Visual conditions of symphony musicians

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Abstract: *Professional symphony musicians work in a very stressful environment which requires them to remain in asymmetric postures for long periods of time. The maladaptations (i.e., astigmatism and anisometropia) made as a result of the stress and the asymmetric postures are investigated. Forrest's[1–4] astigmatism theory is restated and related to the musician with clinical data to support the theory. Stress management through imagery for the musician is discussed. A study is also discussed which shows that good sight readers in music use a fundamentally different eye scan pattern to read music from the pattern that they use to read written language.*

Key words: *stress, posture, astigmatism, head scan, eye scan, head tilt, face turn, working distances, visual imagery*

Professional musicians in a major symphony orchestra spend significant time each day practicing or performing. Most instruments and seating arrangements in the orchestra require that musicians assume an asymmetrical posture. This chronic pattern of asymmetrical use of the visual system is highly correlated with visual adaptations including anisometropia and astigmatism. The postural skews assumed for sustained periods by professional musicians make them ideal subjects to test hypotheses relating posture to visual status.

Forrest[1–4] related astigmatism to differences in the amount of head versus eye movement in the vertical and horizontal planes. If there exists a relative difference in the amount of head versus eye movement to track an object in the horizontal versus the vertical meridians, there will be more minus power in the meridian in which there is relatively more head movement. The greater the relative difference in the two meridians of head versus eye movements, the greater the resulting astigmatism.

In the direction of movement where there is relatively more eye movement, the extraocular muscles are involved in a normal agonist/antagonist relationship. As one muscle contracts, its antagonist relaxes, and vice versa. In the direction of movement perpendicular to this, where there is relatively more head movement, such a relationship is less evident. To steady the eyes in the orbit while the head is being moved, the normal agonist/antagonist relationship is suspended and both muscles contract. This creates asymmetric, dynamic tension on the globe. If this asymmetric scan pattern is repeated over and over, the asymmetric tension on the globe becomes manifest as astigmatism with the meridian of greater myopia (or least hyperopia) being in the direction of greater head movement. The minus axis of the cylindrical compensating lens lies in the direction of more eye movement.

The key is the relative differences in eye scan/head scan patterns in the two principal meridians. If the person uses head movement in all meridians, for example, there will not be an associated astigmatism.

When there is a chronic face turn relative to the task at hand, the eye farthest away from the demand will be more astigmatic. With a head tilt there will be a symmetric tilting of the cylinder axis of the compensating lenses in the same direction as the head tilt. With an elevation or depression of the frontal plane of the face in reference to the task, a corresponding intorsion or extorsion of the cylinder axis will be present.

Childress, Childress, and Conklin[5] reported similar relationships between refractive status and scan patterns. They state: "Occupations requiring major horizontal scanning were much more often associated with with-the-rule astigmatism and occupations requiring vertical scanning showed much more against-the-rule astigmatism." They correlate refractive status with occupational scan demands, but offer no explanation for the observations made.

The population of symphony musicians affords an excellent "real-life" laboratory for testing the above stated hypotheses. Through my photographs of members of a symphony during a live rehearsal, one can see the asymmetries inherent in the musician's position on stage in reference to the music and the conductor, or the asymmetric posture required to play a particular instrument. Specific cases relating analytical data to posture in the orchestra follow.

Case reports

Case 1

This 46-year-old male has played the bass clarinet since age 19. He typically plays 20–25 hours per week and plays the regular clarinet when not playing the bass. When not playing the bass clarinet, he tilts his head to his right, turns his face to his right, and tilts his head

Figure 1: Subject 1, a bass clarinet player, demonstrates a backward head tilt, while gazing to his left to see both his music and the conductor.

Figure 2: Subject 1 directly faces the audience for optimal projection of sound.

straight back. While playing the bass clarinet, the backward tilt of the head is greatly exaggerated with less right tilt being noted. Figure 1 shows Subject 1 in his typical playing posture. Due to his position in the orchestra he looks to his left to see both his music and the conductor. To project his sound optimally, he sits facing the audience directly (Figure 2). Thus, his right eye is significantly farther away from his music and the conductor when positioned in the orchestra.

Clinical data on Oct. 9, 1985, were as follows: Uncompensated visual acuity was 20/20 OD, 20/25+ OS and 0.4 m at 16 inches at near for both the right and left eyes. Convergence nearpoint showed a break point of 10 inches with a recovery of 14 inches. The patient reported seeing five dots as distance on the Worth 4 Dot Test.

