Phakic Intraocular Lenses for the Correction of Myopia—Where Do We Go From Here?

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The history of minus power intraocular lenses (IOL) implanted in phakic eyes for the correction of myopia is familiar to most who work in refractive surgery. It is recited in every article about the subject. Baskoff, Colin, and colleagues have carried out a contemporary multicenter trial using finely finished, vaulted, multiflex style anterior chamber lenses demonstrating that the refractive accuracy of these is superior to that of myopic epikeratoplasty and keratomileusis.\textsuperscript{1,2} Unfortunately, as detailed by Colin and colleagues and by Saragousi and colleagues in this issue of Refractive and Corneal Surgery, the vault high and prominent edge of the optic produced corneal endothelial damage in some of these eyes. Ophthalmic surgeons have abandoned this style of lens, but have not abandoned phakic intraocular lenses for the correction of high myopia.

Indeed, there are three other lenses currently vying to become the first safe and effective phakic IOL to produce a predictable and stable correction of myopia: a newly-designed modification of the anterior chamber multilux lens with a lower vault (Sweden), a four-loop, anterior chamber, “spider lens” (Japan) that has resemblance to the now-abandoned stableflex lens, and posterior chamber silicon lenses (Soviet Union) initially configured as a collar button that rests on the anterior lens capsule within the pupil, and now redesigned as a curved disk that fits in the posterior chamber on the surface of the crystalline lens.

The evaluation of these lenses raises scientific and ethical conundrums. Scientifically, evaluating intraocular lens implants in animals is a difficult procedure. A radically new material or design can benefit from general bioincompatibility testing in animals. But, once a reasonable design of a proven material is created, animal testing is generally impractical. Rabbits and cats are poor models because they develop an intense fibrinoid reaction following surgery. Monkeys are better models, but they require lenses of a special design to fit the eye with its steeper cornea. In addition, monkeys are in short supply, are extremely expensive, generally require a dedicated primate center, are objects of vigorous protection by animal rights activists, and are difficult to refract accurately. Thus, both manufacturers and clinicians turn to that readily available and not so expensive animal—man. If we are to do our experimental work on phakic intraocular lenses on humans, how can it be done most safely and still advance the clinical science of this important refractive surgical technique? The answer is clear: expose as few individuals as possible to risks and require a prospective, thorough analysis of all relevant variables.

In the 1950s, Joaquin Barraquer implanted Strampelli and other styles of anterior chamber intraocular lenses in approximately 450 eyes, half of them in phakic myopic eyes. Over the succeeding 15 years, approximately half of the implants required removal because of endothelial damage and other complications.\textsuperscript{3} The current clinical studies of the vaulted multiflex anterior chamber phakic intraocular lens involved over 300 patients in France (G Baskoff, personal communication, September, 1990).

Fyodorov and colleagues have implanted over a thousand silicon posterior chamber lenses in phakic eyes.\textsuperscript{4} Since intraocular lenses are under the control of the Food and Drug Administration, more cautious approaches are required in the United States. Fortunately, the FDA has provided guidelines for investigational device exemptions (IDE) for small feasibility studies that involve limited numbers of human subjects (IDE Guidance Memorandum 89-1, May 17, 1989).

On November 21, 1984, the American Society for Artificial Internal Organs submitted a citizen petition requesting the FDA to amend the investigation...
of the IDE regulation to allow limited clinical investigation of significant risk devices to be subject to less than the full IDE requirements. As a result, the FDA created a category called feasibility studies, also known as phase I, pilot, prototype, and introductory studies. The FDA has a flexible approach to these small trials, with the goal of assessing the performance of the device which will lead to improvements, abandonment, or the establishment of parameters for larger clinical trials.

Typically, feasibility studies involve one investigator at one site with a limited number of subjects, usually 10 or less. Data from feasibility studies are not considered as pivotal evidence of safety and effectiveness, but rather form a basis to finalize and confirm the design of the device and to determine its potential for future development. Investigators in feasibility trials must demonstrate the lack of unreasonable risk to patients and must provide some evidence of the expected performance of the device based on preclinical studies. Modifications of the device and of the study protocol may occur during the feasibility studies, as long as supplemental information is filed with the FDA and appropriate institutional review board approval is obtained.

This feasibility approach was taken in the development of excimer lasers, which graduated through phase I (10 eyes), phase IIa (25 eyes), phase IIb (100 eyes), and currently phase III (300 eyes, to be increased to 700 eyes after the initial 6-month follow up).

Concerning phakic intraocular lenses, such a feasibility trial will be undertaken in the United States with a newly-designed, low-vault, multiflex style anterior chamber minus power intraocular lens in five patients at the LSU Eye Center in New Orleans this year. This second lens design will have a smaller, lower shoulder and a lower vault. They will be implanted in patients between the ages of 20 and 40 with 7.00 to 10.00 D of myopia. A 1-year follow up will be required with frequent reports to the FDA (H Kaufmann, M McDonald, personal communication, April 26, 1991). This lens also will be tried in Europe.

We endorse the slower, more cautious approach of feasibility studies using a small number of eyes in new refractive surgical procedures.

REFERENCES