VIEWPOINTS

MONOVISION

Many presbyopic contact lens wearers desire to avoid reading glasses, are dissatisfied with the visual limitations imposed by bifocal contact lenses, and find monovision a satisfactory alternative. Practitioners who do not emphasize binocular vision in their practice frequently welcome monovision as a simple way to fit the patient and avoid the need for reading glasses. Practitioners who do vision therapy in their practices, in contrast, frequently view monovision as a procedure which interferes with binocular vision, reduces visual efficiency, and should therefore be avoided. In this issue, the case for monovision (beginning on this page) is discussed by Dr. Paul Erickson, a respected contact lens researcher, and Dr. Paul Farkas, a well-known contact lens practitioner. Concerns about monovision (beginning on page 123) are expressed by Dr. Stuart Rothman, a noted optometric educator and clinician who is extensively engaged in vision therapy. Together, these articles serve to illuminate the issues for the optometric clinician.

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MONOVISION CONTACT LENS FITTING:
A SAFE AND EFFECTIVE CLINICAL OPTION FOR PRESBYOPES

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ABSTRACT

Monovision is the most successful contact lens fitting technique for presbyopic correction. The visual compromises it induces are remarkably manageable, and compare favorably with those induced by contact lens and spectacle multifocals. Monovision is best suited for early presbyopes with modest requirements for resolution and stereopsis. It is particularly advantageous for presbyopes who require clear vision in a variety of gaze positions.

KEY WORDS

monovision, presbyopia, contact lenses, binocular vision

The use of the term *monovision* to describe the concept of correcting one eye for optical infinity and the other eye for the near working distance is unfortunate. It implies that the presbyopic patient so corrected experiences vision in a way analogous to strabismus. A thoughtful review of available information will show that although monovision changes visual performance relative to full binocular correction, most key features of binocular vision are retained.

Monovision patients perceive a clear binocular image by virtue of binocular interactions occurring at the level of the visual cortex. When corresponding retinal loci receive a clear central image in one eye and a moderately blurred image in the other eye, blur is effectively suppressed under most conditions.[1] Aspects of vision not requiring high resolution in both eyes appear to follow normal patterns.

In assessing the efficacy of monovision, it is important to view visual performance issues in the proper context. General practitioners and those specializing in binocular vision problems typically compare monovision to binocular spectacle correction. Contact lens practitioners tend to compare monovision to bifocal contact lens options. A desirable common ground is attained by recognizing that any optical correction of presbyopia produces inherent compromises in vision function and flexibility. Current evidence indicates that the vision compromises associated with monovision are at least as palatable as those associated with multifocal contact lenses[2-5] and spectacles.[5]

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MONOVISION CONTACT LENS FITTING:

A CHANCY ANSWER FOR PRESBYOPIC CONTACT LENS PATIENTS

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ABSTRACT

While the use of monovision contact lenses satisfies the desire of some presbyopic patients for convenience and cosmeisis, a number of compromises of visual functioning result. Research has indicated that binocular visual acuity, contrast sensitivity, and binocular fusional ability can be adversely affected with monovision patients. Further, there is an apparent inconsistency for the clinician who has placed maximal binocular function as a key mission for optometric care to compromise this tenet for presbyopic patients.

KEY WORDS

binocular vision, contact lenses, contrast sensitivity, monovision, presbyopia, stereopsis

Contact lens compensation for presbyopia is an issue of increasing interest to the optometric practitioner as the patient population ages. The "baby-boom" generation, many of whom have been wearing contact lenses since their teens, are now becoming presbyopic. This was the first group of patients to benefit from the many technology breakthroughs in contact lenses in the 1970s and 1980s, including the advent of soft, extended wear, disposable, and gas permeable contact lenses. Many of them wish to continue contact lens wear without the need to use spectacle lenses for reading. The parents of these "baby-boomers" are also frequently interested in contact lens vision compensation.

Monovision, fitting one eye for distance and the fellow eye for near, was first discussed in the literature in the 1960s.[1,2] It has become the most widely used method for the compensation of presbyopia with contact lenses[3] by virtue of its decreased cost to the patient, decreased chair time to the practitioner, and greater availability of lens types and parameters.[4] Success rates between 66% and 75% have been reported.[5,6] This is higher than that obtained with bifocal contact lenses.[5]

Despite its attractiveness, monovision is often viewed with initial skepticism on the part of presbyopic contact lens candidates. Further, monovision has not gained full acceptance by clinicians. The idea of recommending what is, at best, a compromise in vision and visual efficiency, runs counter to functional vision care concepts that stress the importance of evaluating and remediating binocular dysfunction. To many practitioners, it seems inappropriate to emphasize binocular function prior to the onset of presbyopia, and then to deemphasize it once patients become presbyopic. It also seems inconsistent to strive for optimal binocular function in children while prescribing lenses for their parents which interfere with binocular function.