The analytical data were as follows: The number 4 finding for the right eye was $-0.50 - 1.75 \times 110$ and $-1.75 - 0.75 \times 85$ for the left eye. The number 7 finding was Plano -2.00×115 for the right eye with 20/20 visual acuity and $-2.50 - 0.75 \times 75$ in the left eye with 20/20 visual acuity. The number 8 finding through the number 7 as a base lens was 2 exo. The distance equilibrium findings taken through the number 7 as a base were as follows: There was no blur on the base-out with break occurring at 5 prism diopters and recovery occurring at 4 prism diopters. There also was no blur on the base-in finding with a break occurring at 4 prism diopters and a recovery at 0.

The 13B finding was 12 of exo. The 14A findings for both the right and left eyes were +1.00 add over the number 7 finding. The 15A finding was 12 exo. The 14B finding was also +1.00 add over the number 7 finding with the 15B phoria being 6 exo. The 14B was then kept in place for the near equilibrium testing. No blur point was noted on the base-out testing with the break occurring at 12 prism diopters and recovery at 10. Again no blur point was noted on the base-in testing with the break occurring at 12 prism diopters and the recovery at 11.

The number 20 finding was equal to the number 7 finding through which a phoria of 9 exo was found. The number 21 finding was +2.50 add over the number 7 finding through which the phoria was 13 exo.

The right eye, which is farthest from the near vision demand, is, as predicted by the theory, significantly more astigmatic than the left eye. The axes of the astigmatism are extorted as predicted by Forrest, correlated with the head tilt backward when playing the bass clarinet. The axes of astigmatism are extorted asymmetrically, 115 in the right eye and 75 in the left, correlated with the head tilt to the right.

The scanning demands in case 1 are mostly horizontal, as the musician shifts fixation from the music to the conductor. The conductor is well to the left of the musician and

Figure 3: In Subject 2, a cellist, the asymmetric demand with the left eye farther from the task is consistent with the left eye's demonstrating more astigmatism.

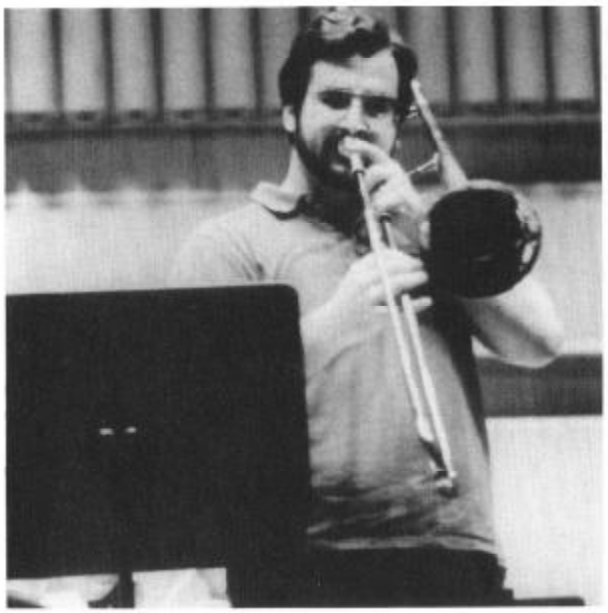

Figure 4: In Subject 3, a trombone player, the left eye must look across the nose to see the music, thus creating greater astigmatism in the left eye.

only slightly above the top edge of the music stand. There is very little head movement by the musician in any direction. However, there is much more demand for horizontal than for vertical scanning. The presence of against-the-rule astigmatism is consistent with Forrest's[1-4] prediction of greater myopia in the meridian of minimal eye movement. The rest of the analytical findings indicate that the refractive condition is of a long-standing nature and that the patient's condition is highly embedded.

For the most part the postures taken by the musicians are perceived by them as being part of what actually makes them sound as good as they do and cannot be changed or altered. The musician in case 1 has tried a number of times to alter his head position in reference to the bass clarinet. Every time he quickly reverts back to his chronic posture due to the fact that he perceives that his sound begins to suffer.

