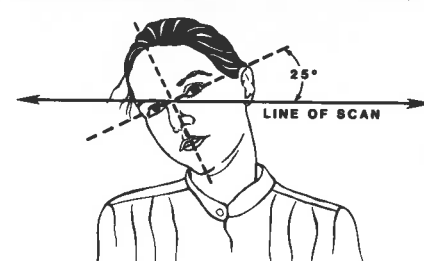


Figure 6: A 25° mismatch between the line of scan and the "horizontal" plane of the eyes.

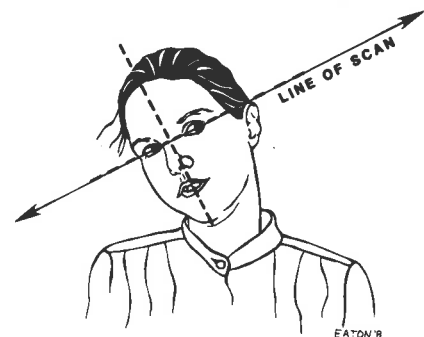


Figure 7: Coincidence of the visual scan meridian and the "horizontal" plane of the eyes results in W. R. astigmatism even when the head is persistently tilted.

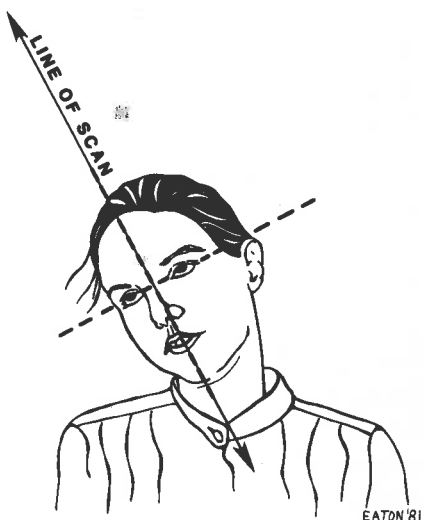


Figure 8: A visual scan meridian that is perpendicular to the "horizontal" plane of the eyes results in A. R. astigmatism even when the head is persistently tilted.

play among the following: the frontal plane of the head (facial plane), the primary position plane (a plane at the level of the two eyes that is perpendicular to the frontal plane of the head), the plane of regard (a plane connecting the lines of sight as they

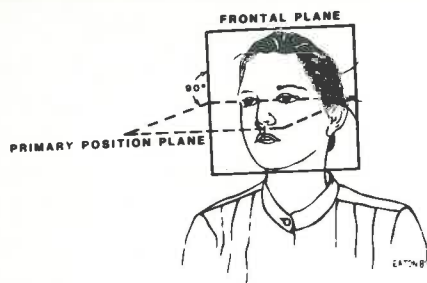
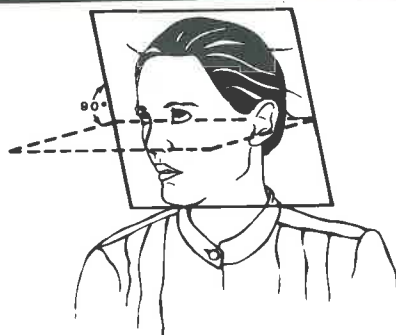
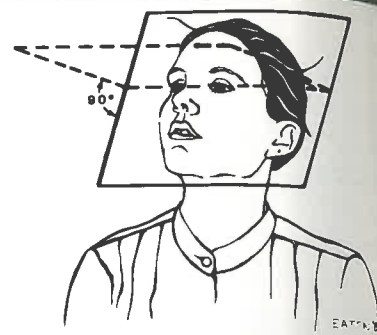


Figure 9: Relationship between the Frontal Plane of the head and the Primary Position Plane.



SCANNING ABOVE PRIMARY POSITION PLANE

Figure 10: Scanning above or below the Primary Position Plane as a result of persistent head angling.