Monovision typically involves fitting the dominant eye with a distance vision contact lens and the non-dominant eye with a near vision contact lens.[2,7,8] Alternate interocular suppression of the blurred image occurs between corresponding retinal areas to permit clear vision at both near and far.[9,10] There are two different philosophies for prescribing the near addition.[11] One suggests that minimizing the add power will maximize binocular function. The other suggests that maximizing the add power will facilitate suppression of the blurred image.

The anisometropic blur induced by monovision contact lens fitting has adverse effects on visual acuity, contrast sensitivity, fusion and stereopsis.

VISUAL ACUITY

Monovision produces a small reduction in high contrast distance visual acuity under binocular viewing conditions.[12] This decrease in binocular visual acuity increases as the add power in the near vision lens is increased. Tasks likely to be adversely affected include driving (involving distance acuity), and reading and writing (involving near acuity). The younger presbyope, who requires a low power addition, may meet minimum visual acuity standards for driving with either eye. The older presbyope, who requires a high power lens addition, will have poor distance acuity with the non-dominant eye, and must be counseled to use the dominant eye for viewing through both rear view and side view mirrors.[13]

Schor et al.[9] report that the suppression of the blurred image is most effective under photopic conditions. Monovision blur is more difficult to suppress when viewing a bright target on a dark background. The blur becomes more pronounced as contrast increases, target size decreases, pupil size increases, and add power increases. These factors ac-

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count for patient complaints of visual difficulty with night driving and reading menus or programs in dimly lit restaurants or theaters.[14,15] Sheedy et al.[16] studied performance on nearpoint tasks, such as card filing and letter editing, and found statistically significant differences in performance time and accuracy between monovision and binocular vision conditions.

CONTRAST SENSITIVITY

Monovision has been found to decrease contrast sensitivity.[17,18] With lower adds, only high spatial frequency resolution is reduced. When the addition is greater than 1.50 D, all spatial frequencies show a decrease in sensitivity as compared to binocular vision conditions. Binocular summation is not evident when high additions are used and contrast sensitivity approaches the monocular condition.

Reduction in the ability to discriminate low and medium spatial frequencies, when high adds are required, may be more detrimental to visual performance than the decrease in acuity discussed earlier. Activities such as driving and sports performance may be affected, particularly when lighting conditions are less than optimal. For example, tennis performance might be worse on cloudy days or indoors.

FUSION

Monocular blur causes a decrease in stereopsis.[19-23] While this phenomenon is less pronounced with monovision than with spectacle blur, stereopsis is reduced with monovision correction.[10] Gutkowski and Cassin[24] found stereopsis reduced from an average of 430 seconds of arc with spectacles to 384 seconds with monovision correction. Koetting[25] found a reduction of stereopsis with a range of 58 to 96 seconds of arc. This reduction in stereopsis correlates with the power of the addition; higher adds cause greater reduction in stereoacuity.[24,26]

The effect of this stereoacuity reduction on visual performance has been studied by Sheedy et al.[16] His subjects showed decreased performance on letter editing and pointer-in-straw performance eight weeks after the dispensing of monovision correction.

Monovision induces a shift in the lateral phoria toward esophoria, both at distance and near,[27,28] as well as a reduction in fusional vergence ranges. These effects are less pronounced when it is the dominant eye that is fit with the distance contact lens. The authors attribute these findings to binocular visual stress created by a blurred monocular image.

CLINICAL CONSIDERATIONS

From a legal standpoint, there is a question of whether negligence would be found if injury were to result from monovision fitting. There is also an issue as to whether the patient can, in fact, be sufficiently informed to responsibly give informed consent about monovision correction. Harris and Classe[29] advise a trial fitting and written documentation before patients are fit with monovision lenses. To provide a basis for informed consent, it is imperative that the practitioner fully explain and demonstrate any limitations or difficulties that the patient may experience with monovision. As of this date, there have been no legal cases documented regarding monovision fitting.

The use of a third contact lens, with a distance prescription for the nondominant eye, has been suggested.[30] Such a lens would be used for driving and other tasks that require critical distance vision. Graves[31] suggests the use of spectacles to be worn over the contact lenses to achieve the same purpose, despite the fact that anisometropic differences may be harder to adapt to in such a spectacle correction. As a practical matter, few monovision patients will actually use a third contact lens or overcorrecting spectacles, since use of such appliances would negate the reasons most patients opt for monovision--the desire for convenience and avoidance of spectacles.