Case 2

Subject 2 is a 40-year-old cellist. She sits in the front row of cellists and shares a stand with a partner. She sits in what is called a frozen chair; that is, her chair does not rotate. She maintains a fixed position in relationship to her music and the conductor. Subject 2 has been in such a frozen chair for 6 years for 35–40 hours per week. To sit on the opposite side of the stand makes her disoriented and aware of significant visual problems. Figure 3 shows Subject 2's chronic posture in the orchestra.

When tested, her clinical data was as follows: Uncompensated visual acuity was 20/20– OD, 20/40+ OS and 0.4 m at 16 inches at near for her right eye and 0.7 m at 16 inches in her left eye.

The analytical data was as follows: The number 4 finding for the right eye was $+0.75 - 0.25 \times 105$ and $+0.75 - 1.50 \times 85$ for the left eye. The number 7 finding was $+0.75 - 0.75 \times 100$ for the right eye with 20/20 visual acuity and $+0.75 - 1.50 \times 90$ in the left eye with 20/20 visual acuity. The number 7A finding was $+0.50 - 0.75 \times 100$ in the right eye with 20/20 visual acuity and $+0.50 - 1.50 \times 90$ in the left eye with visual acuity of 20/20. The number 8 finding through the number 7 as a base lens was 2 exo. The distance equilibrium findings taken through the number 7 as a base were as follows: There was no blur on the base-out with break occurring at 7 prism diopters with recovery occurring at 6 prism diopters. A blur point of 4 prism diopters was recorded on the base-in finding with a break occurring at 8 prism diopters and a recovery at 7.

The 13B finding was 6 of exo. The 14B finding was also +1.00 add over the number 7 finding with the 15B phoria being 6 exo. The 14B was then kept in place for the near equilibrium testing. No blur point was noted on the base-out testing with the break occurring at 22 prism diopters and recovery at 3. Again no blur point was noted on the base-in testing with the break occurring at 16 prism diopters and the recovery at 14. The number 20 finding was −1.00 gross lens in place while the number 21 finding was +2.00 lens in place.

Motility testing showed definite head movement in the horizontal

meridian. Subjectively, eye movements in the vertical meridian felt easier to make. This is consistent with Forrest's prediction of astigmatism with minus cylinder axis 90. The asymmetric demand with the left eye farther from the task is consistent with the left eye's demonstrating more astigmatism. Subject 2 has a head tilt to her left and a slight tilt backward, consistent with the asymmetric axes. The effects of head tilt left and backward superimpose. The tilt backward is expected to produce extorsion of the axes to approximately 95 and 85, respectively. The head tilt to her left then rotates both axes in the direction of the head tilt by 5° in each eye. The resultant axes are 90 and 80 respectively, consistent with the relative findings.

Case 3

Subject 3 plays principal trombone and is 32 years old. The trombone requires the musician to fix his or her head to the instrument at the mouthpiece. During playing, the relationship of the head to the instrument is largely static. The bell of the trombone is in the left visual field and the slide is straight ahead; therefore, the trombonist places the music to his or her right. The asymmetry seen in Figure 4 is exaggerated, since the picture was taken during solo play in front of the orchestra. During solo play Subject 3 has exaggerated his asymmetric posture to permit the bell of the instrument to be unobstructed by the music stand. During routine play, the asymmetry is present but is less exaggerated than is seen in the picture.

It can be seen from Figure 4 how the left eye must look across the nose to see the music. His head is tilted with the top forward and slight toward his left, closer to the top section of the trombone.

This musicians' clinical data were as follows: Compensated visual acuity was 20/20 OD, 20/20 OS and 0.4 m at 16 inches at near for both the right and left eyes. Convergence nearpoint and reach, grasp, release testing were all to the nose and done accurately and quickly.

The analytical data were as follows: The number 4 finding for the right eye was $-1.00 - 2.75 \times 10$ and $-2.50 - 2.00 \times 165$ for the left eye. The number 7 finding was $-1.75 - 1.75 \times 15$ for the right eye with 20/20 visual acuity and $-3.00 - 2.25 \times 160$ in the left eye with 20/20 visual acuity. The number 8 finding through the number 7 as a base lens was 2 exo. The distance equilibrium findings taken through the number 7 as a base were as follows: There was no blur on the base-out with break occurring at 30 prism diopters with recovery occurring at 24 prism diopters. There also was no blur on the base-in finding with a break occurring at 6 prism diopters and a recovery at 4.

