Many patients adapt to this phenomenon or never experience it.

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“It’s dark on the left side,” says the patient on day 1 after phacoemulsification and IOL implantation. The patient is experiencing a phenomenon called dysphotopsia. Dysphotopsias are some of the most common complaints after cataract surgery. Masket first described dysphotopsias in the early 1990s when patients reported undesired light images.

Patients can present with two different types of dysphotopsia: positive and negative. In positive dysphotopsia, patients complain that they see streaks of light or arcs. In negative dysphotopsia, patients complain of a temporal dark crescent. In the case described at the outset, the patient is experiencing a negative dysphotopsia. Other common complaints regarding negative dysphotopsia include statements like these: “It’s like when I used to wear glasses and the frame got in the way,” or “It’s kind of like having blinders on.”

The incidence of negative dysphotopsia is unknown; studies show that it is widely varied. For example, in an initial study of 6,668 patients, Davison reported only 14 (0.2%) dysphotopic symptoms (six positive, six negative, and two combined). By contrast, in a study of 250 consecutive patients who underwent cataract surgery, Osher reported that 15.2% experienced negative dysphotopsias on postoperative day 1, decreasing to 3.2% at 1 year and 2.4% at 2 to 3 years.

THEORIES
There are several theories to explain the phenomenon of negative dysphotopsia. Technological advances in ray tracing and simulation have lent weight to some of these theories. With new research, some have been highly debated, and theories have evolved over the past decade. Some commonly advanced theories are provided in the information to follow.

Ring scotoma. Some ophthalmologists believe that negative dysphotopsia occurs due to a ring scotoma. Olson first described negative dysphotopsia as a ring scotoma in 2005. He hypothesized that there is a central area of field of vision that is magnified by the IOL, with a circle of missing information around it where the image is not magnified. Hence, the IOL creates a ring scotoma. This is seen only temporally because the nose blocks it nasally. He noted that the ring was accentuated and associated with high refractive index lenses and high plus IOLs.

Enigmatic penumbra. Because the patient perceives only a partial shadow with negative dysphotopsia, not a full shadow, technically he or she perceives a penumbra, versus an antumbra. Furthermore, because there are only proposed mechanisms to explain negative dysphotopsias, they are in essence an enigma. Hence, in 2011, Holliday et al coined the phrase enigmatic penumbra for negative dysphotopsias. These authors used ray tracing simulation to determine the optical requirements for negative dysphotopsias to occur. The requirements included a sharp-edged IOL, a nasal retina that extends anteriorly, a small pupil, and distance behind the pupil of 0.06 mm or more. In addi-

AT A GLANCE

- Patients who have negative dysphotopsia complain of a temporal dark crescent. Multiple etiologies have been proposed.
- Nonsurgical remedies can include observation or thick-rimmed spectacles. Surgical remedies include IOL exchange, reverse optic capture, and other options.
- To avoid planting the idea in patients’ minds, it may be best to avoid mentioning this potential complication preoperatively.
tion, a high index of refraction of the IOL material was associated with a higher percentage of negative dysphotopsias.

**Temporal corneal incision.** Others have suggested that temporal corneal incisions can be inciting factors for negative dysphotopsia early after cataract surgery. However, Cooke showed that negative dysphotopsia can occur after superior scleral tunnel incisions as well. In a case he described, symptoms were resolved immediately after an IOL exchange, even when temporal corneal incisions were used. This illustrated that symptoms can occur regardless of where the incision is made.

**IOL position.** The position of the IOL is another important factor to consider. When the IOL is in the capsular bag, there is plenty of space between the lens and the iris. Given such space and a posterior position, the functional retina can cause the patient to perceive shadows. When the optic is in the capsular bag with an IOL that is instead inserted in the ciliary sulcus. Or, by having the capsule overlap the edge of the lens, the extra space will be eliminated. These options will reduce the posterior chamber depth and, consequently, the symptoms. This can also help prevent posterior capsular opacification (PCO), as shown by Smith et al.

**IOL exchange.** Some studies have suggested that certain IOL optic designs increase or decrease negative dysphotopsia symptoms. In particular, round-edged lens designs are known to cause an increase in PCO and thus a need for a subsequent Nd:YAG. Nishi et al postulated that a square lens edge reduced the occurrence of PCO by blocking the migration of lens epithelial cells, which would form PCO if left unchecked. Other studies postulated that certain lens materials (eg, acrylic) might reduce the occurrence of PCO by forming a tight junction between the lens and capsule, thus blocking migration of lens epithelial cells. However, the square-edged lens brings the tradeoff of increased positive dysphotopsias, such as light streaks and arcs, due to the internal reflection caused by the square lens.

