MONOCULAR APHAKIA

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IN THIS paper I shall endeavor to recall to you as logically as I can certain facts and truisms concerning aphakia which, in my opinion, should be carefully considered by every ophthalmologist in any case before undertaking the management of cataract, especially when the patient is or will be aphakic in one eye only.

A person may be aphakic in one eye while the other eye is (1) normal, with good visual acuity and (*a*) no material refractive error, or with (*b*) notable refractive error and (*c*) good accommodation (young person), or with (*d*) presbyopia; (2) cataractous, or otherwise diseased, with poor visual acuity, with or without correction, and with or without accommodation, or (3) blind, or nearly so.

THE APHAKIC EYE

On removal of its lens, the eye is reduced to the simplest kind of an image-forming instrument. The entire optical system in the aphakic eye consists of the curved corneal surface, separating air from aqueous and vitreous. It represents a high-grade curvature hypermetropia. A change in both the number and the location of the cardinal points and planes of a normal eye occurs when the lens is removed. This change alters the direction of the visual axis, which makes it necessary for the eye to turn about 2 degrees outward to obtain an image at the fovea.

The retinal image, even with the correcting lens close to the eye, is about 30% larger in the aphakic eye than in the normal eye. The size depends on the previous refraction—larger if the eye was myopic than if it was hypermetropic—but always larger than in a normal eye.

The aberrations of the aphakic eye are much greater than those of the lens-containing eye. Normally, the harmful effects of the chromatic and monochromatic aberrations on distinct vision are rendered innocuous by both the physiologic characteristics and the structure of the optical system of the eye. The faults of the corneal surfaces are neutralized to a remarkable extent by the curvature of the surfaces and the nature of the indexes of refraction of the crystalline lens.

The removal of the crystalline lens, especially a senile lens, renders the eye hundreds of times as sensitive to violet and ultraviolet rays as before.

The aphakic eye is static. Total absence of accommodation is very important. There is always some accommodation in a normal eye, regardless of the age of a person, and even the slightest amount is a help in the adaptability of the eye. In a static eye properly corrected for distance, the vision is blurred from 4 meters in. It is only reasonable to suppose that in aphakia the optic reflexes are disturbed.

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In addition to the optical and physiological changes naturally produced by removal of the crystalline lens, there are numerous imperfections due to faulty technique or to unavoidable complications, one or more of which might, and usually do, occur after every extraction—for instance, irregular or regular astigmatism, changes in the shape of the pupil or the action of the iris, loss of transparency of the media, or newly formed opacities. Regardless of the dexterity of the surgeon, and even with a satisfactory result of the operation for senile cataract, there remains in nearly every instance a more or less mutilated eye.

The eye becomes a different optical instrument on removal of its lens. It cannot be compared in excellence and adaptability with the normal eye. An entirely new kind of vision is provided, probably as acute as or even more acute than before; but with magnified images, no accommodation, greater aberrations, lessened focal depth, and a changed pupil, which allows a different quantity and quality of light to enter the eye. The patient must accustom himself to the strong aphakic spectacle lens, with its many faults, small field, image distortion, and a newly acquired astigmatism; or to a contact lens and all the bother that goes with it.

The aphakic eye is so different from a normal eye that elderly people seldom, if ever, are able to obtain good single binocular vision with two aphakic eyes when corrected with spectacle lenses. How, then, could an aphakic eye possibly be paired up with a normal eye to make a comfortable, workable team? It cannot be done, whether it is corrected by a spectacle lens, a contact lens, or a minifying lens. Nevertheless, many claims have been made that good binocular single vision, even good stereoscopic vision, from infinity in to 10 in. (25 cm.), in patients of all ages, even to very young persons with good accommodation in the phakic eye, has been given to monocular aphakics by the use of a contact lens; that the retinal image is then of the same size, or nearly the same size, as that in the other, the normal, eye.

As a matter of fact, the retinal image in the aphakic eye, when corrected with a contact lens, is at least 10% larger than that in a previously emmetropic eye, as compared with about 30% when the same eye is corrected with a spectacle lens. This still is not an unimportant size difference. But even if the retinal images were equal in size, good single binocular vision could not be attained for two eyes one of which is normal and the other aphakic. No matter how the aphakic eye is corrected, it can never be made an adequate substitute for a normal, dynamic eye, and mere absence of diplopia does not indicate single binocular vision. While certain devices may apparently, for some unknown reason, enable a patient to obtain single vision, careful examination will show it to be spurious—nothing more than the patient has learned to disregard entirely the image of one or the other eye.

It does not require very careful examination of most case reports to show their unreliability. In many instances the only thing they actually prove is that they were hastily made, and that they are superficial, faulty, and incomplete. Too much is left unexplained.

Consider, for example, the case of a young person with good accommodation and emmetropia in one eye, and with aphakia in the other eye, corrected with a contact lens. The visual acuity is 6/6 in each eye. Suppose he can overcome the aniseikonia and that he can superimpose one image on the other without diplopia. He has, then, a sort of single binocular vision at 6 meters. Even at this distance he will use 1/6 D. of accommodation in the normal eye. As the object is brought closer and closer, the accommodation of the normal eye will be brought more and

more into play and the retinal image will become smaller and smaller but remain distinct, while in the aphakic eye the vision will become increasingly blurred and the image larger and larger. The discrepancy increases until at the reading distance the aphakic eye will require a convex lens of about 2.75 D., while the normal eye will use its accommodation. The aniseikonia will be increased; the prismatic effect of the spectacle reading lens will come into play, and there certainly will not be single binocular vision at the reading distance under these conditions.

All that takes place when one eye is emmetropic is exaggerated if the normal eye is ametropic. Depending on the strength and character of the correcting lens, numerous disturbing factors will be introduced the moment the eye turns from looking exactly along the pole of the spectacle lens. In this case, even if the normal eye is corrected with a contact lens, an extra glass for reading will be necessary for the aphakic eye.

A young person, therefore, with monocular aphakia and with the other eye emmetropic will have to wear a contact lens besides a reading lens in a spectacle for the aphakic eye. The young person with monocular aphakia, and with the other eye ametropic will wear either a contact lens in both eyes with an extra reading lens for the aphakic eye or a contact lens in one eye and spectacles with a single lens for the normal eye and a bifocal lens for the other. Usually in these instances prisms are necessary.

The monocular presbyope, having good vision with or without glasses in the normal eye, is seldom a satisfied person, whatever is done for the aphakic eye, at least not in my experience.

The patient with good visual acuity in his aphakic eye and with vision in the other eye too poor to be of any use is the least bother to himself and to the ophthalmologist.

A one-eyed person is not necessarily unhappy, and not terribly handicapped. Many who have never had binocular single vision go through life and do very well in most occupations and in many sports. One-eyed persons can have a considerable sense of depth and solidity, and judgment of distance. For direct vision one eye is as good as two.

Of course, two eyes with good, comfortable binocular single vision are better than one. Stereopsis is a great advantage, and it would be worth a great deal of trouble to acquire it. In my opinion, however, if a patient already has one useful eye, whether aphakic or normal, it is not worth subjecting him to the hazard, apprehension, nervousness, and cost of an operation, then the fitting of a contact lens, besides a pair of spectacles, and, after all that, a course of training, all in order that he may obtain at best a counterfeit sort of single binocular vision.