The 13B finding was 6 of eso. The 14B finding was also +0.75 add over the number 7 finding with the 15B phoria being ortho. The 14B was then kept in place for the near equilibrium testing. No blur point was noted on the base-out testing with the break occurring at 36 prism diopters and recovery at 24. Again no blur point was noted on the base-in testing with the break occurring at 14 prism diopters and the recovery at 12.

The number 20 finding was a −2.00 add in reference to the number 7 finding. The number 21 finding was +2.50 add over the number 7 finding.

Subject 3 shows greater astigmatism in the left eye, characteristic of his postural constraint which places the left eye farther from the task. He shows intorted cylinder axes related to his head tilt forward and slightly leftward. As in the case of Subject 2, the reason for the lack of symmetry in the intorsion of the axes is due to the tilt of the head to his left shoulder. Seven trombone players have been evaluated and, to date, of the five that have astigmatism, all have had more in the left eye. Typically, most trombonists tilt their heads to their left shoulders ever so slightly.

Case 4

Subject 4 is a 30-year-old violinist who rotates through the second violin section. She was fit with PMMA contact lenses and now wears the contact lenses for performances only.

This musician's clinical data were as follows: Visual acuity as compensated by her current contact lenses was 20/20 OD, 20/20 OS and 0.4 m at 16 inches at near for both the right and left eyes. Convergence nearpoint and reach, grasp, release testing were all to the nose and done accurately and quickly. Her keratometric readings were 43.50 by 45.62 at axis 180 in the right eye and 43.75 by 45.87 at axis 180 in the left eye.

The analytical data were as follows: The number 4 finding for the right eye was $-4.75 - 1.75 \times 175$ and $-4.25 - 2.00 \times 180$ for the left eye. The number 7 finding was $-5.25 - 1.50 \times 175$ for the right eye with 20/20− visual acuity and $-4.75 - 1.50 \times 175$ in the left eye with 20/20− visual acuity. The number 8 finding through the number 7 as a base lens was ortho. The distance equilibrium findings taken through the number 7 as a base were as follows: Blur occurred at 16 prism diopters on the base-out testing with the break occurring at 32 prism diopters and recovery occurring at 16 prism diopters. The blur point on the base-in testing was 10 prism diopters with the break occurring at 12 prism diopters and a recovery at 10.

The 13B finding was 6 of exo. The 14B finding was also +1.25 add over the number 7 finding with the 15B phoria being 6 exo. The 14B was then kept in place for the near equilibrium testing. The base-out blur point was 14 prism diopters with the break occurring at 32 prism diopters and recovery at 16. No blur point was noted on the base-in testing with the break occurring at 24 prism diopters and the recovery at

Figure 5: In Subject 4, a violinist, a neck brace has been used to alter head posture. Bringing the head to a nearly vertical alignment resulted in a shift of the axes of the astigmatism in both eyes.

Figure 6: Subject 5 (left) and Subject 6 (right), bass players, share a music stand in orchestra play, and demonstrate that the eye that has the greater refractive condition is the one that is the farthest away from the distant visual demand.

20. The number 20 finding was equal to the number 7 finding while the number 21 finding was +3.75 add over the number 7 finding.

Thanks to the cooperation of her former optometrist, records from her early childhood were obtained and yielded the following information: Her compensatory prescription at the age of 11 was −3.75 − 0.50 × 15 OD and −3.50 − 0.50 × 165 OS. Her keratometric readings at the age of 13 were 43.62 by 44.37 at axis 180 OD and 43.50 by 44.37 at axis 180 OS. At the age of 13 her compensatory prescription was −4.50 − 0.50 × 20 OD and −4.00 − 0.75 × 160 OS.

Subject 4's findings document the correlation between her head tilt toward her left shoulder and the symmetric tilting of both axes to 175. When reading music she tends to use mostly eye scan in the horizontal direction, but moves the entire head-violin-upperback combination as a unit, which leaves the eyes fixed, in the vertical direction.