SCANNING BELOW PRIMARY POSITION PLANE

fixate the object of regard), and the preferred scan (horizontal, vertical or oblique). (See Figure 9.)

Symmetrical oblique astigmatism appears to result from a consistent disparity (or mismatch) between the primary position plane (P.P.P.) and the plane of regard. It is caused by a persistently angled relationship between head position and the position of the habitually scanned fixation targets. (See figure 10.)

In binocular individuals, persistent scanning above the P.P.P. appears to result in intorted axes. Vertical eye scanners are noted to exhibit intorted axes closer to the vertical while horizontal eye scanners are seen to exhibit intorted axes closer to the horizontal. The further the average scan is above the P.P.P. the closer the axes appear to approach O.D. 45 and O.S. 135.

Similarly, binocular individuals who persistently scan below the P.P.P. tend to reveal extorted axes. Vertical eye scanners are noted to exhibit extorted axes closer to the vertical while horizontal eye scanners are seen to exhibit extorted axes closer to the horizontal. The further the average scan is below the P.P.P. the closer the axes appear to approach O.D. 135 and O.S. 45.

It has been noted as well that for those whose work involves much near-to-far scanning, the location of the greater part of the slope of the scan (whether it is above or below the P.P.P.) determines the type of astigmatic obliquity (either extorted or intorted). It was also observed that "chin down" scanners do not appear to have to scan as much above the P.P.P. to achieve axes 45-135 obliquity as "chin up" scanners have to look below the P.P.P. to achieve axes 135-45.

Finally, it was noted that those who persistently resort to monocular seeing, whether due to strabismus or inefficient (fragile) binocularity tend to demonstrate the reverse obliquity. For example, "chin down" monocular scanners usually demonstrate extorted axes while "chin up" monocular scanners will tend to reveal intorted axes.

8. Asymmetrical astigmatism is a condition in which the axes of astigmatism are neither parallel nor totally symmetrical. This appears to be due mainly to a combined oblique eye scan/head tilt relationship superimposed upon an angled (chin up or chin down) head position.
9. The extreme of asymmetry is seen in perpendicularly-opposing astigmatism where the astigmatism in one eye approaches

vertical while that of the other approaches horizontal. This type of astigmatism appears to be evident in those who utilize a different type of scan for things done on the right side as opposed to the left side. In most instances, this is seen to be accompanied by poor binocularity.

Relationships

The long-term investigation that led to the development of the model and the studies that followed to substantiate it demonstrated a number of interesting factors. One of these was the apparent meaningfulness of small astigmatic changes of approximately .25 to .75 diopters as sensitive indicators of specific changes in work habits and eye usage.

A second factor had to do with the relationships between astigmatism and contact lens wear. A number of hard and soft contact lens patients whose astigmatism had changed (without evidence of any corneal edema) pointed out that specific areas of discomfort caused them to alter their usual visual scanning habits. Hard contact lens patients, for example, who had difficulty gazing upwards while wearing their lenses tended to become head movers when looking up and concurrently demonstrated an increase in with-the-rule astigmatism. One soft contact lens patient, in particular, had diminished acuity on lateral gaze due



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lens decentration triggered by
grow and tight outer lid angles.
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difficulty by becoming a greater
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tain clear vision while concu-
ly developing against-the rule-
astigmatism.

A third factor had to do with
keratometry. Retinoscopic and
subjective measurements were
de to determine the total ocular
astigmatism. In cases of discrep-
y, the final reference was always
de to the astigmatism found un-
subjective testing. Even though
significant relationship was seen
between changes in eye scan habits
changes in total intraocular as-
tigmatism, keratometric data, how-
did not demonstrate this same
sistency. Often there was little
no change at all. When kerato-
metric findings did change, there
appeared to be a significant time
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ent from patient to patient.

The fact that the meridional stat-
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tionship between corneal deforma-
tion and extraocular muscle action
involving the formation of astig-
matism and second, if so, why does
this not show up in a consistent
manner in keratometry?