CONCLUSION

Despite the evidence cited above, monovision has been used successfully in practice. Patient satisfaction with monovision may reflect the fact that, thus far, most bifocal contact lens corrections require greater visual compromise than does monovision. For satisfied patients, the advantage of not needing to use spectacle lenses for reading is worth whatever visual compromise they have to make.

In this author's view, vision care practitioners should think long and hard about recommending monovision to patients with normal binocular vision. The clinician should recommend the method of treatment that is in the patient's best interest. This may be in direct conflict with the patient's desire at the time of fitting.

It is the practitioner's duty to inform the patient of the various treatment options and the advantages and disadvantages of each. Potential risks, both short and long term, must be discussed and documented. The patient must be given the information in order to make an informed decision about treatment. The best treatment option may not necessarily be the easiest for either the practitioner or the patient.

For most patients, single, clear, binocular vision is the best option. This is what we consistently reinforce in virtually every patient encounter. Monovision causes impairment of binocular visual acuity, binocular contrast sensitivity, and first, second, and third degree fusion. It also interferes with performance on tasks such as driving, reading and sports activities.

Clear, single, binocular vision has long been a standard of optometric care. To discard this concept when patients become presbyopic, and embrace a philosophy that violates our core concepts of optimum visual performance has serious implications. Although patients want the convenience of contact lens correction without the need for spectacles, this should not be achieved at the expense of visual efficiency. As vision care providers, we need to encourage the development of technology that will achieve these goals without compromising visual function.

REFERENCES

1. Fonda G. Presbyopia corrected with single vision corneal lenses. In: Girard LJ, ed. Corneal and scleral contact lenses. St Louis: C.V. Mosby, 1968: 276-279.
2. Fleischman WE. The single vision reading contact lens. Am J Optom Arch Am Acad Optom; 1968, 45: 408-09.
3. Fitting the presbyope: a roundtable discussion. Contact Lens Spectrum, Oct 91: 27-32.
4. Stein H. The management of presbyopia with contact lenses: a review. CLAO J; 1990, 16 (1): 33-38.
5. Back A, Holden B, Hine N. Correction of presbyopia with contact lenses; comparative success rates with three systems. Optom & Vis Sci, Vol. 66: 518-525.

6. Wood WW. Monovision does work. Optom Manage, 1985, 21: 49-50.
7. Hersh D. A novel modality for management of presbyopic contact lens patients. Opt J Rev Optom, 1969, 106 (6): 35-40.
8. Brungardt T. The monovision system for presbyopic contact lens fitting. Optom Wkly, 1973, 64 (2): 47.
9. Schor C, Landsman L, Erickson P. Ocular dominance and the interocular suppression of blur in monovision. Am J Optom Physiol Optics, 1987, 64 (10): 723-730.
10. Lebow K, Goldberg J. Characteristics of binocular vision found for presbyopic patients wearing single vision contact lenses. J Am Optom Assoc, 1975, 46 (11): 1116-1123.
11. Heath D, Hines C, Schwartz F. Suppression behavior analyzed as a function of monovision addition power. Am J Optom Physiol Optics, 1986, 63: 198-201.
12. Erickson P, Schor C. Visual function with presbyopic contact lens correction. Optom Vision Sci, 1990, 67 (1): 22-28.
13. Josephson J, Erickson P, Back A, et al. Monovision. J Am Optom Assoc, 1990, 61: 820-826.
14. Josephson J, Caffery B. Monovision vs. aspheric bifocal contact lenses: a crossover study. J Am Optom Assoc, 1987, 58 (8): 652-3.
15. Schor C, Carson M, Peterson G, et al. Effects of interocular blur suppression ability on monovision task performance. J Am Optom Assoc, 1989, 60 (3): 188-192.
16. Sheedy J, Harris MG, Busby L, et al. Monovision contact lens wear and occupational task performance. Am J Optom Physiol Optics, 1988, 65 (1): 14-18.
17. Collins MJ, Brown B, Bowman KJ. Contrast sensitivity with contact lens corrections for presbyopia. Ophthal Physiol Opt, 1989, 9: 133-138.
18. Loshin DS, Loshin MS, Comer G. Binocular summation with monovision contact lens correction for presbyopia. Int Contact Lens Clin, 1982, 9: 161-165.
19. Levy NS, Glick EB. Stereoscopic perception and Snellen visual acuity. Am J Ophthal, 1974, 78: 722-724.
20. Donzis PB, Rappazzo A, Bunde RM, Gordon M. Effect of binocular variations of Snellen visual acuity on Titmus stereoacuity. Arch Ophthal, June 1983, 101: 930-32.
21. Ong J, Burley WS Jr. Effect of induced anisometropia on depth perception. Am J Optom Arch Am Acad Optom, 1972, 49: 333-4.
22. Westheimer G, McKee SP. Stereoscopic acuity with defocused and spatially filtered retinal images. J Opt Soc Am, 70: 772-8.
23. Peters H. The influence of anisometropia on stereosensitivity. Am J Optom Arch Am Acad Optom, 46: 120-3.
24. Gutkowski M, Cassin B. Stereopsis and monovision in the contact lens management of presbyopia, Binoc Vis Quarterly, 1991, 6 (1): 31-6.
25. Koetting RA. Stereopsis in presbyopes fitted with single vision contact lenses. Am J Optom Arch Am Acad Optom, 47 (7): 557-61.
26. Goodwin RT, Romano PE. Stereoacuity degradation by experimental and real monocular and binocular amblyopia. Invest Ophth Vis Sci, 26: 917-23.
27. McGill E, Erickson P. Sighting dominance and monovision distance binocular fusional ranges. J Am Optom Assoc, 1991, 62 (10): 738-41.
28. McGill E, Erickson P. The effect of monovision lenses on the nearpoint range of single binocular vision. J Am Optom Assoc, 1991, 62 (11): 829-31.
29. Harris MG, Classe JG. Clinicolegal considerations of monovision. J Am Optom Assoc, 59 (6): 491-5.
30. McMonnies CW. Monocular fogging in contact lens practice. Australian J Optom, 1974, 57 (1): 28-32.
31. Graves OM. The soft lens for presbyopia. Contact Lens Forum, 1978, 3 (1): 38-40.