At the time of the above analysis, Subject 4 did not use the neck brace on her violin and was noted to always tilt her head toward her left shoulder to hold the violin. This tilt is much less evident in Figure 5 due to the fact that she now uses a neck brace which has brought her head to a nearly level position. Use of the neck attachment, which allows her head to return to nearly vertical alignment, has resulted in a shift of the axes of the astigmatism to 180 in both eyes. Findings taken in January 1986, show: The number 7 finding was 5.50 − 0.25 × 180 OD with 20/20 visual acuity and −4.25 − 1.00 × 180 OS with 20/20 visual acuity. Her keratometric readings at this time were 43.25 by 45.25 at axis 180 OD and 43.00 by 45.00 at axis 180 OS.

It is interesting to note the findings from Subject 4's childhood before playing the violin had become a serious professional pursuit. At that time the cylinder axes were symmetrically extorted to 15 and 165 respectively.

Cases 5 and 6

Subject 5 and Subject 6 play double bass in the Baltimore Symphony, sharing a stand and not rotating with the rest of the group. Subject 6 is 33 years old, is myopic and is under treatment for glaucoma. Subject 6 typically uses his glasses for distance tasks and reading music, but does not use them for regular reading. His prescription at the time of first examination was −1.87 OD and −1.37 OS.

While playing, Subject 6 turns his face toward his right shoulder and tilts his head toward his right, away from the neck of the bass. Subject 6 is currently the principal bass player and is on the right side of the stand (Figure 6). For 10 years prior to joining the Baltimore Symphony, he was positioned on the opposite side of the music stand; only in the year prior to my examination did he switch sides. Observation of the other bass players in the symphony showed that all inside stand players held their heads one way and the outside stand players held their heads the opposite way. A player that is designated as an outside stand player is the stand partner that is closer to the audience than the inside stand partner. Although now an outside stand player, Subject 6 held his head in the posture of the inside stand players, the position he had held for the previous 10 years.

On Oct. 29, 1982, initial testing data for Subject 6 showed aided visual acuity of 20/60− OD and 20/30 OS at distance, and 0.4 m at 16 inches OS at near. Convergence nearpoint and reach, grasp, release testing were all to the nose and done accurately and quickly. His old prescription was −1.87 OD and −1.37 OS.

The analytical data were as follows: The number 4 finding for the right eye was −2.50 sphere and −1.50 − 0.25 × 90 for the left eye. The number 7 finding was −2.50 − 0.25 × 160 for the right eye with 20/20 visual acuity and −1.75 sphere in the left eye with 20/20 visual acuity. The number 8 finding through the number 7 as a base lens was ortho. The distance equilibrium findings taken through the number 7 as a base were as follows: No blur point was noted on the base-out testing with the break occurring at 20 prism diopters and recovery occurring at 16 prism diopters. Again no blur point was noted on the base-in testing at distance while the break point occurred at 8 prism diopters with the recovery at 6.

The 13B finding was 10 of eso. The 14B finding was also +0.50 add over the number 7 finding with the 15B phoria being 3 exo. The 14B was then kept in place for the near equilibrium testing. No base-out blur point was recorded with the break occurring at 32 prism diopters and recovery at 26. No blur point was noted on the base-in testing with the break occurring at 20 prism diopters and the recovery at 18. The number 20 finding was a −1.50 add over the number 7 finding while the number 21 finding was +2.50 add over the number 7 finding.

Subject 6 has an anisometropia, with the right eye requiring more compensatory minus than the left to restore standard visual acuity. According to Harmon,[7] the eye that has the greater refractive condition is the one that is farthest away from distance visual demands. The anisometropia is consistent with the previously held position with the right eye being farthest from the conductor.

Subject 6 desired to reduce his dependency upon compensatory lenses. In-office vision therapy was started with little change. Near the end of the vision therapy in April 1983, he was given treatment lenses of −1.50 with 4 base left / +1.00 add OD, and −1.00 with 4 base left / +1.00 add OS.

The yoked prism was prescribed in accordance with the lens directives as stated in Robert Kraskin's OEP Curriculum II papers entitled, "Lens Power in Action."[6] Kraskin states that if there is evidence of a postural asymmetry along with anisometropia, then the application of lateral yoked prism for treatment purposes should be investigated. This is done by adding a right and left phoria to the analytical (phorias taken with first the right and then the left as the measuring side), performing the Randot Stereo Test through 5 diopter right and left prisms and observing the patient's behavior on the walking rail with the same set of prisms. If there is a difference in performance with one prism direction versus the other, and there is a difference in the right and left phorias, then the yoked prism will be effective. The treatment prism is prescribed in the direction which causes a decrement of performance and is prescribed on the principle of a rebound effect.