The difference in astigmatism
between the total intraocular and
keratometric findings has been
called residual astigmatism. Tradi-
tionally, this difference has been
attributed to the shape, decentra-
tion, or tilt of the crystalline lens of
the eye even though no definitive
studies appear to be obtainable to
demonstrate that lenticular astig-
matism actually exists in an undi-
seased lens. Others have attributed
residual astigmatism to the angle
between the apex of the cornea and
the line of sight.^{28,29,30} Still others
have indicated that most residual
astigmatism can be accounted for
by a tilt of the corneal cap.³¹

These hypotheses may account
for some of the apparent inconsis-
tencies between a given kerato-
metric and a retinoscopic (or sub-
jective) finding but none appears to
adequately account for the relative
inconsistency of central corneal
keratometric readings in the face of
significant concurrent changes in
total ocular astigmatism.

In a recent controlled experiment
Cuttone et al.,³² created superiorly
placed corneoscleral limbal masses
and upper eyelid colobomas in a
total of 20 rabbit eyes. Refractive
changes were recorded over a one
month period using retinoscopy,
keratometry and photoelectronic
keratoscopy. In most instances, the
rabbits having had these proce-
dures demonstrated an increased
astigmatism. The astigmatic
change as measured by retinoscopy
was highly related to that found by
photokeratoscopy using ΔP values
(the algebraic difference between
the most central and the most pe-
ripheral point in each of four me-
ridians). No consistent effect was
found in regard to central kera-

tometry readings. This was ac-
counted for by the investigators as
being due to a flattening of the
periphery of the cornea which is
measurable by retinoscopic means
as well as photokeratoscopy long
before central corneal measures are
affected.

Extraocular muscle action

Far more is unknown than is
known about the workings of the
visual process, yet so much is taken
for granted. There are so many le-
gitimate "whys" that should be
considered and reconsidered. For
example, as Simpkins³⁷ posed, why
is the eyeball pliable? Why is the
cornea more steeply curve than the
rest of the globe? Why is the basic
shape of the globe dependent upon
the internal outward pressure of
the intraocular fluids? Why is the
center of rotation of the eye not
coincident with the actual center of
the globe? Why do the recti mus-
cles pull from in front backwards
and the obliques from behind for-
wards? Why are the recti inserted
at varying distances from the lim-
bus?

Is it possible that the action of
antagonistic muscles can either
stretch or squeeze the globe to lit-
erally lengthen or shorten the vi-
sual axis?

Is it possible that the difference
in curvature of the cornea and
sclera allows slight changes in the
length of the visual axis to be sen-
sitivity reflected in corneal shape?

All the answers are certainly not
available but the action of the ex-
traocular muscles does appear to
create forces that must be reckoned
with. Since eye movement has been
observed to be related to functional
astigmatism, then the extraocular
muscles should be considered to be
involved in some manner in its cre-
ation. If this is so, then the accepted
rules that appear to govern extra-
ocular muscle action should also
somehow relate to what has been
observed.

It is not within the scope of this paper to analyze all the specific muscle actions but it can be stated that the known actions of the extraocular muscles do appear to be related to the formation of many forms of functional astigmatism. Symmetrical oblique astigmatism can be used as a case in point.

All eye movements, in general, are combinations of versions (yoked, parallel movements) and vergences (non-parallel, disjunctive eye movements). The interplay between versions and vergences as one scans to the right and to the left inside of infinity is called asymmetric vergence.

Torsion (or cyclotorsion) is a rotation of the vertical meridian of the eye using the line of sight as an axis. (See Figure 11.) There is no torsion in vertical and horizontal movements from the primary position. Torsion arises from oblique eye movements. It also arises from lateral eye movements from a raised or depressed eye position. Torsion also arises from convergence.

