Several methods have been proposed for surgical correction of presbyopia, including techniques that address the cornea, the crystalline lens, and the sclera. A number of parameters have overlapping effects on the best choice of presbyopia-correcting technique for a given patient: the patient’s type and degree of ametropia, the patients’ age, and the patient’s visual needs.

Currently, three strategies are widely used to correct presbyopia—monovision, multifocality, and pseudoadaptation. Two others—corneal inlays (Figures 1 and 2) and scleral expansion—are still under evaluation.

Corneal inlays provide near vision through either a refractive or stenopic effect (pinhole; Figure 2). Scleral expansion techniques aim to restore accommodation by facilitating the action of the ciliary muscle. This effect is more likely to be achieved in the future with the use of femtosecond laser incisions in the crystalline lens.

This article reviews the three widely used strategies for presbyopia correction and suggests an algorithm for choosing the best technique based on individual patient parameters.

**MONOVISION**

Monovision is the oldest strategy for presbyopia correction, inducing distance vision correction in the dominant eye and near or intermediate vision in the non-dominant eye. Monovision can be created with any refractive surgery technique. The results are good, especially for myopic patients, but hyperopic patients may also do well with monovision.

Before surgery, identify the dominant eye, and determine the degree of myopic tolerance of the non-dominant eye. Patients should be informed that glasses may be needed to avoid visual fatigue and that they may need time to adapt to their vision.

**MULTIFOCALITY**

Today, creating multifocality is the most prevalent surgical treatment for presbyopia. It is based on the sharing of light at several foci—distance, near, and in some cases intermediate. Neutralization of the blurred image(s) requires neural adaptation over time.

Multifocality can be induced with LASIK, IOLs, conductive keratoplasty, or Intracor (Technolas Perfect Vision GmbH, Munich, Germany).

**LASIK**. Most presby-LASIK treatments place the near vision zone at the center of the pupil; the exception is treatments performed with Nidek’s excimer laser system (Gamagori, Japan), which places the distance zone in the center. Some lasers correct presbyopia by increasing corneal asphericity to induce a hyperprolate cornea.

**Multifocal IOLs**. Multifocal IOLs have the advantage of correcting all ametropias associated with presbyopia and maintaining binocular vision. They can be separated into two groups: refractive IOLs, which contain several concentric optical zones for focusing at varying distances; and diffractive IOLs, which are less pupil dependent and distribute light for distance and near vision. The latest diffractive designs also distribute light for intermediate vision.

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**Figure 1. Some inlays are placed under the stromal flap.**
When implanting multifocal IOLs in presbyopic patients, certain considerations are required to achieve the best outcome:

- Patient selection must be meticulous;
- The choice of implant must be customized using either the same optical principle in both eyes or different styles of multifocal IOL selected with the mix-and-match strategy;
- Surgically, the rhexis must be centered and must cover the edge of the optic, the ophthalmic viscosurgical device must be removed from under the optic, and the IOL calculation must be highly precise (ideally using optical coherence biometry, topography, and the latest-generation IOL calculation formula); and
- Emmetropia must be achieved, and any astigmatism must eventually be corrected.

Conductive keratoplasty. This option is less frequently used because of the regression of the effect. The treatment is performed at a 6-mm optical zone and to a depth of 500 µm. The temperature of the corneal collagen fibers reaches 65° C, and the treatment induces paracentral stromal collagen contraction to steepen the central cornea. When eight spots are placed, 2.50 D of hyperopia can be corrected; when two rows of 16 spots are placed at 7 and 8 mm, an additional 1.50 D of correction is possible.

Intracor. Intrastromal correction of presbyopia is a noninvasive technique currently suitable for patients with emmetropia or low hyperopia—who are the most difficult to correct. The correction is done by focusing femtosecond laser pulses in the stroma to reshape the cornea and redistribute its biomechanical strengths. Five concentric incisions (Figure 3) are made, and the treatment is performed without the need for flap creation or epithelial removal. Bowman’s layer remains intact. Other advantages of this technique include quick visual recovery, no risk of flap complications or dry eye, and no central corneal weakening. The main challenge with Intracor is centering the treatment precisely.

Intracor’s effect is based on a steepening of the central cornea, which becomes multifocal. This is associated with a defocus, causing a myopic shift, and an increase in spherical aberration, inducing an improvement in depth of field.

PSEUDOACCOMMODATION

Today, surgeons also have the option of accommodating IOLs to correct presbyopia. Pseudoaccommodation can be achieved with these lens designs, which are based on one of two principles: modification of the lens curvature or an anterior shift of the optic. The leading accommodating IOL is the Crystalens AO (Bausch + Lomb, Rochester, New York). The theoretical advantages

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<th>TAKE-HOME MESSAGE</th>
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<td>• An algorithm based on individual patient parameters may be useful when choosing the best presbyopia-correction technique.</td>
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<tr>
<td>• Parameters include visual needs, age, and type and degree of the initial ametropia.</td>
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<td>• Adopting an algorithm will enhance the surgeon’s ability to provide a customized solution.</td>
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of this approach include no division of light, no decrease in contrast sensitivity, fewer halos, and better intermediate vision.

**CHOOSE YOUR TECHNIQUE**

Given the techniques available, how do we choose the best technique for each patient? The answer is to individualize your treatments based on the parameters noted at the outset: the patient’s visual needs, his or her age, and the type and degree of the initial ametropia. Below are the general guidelines that I follow.

In patients with low or mild myopia, I find the best choice is monovision LASIK or epi-LASIK. In patients with high myopia, if vitreous detachment has not occurred, our preferred treatment is monovision with a phakic IOL; after vitreous detachment, the best choice becomes lens extraction with monovision or a multifocal IOL.

In patients with hyperopia, I perform LASIK if he or she is less than age 55 years. Any patient above age 55 can undergo lens extraction with two possibilities: a multifocal IOL if close vision is particularly necessary and any halo effect would not be disruptive, or an accommodating IOL if the halo effect would be disruptive and close vision needs are less important.

In emmetropic patients, I believe the best choice is Intracor before the age of 65 years and lens extraction with a multifocal or accommodating IOL after that age.

**CONCLUSION**

Today’s presbyopia-correction techniques can provide a customized solution for any patient’s ametropia. LASIK is successful for presbyopic ametropes and should continue to improve with new strategies. The latest multifocal IOLs are efficient and successful if care is taken with patient selection, and results with accommodating IOLs are promising even if long-term stability has yet to be confirmed. Lastly, Intracor seems to be the best solution for emmetropic patients, who are the most difficult to correct.

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**CONTACT US**

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