At his progress evaluation on May 18, 1983, Subject 6 reported that he felt more aggressive. He was aware of looking more directly at people. He stated that he was more organized and was getting more things done. He noted that the right eye was being used more, along with there being an increased awareness of the right side of his body. He felt much more balanced. He continued to use the lenses, and at his progress evaluation on Sept. 1, 1983, he felt that things had stabilized. He was now aware that his head had turned to a new position and thought that it was time to eliminate the prism. Because there still was a significant difference in Randot stereogram testing and walking rail performances, the prism was kept on. By Nov. 2, 1983, the performances with 5 bases right and 5 bases left were identical, so the prescription was changed to −1.00 with 2 base left / +1.00 add OD, −1.00 with 2 base left / +1.00 add OS. This is worn only when he is in the orchestra to reduce the asymmetric forces at play and to stabilize his visual condition. This prescription is now seen as compensatory not only in the myopic portion but in the prismatic portion also. Lenses are only worn in the orchestra to counter the asymmetric posture which cannot be altered. During home practice they are not needed because the music is placed directly in front of Subject 6. Visual acuity at 20 feet with his compensatory lens is 20/30 + 2 binocularly. Subjective refraction is −2.00 OD and −1.75 OS spheres. He maintained this level until early 1985, when he obtained soft contact lenses which were worn full time. Since, he has increased in myopia and the asymmetry has increased. Subjective refraction on Dec. 10, 1985, was −3.00 OD, −2.00 OS.

Subject 6's stand partner, Subject 5, was examined on Oct. 4, 1985, and showed a constant left hyper exotropia at both distance and near. At distance he demonstrated 12 left hyper and 15 exo; at near these measures reduced to 4 and 10 prism diopters respectively. He had had strabismus surgery on both eyes at the age of 4 and never had any vision therapy or patching. He feels that he uses his right eye for distance and his left eye for near visual activities although he stated that he used his right eye for music. Even though the double bass is one of the biggest instruments in the orchestra, two musicians share a single music stand. By necessity, they stand away from each other and have the greatest difference between the angles of view to the music and the conductor.

On Oct. 4, 1985, Subject 5 showed corrected visual acuity of 20/20 OD and 20/25 OS at distance and 0.4 m at 16 inches OD and 0.4 m at 16 inches OS at near. On distance cover test he showed a constant left hyper (12) exo (15) tropia and at near also a constant left hyper (4) exo (10) tropia. While performing the protocol of a convergence nearpoint test he stayed in his relative posture until, at 4 inches, he

stopped in his attempts at convergence. When tested at near using the Worth 4 Dot he reported seeing two, three, or four dots at will. He was able to change the number of dots seen to his liking. On the Randot Stereo Test he was not able to see any of the targets. Keratometric findings were 43.50 by 43.12 at axis 180 in the right eye and 43.12 by 43.37 at axis 180 in the left eye.

His number 4 finding was $-0.75 - 2.75 \times 100$ for the right eye and $-3.25 - 2.25 \times 75$ in the left eye. The number 7 finding was $-0.75 - 1.50 \times 100$ in the right eye with compensated visual acuity being 20/20 and the finding for the left eye was $-4.25 - 1.00 \times 70$ through which he achieved 20/20 − 2 visual acuity. Through the number 7 finding his distance phoria was 3 eso with 8 left hyper. The 13B showed variable highly esophoric postures and no add was found on the 14B. Ductions at distance and near were attempted with the patient not reporting any changes other than changes in the horizontal positioning of the target. He was able to see it any way he desired by switching his attention to either visual channel.

On the Keystone Basic Binocular Test he was able to see some depth with the largest targets. With Bagolini striated lenses, he reported seeing mostly an "X" with some OS suppression centrally about the crossing point. Only one light was seen on the "X."

Subject 5 mentioned that when his eyes are aligned, things change focus. He stated, "With my left eye it is not so much a strain to see things as it is to interpret them." The asymmetry in the amount of the astigmatism is consistent with his right eye being farther from the near vision demand, and the extorsion of the cylindrical axes is consistent with not only a slight head tilt back but the music being far below his line of sight. Forrest indicates that there does not always need be an observable head tilt or turn, but rather a skew in the relationship between the head posture and the line of sight used in performing the near visual task. Thus, one could observe a normal head posture with extorted visual axes if the person performed sustained near visual activities below a line perpendicular to the facial plane (depressed line of sight).