Convergence induces an excyclotorsion which increases as convergence increases. Extorsion also increases as one converges above the primary position plane. It decreases as one converges below the primary position plane until at approximately 30-40° below the horizontal plane where a point of zero torsion is reached. As one converges further below this point intorsion increases.^{34, 35, 36} Scanning on a "Z" axis plane that is inclined with the top further from the subject also causes extorsion.³⁷

Symmetrical cyclotorsion (binocular extorsion and intorsion) in a functionally binocular individual is normally compensated for a reverse torsional response to maintain fusion (compensatory cycloduction). If this torsion is not totally compensated for the result could be diplopia, suppression or a

meridional aniseikonia. (See Figure 12.)

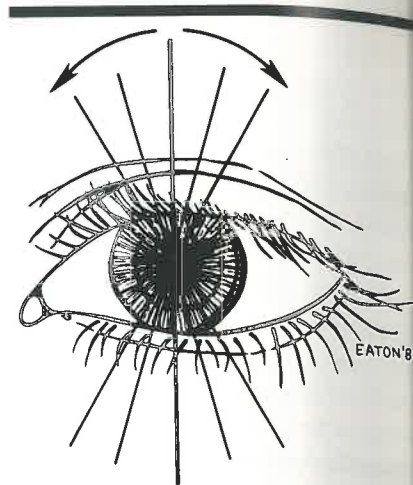
Interestingly, it has been long noted that even though cyclophorias are normally compensated for by the action of the oblique muscles there is less need for such compensation when oblique astigmatism is also present.³⁸ It can be implied, therefore, that oblique astigmatism might be a method for maintaining binocular parallelism of the vertical axes thereby reducing the need for a compensatory cycloduction, suppression or meridional aniseikonia.

It has also been noted that prescribing obliquely placed cylindrical lenses out-of-pattern, so that an artificial oblique astigmatism is created, can be used as a device to counteract and reduce a cyclophoria.³⁹ Perhaps, therefore, the formation of a natural oblique astigmatism is nature's way of counteracting and reducing a persistent cyclophoria.

In binocular individuals the adaptive development of astigmatism appears to be related to the compensations that are made to cope with the cyclotorsion. For example, scanning (or converging) above the primary position plane induces a binocular excyclotorsion. To maintain fusion, there must be a compensating binocular intorting response. It is adaptation to this compensatory force that appears to precipitate the formation of intorted symmetrical oblique astigmatism.

A similar condition of excyclotorsion in a monocular individual, or in one who tends to suppress one eye under binocular stress, appears to result in an adaptation that is directly related to the primary direction of torsion since there is no compensatory cycloduction needed to preserve fusion. In this case the persistent chin down (above P.P.P.) scanner would tend to develop extorted symmetrical oblique astigmatism.

Similarly, parallel oblique astig-



TORSION

Figure 11: CYCLOTORSION— A rotation of the vertical meridian of the eye.

matism of any kind appears to represent an adaptation to primary rather than compensatory forces since the cyclotorsion of each eye is yoked to the other in the same direction in terms of a right or left binocular torsional effect. (See figure 13.) The normal response to this situation would be to reduce the stress by going in the direction of the stress. Therefore, the axes of astigmatism in these cases could be expected to correspond to the direction of the cyclotorsion, either dextro or levo.

In turn, a persistent difference in meridional eye scanning that is predominantly vertical or horizontal in relation to the task might be hypothesized to result in vertical or horizontal rather than oblique astigmatism since minimal persistent torsional elements of one specifically and type or another would be involved.

Astigmatism, therefore, can be viewed as being both a sensitive indicator of persistent restraint in eye movements and as an indicator of the types of compensations that are made for different kinds of persistent extraocular muscle action.

Implications

Functional astigmatism, then, appears to be the physical ocular

CYCLOTORSION—A rotation of the eye.