**MANAGEMENT OPTIONS**

There are several options to consider in the management of negative dysphotopsia. In the short term, the temporal dark crescent can be temporarily mitigated via dilation or by blocking the temporal field with a hand.

**Adaptation.** The initial treatment is to wait and see if the shadow goes away on its own. Typically, the phenomenon is observed for 3 to 6 months before any major surgical option is undertaken. Most of the time, the symptoms will fade, or the patient will adapt to the shadows. Frequently, the shadow will disappear when the temporal field is blocked using an object such as a hand. Prescribing thick-rimmed glasses will have the same effect, and this is another nonsurgical treatment option. In the end, the patient will often adapt to the symptoms, which will fade over time.

**Anterior capsulotomy.** Another option is to perform Nd:YAG laser capsulotomy to the nasal anterior capsule. This is a controversial approach. The basic premise is that a translucent capsule will scatter the light rays, eliminating any negative dysphotopsia. However, by doing this, the surgeon creates the unwanted effect of increasing the difficulty of performing a seamless IOL exchange subsequently. It also increases the risk of undesirable side effects if an IOL exchange is required. Thus, it is best to discuss with the patient that, if an Nd:YAG capsulotomy is performed, a future IOL exchange will be difficult.

**Optic out of capsular bag.** When the optic is in the capsular bag, there is a space of roughly 0.5 mm between the IOL and the iris. This extra space allows light to reflect off the edge of the optic, causing a shadow. To mitigate this extra space, one management option is to replace the IOL in the capsular bag with an IOL that is instead inserted in the ciliary sulcus. Or, by having the capsule overlap the edge of the lens, the extra space will be eliminated. These options will reduce the posterior chamber depth and, consequently, the symptoms. This can also help prevent posterior capsular opacification (PCO), as shown by Smith et al.

**THE BIG QUESTION: What, if anything, should surgeons tell their patients about the potential for dysphotopsia during preoperative counseling?**
ment.14 This suggests that the distance between the IOL and iris may play a role in negative dysphotopsia, and that, in reducing it by placing the IOL in the ciliary sulcus, symptoms can be relieved. However, Vamosi contended that, because the distance between the iris and lens in symptomatic patients was not significantly greater than in asymptomatic patients, the entire story has yet to be told. Burke also showed that sulcus placement eliminated symptoms in five patients. He theorized that, when the lens is moved anteriorly out of view of the functional retina, the symptoms are no longer perceived.14

**Piggyback IOL.** Another option to reduce the space between iris and IOL is to implant a piggyback IOL. The reasoning is the same as bringing the optic out of the capsular bag. In this procedure, the initial IOL remains in the same position while another IOL is implanted in the ciliary sulcus. The space between the iris and IOL is diminished, and the symptoms are eliminated.13,15

**Reverse optic capture.** This is a technique in which the anterior capsule edge is freed from the optic, and the optic is then elevated anterior to the capsulorrhexis or capsule edge. The haptics remain in the capsular bag. In a case series, Masket et al found that reverse optic capture relieved symptoms in all patients.15

**Different material or design.** As mentioned previously, some ophthalmologists postulate that the material or design of a lens contributes to the symptoms of negative dysphotopsia. Therefore, many will choose to perform an IOL exchange using a different lens style, and many times this option works. Recently, however, Radmall et al examined 87 patients who underwent cataract surgery using two acrylic IOLs (SN60WF, Alcon; and ZCB00, Abbott Medical Optics) with different refractive indices (1.55 and 1.47, respectively).16 The study found no significant difference between the two IOLs in negative dysphotopsias.

**Anti-dysphotopic IOL.** Masket recently designed an IOL that is meant to eliminate negative dysphotopsia by having the optic edge overlap the anterior capsule in a manner similar to reverse optic capture. The Masket ND IOL 90S (Morcher) has a groove around the optic that the edge of the capsule can be inserted into.17 In results he announced last year, no patients had experienced symptoms with this new IOL design.18

**CONCLUSION**

The big question is what to tell the patient about the potential for dysphotopsia during preoperative counseling. Some ophthalmologists will state that you are obligated to tell patients about all potential outcomes. Conversely, simply suggesting the notion that something could happen may make patients more likely to experience symptoms. Because the majority of cataract surgery patients do not complain of symptoms, and, if they do, they normally adapt over time, most surgeons do not typically discuss dysphotopsia during preoperative counseling. This is because most patients who are unaware of the potential problem never complain of it, and, by bringing it to their attention, we may make them more inclined to look for shadows postoperatively.

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**PATIENT EDUCATION**

The more that a patient focuses on negative dysphotopsia, the worse it will be for him or her. The adaptation that our brains normally undertake will be prevented because the symptoms are always at the patient’s center of attention. During postoperative evaluation, it is helpful to recommended to the patient not to focus on any shadows. (They may not occur in the first place.)

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