EXPERIMENTAL SIMULATION OF APHAKIA*

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WITH a correctly fitting pair of approximately -14 D. corneal contact lenses, a person with normal emmetropic eyes can become a 12 D. experimental hyperope, and he can very nearly simulate the exact type of vision of the spectacle-corrected aphakic by wearing a correctly fitted set of $+12.00$ D. Sph. cataract spectacle lenses.

With this "simulator of aphakia", the inquisitive scientific researcher in aphakia can answer the following questions for himself:

What are the transient and permanent defects of vision through aphakic spectacle lenses? Does the spectacle-corrected aphakic have a very severe loss of his *visual field*, of his *field of view*, or both? Why do spectacle-corrected aphakics almost invariably complain of "no side vision" through their aphakic spectacles—spheric or aspheric? What is the so-called "ring scotoma" of cataract spectacle lenses and how wide is it? What is the "Jack-in-the-box phenomenon" caused by the "ring scotoma"? How severe are magnification, false spatial orientation, peripheral distortion, and curvature of field of aphakic spectacles? Is the peripheral blur of marginal error as severely handicapping to the aphakic as some advertisements for aspheric cataract spectacles would lead us to believe, or do aspherics actually give only a mild, or even an insignificant improvement compared with the less expensive but ideally used (Welsh, 1963) non-aspheric cataract lenses? Why is only the top portion of the bifocal segment useful in spectacle aphakia for clear near vision? Are contact lenses the answer in restoring visual function for the binocular aphakic or for the aphakic with only one useful eye? If a patient with incipient or mature cataracts has his vision restored to 20/15 O.U. with bilateral cataract extraction, what per cent. of loss of visual function does the patient still have if he is forced to wear aphakic spectacle lenses for his aphakic correction?

All the above questions are extremely important for the cataract surgeon to be able to answer. If the cataract surgeon can *see for himself*, with a reasonable "simulator" of aphakic vision, he will be quite impressed with the correct answers to the above questions.

After carefully reading about vision of aphakic ophthalmologists (Woods, 1952; Stevenson, 1961; and McLemore, 1963), and after writing a monograph on aphakic vision (Welsh, 1961a), I recently tried this most revealing and enlightening experiment on myself. I suggest that all interested cataract surgeons do the same—but walk about with extreme caution during the experiment!

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Experiment

After inserting both the high-minus contact lenses, I found that my vision was terribly blurred. Even with this severely blurred vision, I could walk about with moderate confidence in familiar surroundings. I could not see well enough to find my "cataract" spectacles unless I knew exactly where I had put them. On applying the "cataract" spectacles vision was immediately remarkably clear. But everything was tremendously magnified, and all objects in the field of view seemed to swim back and forth with each turning of the eyes or with movement of the head. Vertical lines such as door jambs bowed out at the top and bottom when seen through the lens periphery. Both peripheral and direct vision lateral to the spectacle lenses were present and of some use, but here it was just as blurred as before putting on the spectacles. Through the spectacles everything seemed much closer than normal. People were much taller. In group conversation at 2 to 3 feet I was impressed by the fact that only two faces fitted into the stationary-head field of view even with a close vertex adjustment. The floor seemed much closer. My feet were missing; I had actually to bend my head forward about 45° to see them. It was necessary to walk with legs apart, as on a rolling ship, to keep myself from falling. The "ring scotoma" was present but no blind area was perceptible unless tested for; though apparently something was missing at the side. The "Jack-in-the-box phenomenon" (Welsh, 1961b) was not very evident but it was present if tested for. What was obvious was a very small limited field of view for direct vision through the cataract lenses. I could recognize that peripheral vision through the lenses with primary fixation seemed considerably wider than the field of view for direct vision. The limited field of view makes one desire to turn one's head rapidly to see what is to the side.

Vision was clear only through the top of the bifocal segments. In contrast, vision seemed acceptably clear for recognizing objects over the entire small field of vision through all the types of +12-00 D. Sph. 44 eye size spheric and aspheric cataract spectacle lenses tried.

I walked down the hall to the elevator with relative ease except that the swimming back and forth of the field of view gave a nauseating feeling in the pit of my stomach. Outside on the pavement the basic instinct of self-preservation made me turn my head rapidly back and forth to see who and what was where to avoid a collision. Crossing the street at the busy corner next to my medical building was horrifying—though I had crossed it for fifteen years—notwithstanding the special crossing light there for pedestrians only. This feeling of helplessness results from the limited peripheral and scanning vision, neither of which is wide enough through the spectacle lenses to show the cars coming from the right or left. I had to turn my head to the right and then quickly to the left to see that no cars were coming, even though the light indicated that it was safe to cross.

After repeating this experiment on several occasions, I hastened to tell my local ophthalmological colleagues that 20/15 vision through aphakic spectacle lenses is just about as handicapping, or even more so, as having 20/15 emmetropia in each eye, but with both eyes ankylosed in the primary position of gaze combined with a bilateral 25° visual field. Every ophthalmologist would agree that the visual function of a patient with a combination of these defects would be most severely incapacitated and that it would require rapid head-turning for him to orient himself in space.

Conclusions

From this experiment, my feeling is that bilateral aphakic vision corrected with cataract spectacle lenses—spheric or aspheric—is indeed very bad. How a patient becomes adjusted to, and satisfied with, this type of vision is difficult for me to

understand. It is no wonder that aphakics who wear contact lenses are so enthusiastic about the vision uniquely obtainable with these. The cataract surgeon's obligation towards total visual rehabilitation of his cataract patients should not end with just a perfect surgical result and a simple prescription for cataract spectacles.

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