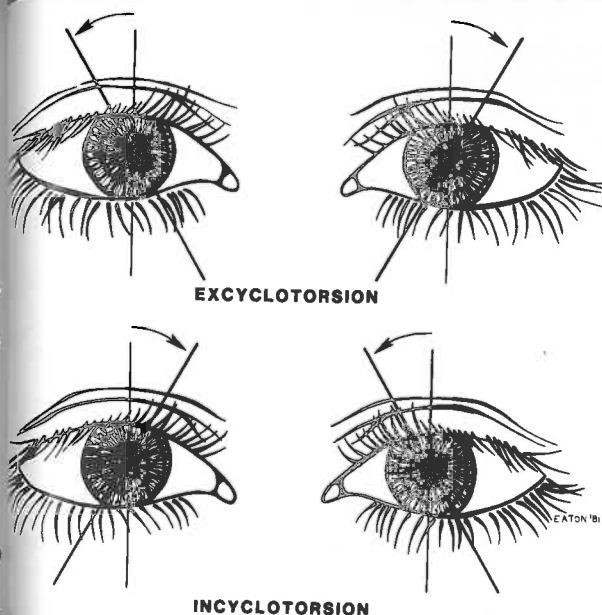


Figure 12: SYMMETRICAL CYCLOTORSION—Binocular excyclotorsion or incyclotorsion of the eyes.

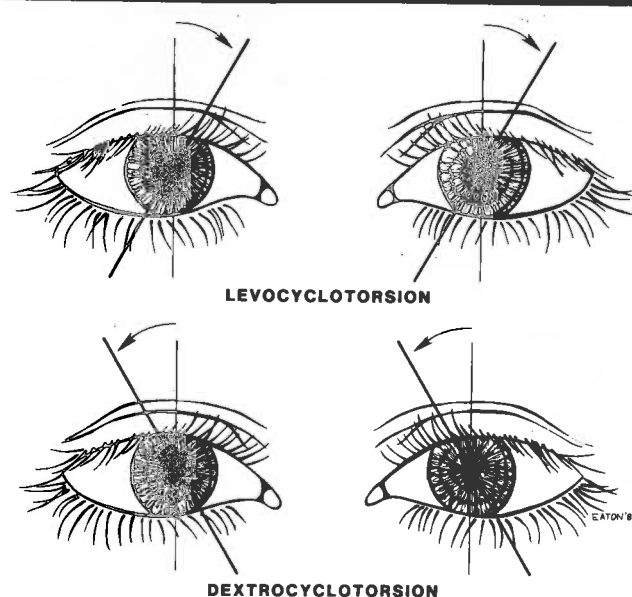


Figure 13: PARALLEL CYCLOTORSION—a unidirectional (left or right) cyclotorsion of the eyes.

and appears to represent a compensatory force for the torsion of each eye. In the same way, a right or left effect. (See figure 12: SYMMETRICAL CYCLOTORSION—A rotation of the eye.) The normal response to a right or left effect would be to reduce the angle in the direction of the effect. Therefore, the axes of the eyes in these cases could be expected to respond to the direction of the cyclotorsion, either by a persistent difference in eye movement scanning patterns in one meridian as compared to the meridian 90° away. There are many factors that can precipitate this meridional difference in eye movement patterns. For one thing, astigmatism is present in infants^{40,41} and as if to substantiate the model, Salapatek and Kessen⁴² have shown that infants as young as eight days of age demonstrate decided eye scanning preferences. As for older children and adults, the study that led to the development of the model indicates that a prime cause is work, television and television habits and a change in these habits will therefore, can be expected to alter the astigmatic status. In turn, these scanning habits are strongly influenced by the physical environment in which one works, studies or watches television, including the lighting and type and placement of the furniture. In addition, accommodative problems (including amblyopia), presbyopia, poor ocular organization and even the physical oculomotor mechanics involved in using a bi-

focal can be major factors inducing changes in eye scan habits. In fact, the relationship of both presbyopia and early myopia with the formation of against-the-rule (-cyl.×90) astigmatism appears to come about due to the "centralizing" effect that is often seen as a reaction to accommodative tension.