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PRACTICAL CONSIDERATIONS

Monovision has been successfully employed for 30 years. In general terms, monovision fitting is simple and cost effective. Fitting techniques are similar to those required for any contact lens prescription. The level of complexity required is similar to that for non-presbyopic contact lens fitting. Similarly, the cost of materials is the same as for non-presbyopic contact lenses and less than for bifocal contact lenses. In contrast with contact lens multifocals, there are no practical limits to the lens parameters (toric lenses, hard or soft lenses) which can be applied. For computer use, monovision may be advantageous in that clear images can be obtained for the prescribed working distance independent of the position of gaze. In addition, there are inherent advantages associated with the minimized vertex distance of contact lenses that can enhance the field of view and reduce unwanted effects related to off axis optics.[6]

Finally, the psychological impact on new presbyopes (especially those who have not previously worn spectacles) of multifocal prescriptions can be minimized or eliminated by applying monovision correction. Proper attention to these cosmetic factors can be of significant value in practice building.

FUNCTIONAL CONSIDERATIONS

In spite of its history of clinical success, many clinicians remain unconvinced of the propriety of a technique that intentionally creates one or two diopters of anisometropia in patients who have experienced balanced binocular vision throughout life. To address this understandable skepticism, we next review research on a variety of vision functions with monovision.

1. Spatial Vision

Under optimum viewing conditions (high illumination, high contrast targets), binocular visual acuity with monovision is typically reduced less than one line from that achieved with full binocular correction.[2] High contrast visual acuity of 6/6 is usually retained.[2] There is a general reduction in contrast sensitivity compared to binocular correction[5,7,8] that is proportional to the "add" (amount of anisometropia).[8] These reductions are generally less than those found with contact lens multifocals.[2]

Suppression of blur with monovision tends to break down with bright targets against a dark background.[1] In our experience and that of other practitioners,[9] this is manifested under night viewing conditions, and is the most common complaint of monovision patients. However, similar complaints are common with bifocal contact lens wearers.[10,11]

2. Hyperacuity

Hyperacuity functions (Vernier and stereo) are known to be extremely sensitive to monocular blur. Reduction in these functions are proportional to the amount of monocular blur[12] and hence to the additional plus in the near lens. Using the Wirt Titmus stereo test, McGill and Erickson[2] found that stereoacuity was typically reduced from 40 seconds of arc with full binocular correction to 80 to 100 seconds of arc with a 2 D monovision add. Ironically, stereoacuity with most contact lens bifocals is often worse than with monovision.[2,4]

3. Binocular Fusion

Although fixation disparity testing is not well suited to monovision conditions, no significant differences have been found