Subject 5 is observed to move his head when making shifts from the music to the conductor. Little or no movement of his head is observed in the vertical direction which is consistent with the finding of against-the-rule astigmatism. Prior to coming to the Baltimore Symphony, Subject 5 spent several years as a principal player on the opposite side of the stand during which time his left eye would have been farthest away from the music. Without optometric data from this period of time it would be impossible to know if the amount of astigmatism in each eye has changed relative to each other since his change in physical position. The current refractive status, however, is consistent with Harmon's theories of anisometropia and postural development and with Forrest's data on astigmatism.

Case 7

Subject 7 is a 28-year-old associate principal French horn player. As a junior high school student he was given "eye exercises" for a "muscle imbalance." In high school and college he had stress relieving lenses which he found helpful, but he no longer uses them.

Visual acuity was 20/20− OD, 20/25 OS and 0.4 m at 16 inches at near for both right and left eyes without the aid of any compensatory lenses. Convergence nearpoint showed a break point of 4 inches with the left eye turning out and with diplopia being reported. At 5 inches he recovered binocular alignment.

The analytical data were as follows: The number 4 finding for the right eye was +0.50 sphere and +1.25 sphere for the left eye. The number 7 finding was +0.50 sphere for the right eye with 20/20 visual acuity and +1.25 sphere in the left eye with 20/20 visual acuity. The number 8 finding was taken through the number 7 as both a right and left phoria showing 2 exo from the right side and 1 exo from the left side. The distance equilibrium findings taken through the number 7 as a base were as follows: Blur occurred at 12 prism diopters on the base-out testing with the break occurring at 14 prism diopters and recovery occurring at 9 prism diopters. There was no blur point on the base-in testing with the break occurring at 2 prism diopters and a recovery at 1.

The 13B finding was 6–7 of exo from the right side and 7 exo from the left side. The 14A finding was +1.50 gross lens in place for the right eye and +2.25 gross lens in place for the left eye. The 15B phoria through the 14A was 6 of exo from the right side and 6 of exo from the left side. The 14B finding was a +0.75 add over the number 7 finding with the 15B phoria being 6 exo from both the right and left sides. The 14B was then kept in place for the near equilibrium testing. No blur point was noted on the near base out finding with the break occurring at 12 prism diopters and recovery at 11. A blur point of 12 prism diopters was noted on the base-in testing with the break occurring at 16 prism diopters and the recovery at 15. The number 20 finding was −2.75 add over the number 7 finding while the 21 finding was +2.25 add over the number 7 finding.

For each phoria there are two measures: a right and left phoria. This is typically done when there is both an observable postural asymmetry and an anisometropia on the number 7 finding and is done in conjunction with information gathering relative to yoked prism prescribing. Significant postural asymmetries are not sufficient to cause astigmatism (according to Forrest).

There still needs to be a difference in the relative amount of head versus eye movements for the astigmatism to be present.

Although Subject 7 had the postural asymmetry, he only showed a spherical anisometropia. His photograph and clinical data have been included here to demonstrate that not every musician with an asymmetric posture will have astigmatism. The explanation of the anisometropia is demonstrated by Harmon[7] and Kraskin.[6] When looking at the spherical component of the refractive status, anisometropic conditions result from significant asymmetries in the bilateral organism. Generally, the side that is turned away from the distance task will be the one with the greater refractive condition, be it hyperopia or myopia. For example, in a hyperopic individual, as above, with +0.50 OD and +1.25 OS, the left eye would be turned away from distance tasks with the right eye turned forward into the task. Assuming the same posture, the myope might be −0.50 in the right eye and −2.00 in the left eye.

Conclusion

In many ways the visual demands of symphony musicians are both unique to them and at the same time very similar to the demands of all people who use their visual systems in today's stressful society. Symphony musicians make excellent subjects for studying the effects of posture on vision, particularly on astigmatism and anisometropia.

The evidence cited supports the work of Harmon,[7] Childress,[5] Kraskin[6] and Forrest.[1–4] Their work leads to a more thorough understanding of the process by which the visual adaptations of astigmatism and anisometropia are acquired through asymmetric use of the body and the visual system. ■■

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