Regardless of the potential instigating factors, however, the change in astigmatic status appears to occur only in those who change the habitual interplay within the visual scan, head scan and head posture triad. If the visual scan habits are not changed, the astigmatic status does not appear to change.

Finally, since functional astigmatism appears to be molded by use at any age, it should be capable of being reversed to some degree by specific therapy geared to altering the relationships within the eye scan, head scan, head posture triad. A study in progress indicates that this assumption is, in fact, a valid one. Reduction in astigmatism through therapy does appear to be feasible at any age and within reasonable periods of time, regardless

of the corrective prescription that is worn by the individual. The subject of therapy will be treated in greater detail in a future paper.

The major implication is that even though there may be physical or physiological causes for some types of astigmatism, the vast majority of those with astigmatism appear to have a functional variety that is caused and altered by how the eyes are used in the ongoing interaction between the individual and his environment. **AOA**

Submitted for publication in the JAOA in 6/80

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ACKNOWLEDGMENT

The author wishes to convey his appreciation to Ms. Marian Eaton of the Learning Resources Center of the State College of Optometry of the State University of New York for her participation in the preparation of the illustrations contained in this article.

APPENDIX

The following is an abridged outline of a suggested examiner protocol utilizing a visual imagery approach to determine how major visual tasks are performed.

I. Patient Instructions

1. Sit comfortably. Do not sit stiffly or push yourself all the way back in the chair. Your arms should be at your sides with your hands in your lap, at least for now.
2. Close your eyes and keep them gently closed throughout.
3. Be completely relaxed. Feel your forehead and scalp muscles relax. Feel the muscles in and around your eyes become relaxed. Feel your cheek muscles and jaw muscles totally relax. Feel your neck muscles and your shoulder muscles relax. Feel them literally go limp.
4. Listen carefully to what I say. Try to do or act out what I ask you to do. Try to picture what I ask you to picture even if what you get to see in your mind's eye is not completely clear or vivid. In fact, it may be nothing more than a vague sensation. In any case, just listen to what I say and respond as best you can.
5. Picture yourself at work on the job (or if a student, at your desk in school). With your eyes closed and your body relaxed try to shift into the position you would normally be in when you work. Try to keep a picture in your mind of the room, the desk, the things that are usually on the desk or near you, the people around you and your normal body posture as you are involved in your work. Keep your eyes closed at all times and be totally relaxed.

II. Examiner Questions

(The following are only suggestions. They can be varied and elaborated upon depending on the particular occupation of the patient. Throughout, watch the position of the torso, head, arms and hands. Watch for eye movements through the closed lids.)

1. You are working at your desk. Picture yourself writing something. Shift the paper to where it would normally be and start writing. Now:
 - a. Look at your notes.
 - b. Someone walked in. Look up.
 - c. Someone near you or at your desk is talking to you. Look at the speaker.

- d. The telephone is ringing. Answer it.
- e. Look across the room to the clock (door, chalkboard, teacher, etc.).
- f. Start typing. Look at what you are typing. Now, look at your notes.
- g. Your desk work has gotten difficult. There is a problem to be worked out. It's very technical and detailed and it has to be completed very quickly. Work on it, now.
- h. You have a lot of things piled up on your desk. Picture where your main area of work would be in this situation. Look there and get to work now. Periodically look to where you would keep your reference papers or notes.

2. You are at home now. Picture yourself sitting in your usual seat as you do the following tasks. (With each of the following give instructions to the patient to change his gaze to something or someone else in the room that he might habitually expect to be there.)

- a. reading
- b. doing a crossword puzzle
- c. eating
- d. watching T.V.
- e. having a conversation
- f. writing a letter
- g. knitting, crocheting, needle-point
- h. playing cards
 - i. playing a board game (chess, Scrabble, Monopoly, etc.)
 - j. using the telephone
 - k. preparing a meal or snack

3. You are driving your car:
 - a. position yourself comfortably and look at the traffic ahead.
 - b. look into the rear view mirror.
 - c. look into the side view mirror.
 - d. talk to a passenger beside you.

4. You are walking. Picture yourself with the body and head posture you would normally have when you walk, swinging or not swinging your arms as the case may be. Now:
 - a. You are coming to a curb. Look down at it.
 - b. There is something shiny on the ground. Look down at it.
 - c. There is something unusual in the sky (a cloud formation, a plane, etc.). Look up at it.

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APPENDIX

The following is an abridged outline of a suggested examiner protocol utilizing a visual imagery approach to determine how major visual tasks are performed.

I. Patient Instructions

1. Sit comfortably. Do not sit stiffly or push yourself all the way back in the chair. Your arms should be at your sides with your hands in your lap, at least for now.
 2. Close your eyes and keep them gently closed throughout.
 3. Be completely relaxed. Feel your forehead and scalp muscles relax. Feel the muscles in and around your eyes become relaxed. Feel your cheek muscles and jaw muscles totally relax. Feel your neck muscles and your shoulder muscles relax. Feel them literally go limp.
 4. Listen carefully to what I say. Try to do or act out what I ask you to do. Try to picture what I ask you to picture even if what you get to see in your mind's eye is not completely clear or vivid. In fact, it may be nothing more than a vague sensation. In any case, just listen to what I say and respond as best you can.
 5. Picture yourself at work on the job (or if a student, at your desk in school). With your eyes closed and your body relaxed try to shift into the position you would normally be in when you work. Try to keep a picture in your mind of the room, the desk, the things that are usually on the desk or near you, the people around you and your normal body posture as you are involved in your work. Keep your eyes closed at all times and be totally relaxed.
- d. The telephone is ringing. Answer it.
 - e. Look across the room to the clock (door, chalkboard, teacher, etc.).
 - f. Start typing. Look at what you are typing. Now, look at your notes.
 - g. Your desk work has gotten difficult. There is a problem to be worked out. It's very technical and detailed and it has to be completed very quickly. Work on it, now.
 - h. You have a lot of things piled up on your desk. Picture where your main area of work would be in this situation. Look there and get to work now. Periodically look to where you would keep your reference papers or notes.
2. You are at home now. Picture yourself sitting in your usual seat as you do the following tasks. (With each of the following give instructions to the patient to change his gaze to something or someone else in the room that he might habitually expect to be there.)
 - a. reading
 - b. doing a crossword puzzle
 - c. eating
 - d. watching T.V.
 - e. having a conversation
 - f. writing a letter
 - g. knitting, crocheting, needlepoint
 - h. playing cards
 - i. playing a board game (chess, Scrabble, Monopoly, etc.)
 - j. using the telephone
 - k. preparing a meal or snack
3. You are driving your car:
 - a. position yourself comfortably and look at the traffic ahead.
 - b. look into the rear view mirror.
 - c. look into the side view mirror.
 - d. talk to a passenger beside you.
4. You are walking. Picture yourself with the body and head posture you would normally have when you walk, swinging or not swinging your arms as the case may be. Now:
 - a. You are coming to a curb. Look down at it.
 - b. There is something shiny on the ground. Look down at it.
 - c. There is something unusual in the sky (a cloud formation, a plane, etc.). Look up at it.

II. Examiner Questions

(The following are only suggestions. They can be varied and elaborated upon depending on the particular occupation of the patient. Throughout, watch the position of the torso, head, arms and hands. Watch for eye movements through the closed lids.)

1. You are working at your desk. Picture yourself writing something. Shift the paper to where it would normally be and start writing. Now:
 - a. Look at your notes.
 - b. Someone walked in. Look up.
 - c. Someone near you or at your desk is talking to you. Look at the speaker.

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