Is There an Optimal Incision Size for Routine Cataract Surgery?

A personal review of incision size in relation to IOL injection and phacoemulsification.

BY KHIUN F. TJIA, MD

Cataract surgery has developed from large-incision intracapsular procedures into microincisional techniques featuring incisions as small as 1 mm in biaxial phaco. The big question for many cataract surgeons is: What incision size should I choose for routine cataract cases? In this article, I share my opinion and insight with you, which may help answer this question.

Regardless of personal surgical preferences including incision size, phaco machine, and IOL type, we should never forget that the patient's best final visual outcome is the one and only objective we should aim for. Because the focus of this article is incision size, wound strength and induced astigmatism are the most important parameters to consider for patient visual outcome.

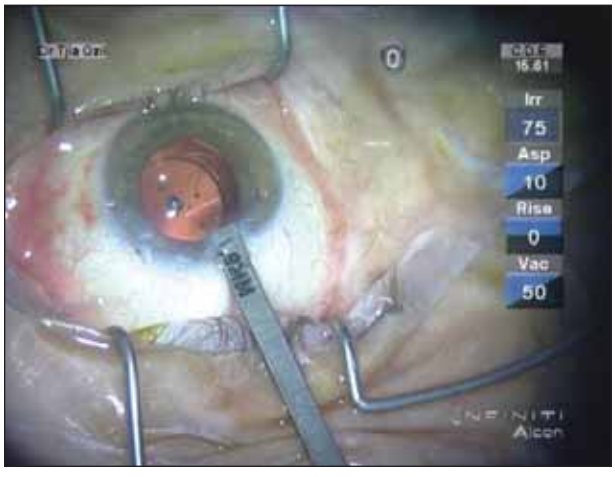

Figure 1. The Akreos MI60 can be introduced through a 1.8-mm incision with minimal wound stretch.

WOUND STRENGTH

IOL injection can stretch the wound significantly, compromising wound integrity and increasing the risk for endophthalmitis. The amount of wound stretch is dependent upon the choice of IOL cartridge in relation to the wound size as well as the injection technique and the force applied to the incision during injection.

When the cartridge nozzle is introduced completely through the wound for an instant, as with in-the-bag IOL delivery, larger incision sizes are required. However, wound-assisted injection procedures require a smaller incision because the tip of the cartridge only is held against the wound or a small part of the nozzle is slipped into the wound opening. The amount of pressure applied also influences wound stretch with these wound-assisted techniques.

The speed of IOL delivery, especially for hydrophobic acrylic IOLs, also plays a role during wound-assisted injection. Whenever an IOL is injected slowly and/or with a halt, the IOL can unfold inside the incision tunnel

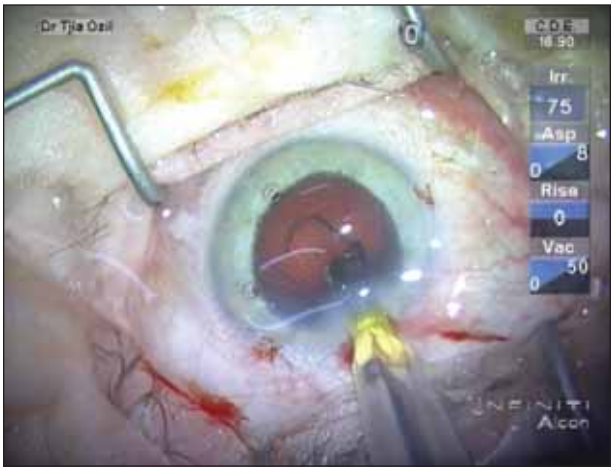

Figure 2. Hoya's microincision hydrophobic acrylic IOL can be injected through a 2.2-mm incision with limited wound stretch.

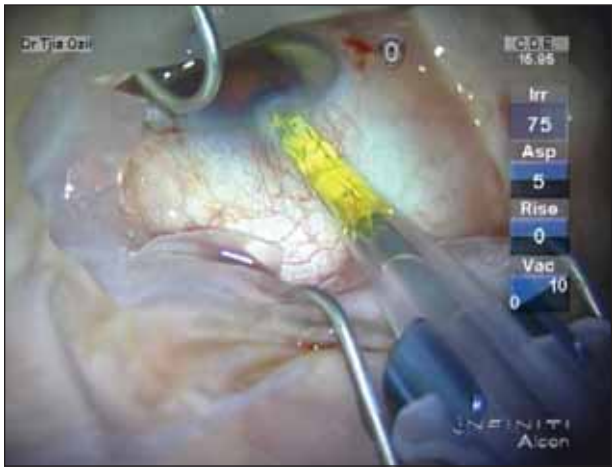

Figure 3. The AcrySof IQ injected through a 1.8-mm incision.

and distort the wound significantly. Hydrophilic acrylic material is easier to compress because its 25% water content can be squeezed out of the IOL. Its compression/unfolding characteristics are independent of temperature, unlike IOLs made of hydrophobic acrylic material. (Hydrophobic acrylic behaves quite differently at lower temperatures than at slightly higher temperatures.)

I have evaluated the minimum required incision size for various IOLs on the market. Many hydrophilic acrylic IOLs can be injected through 2.2-mm incisions or smaller with acceptable wound stretch. For example, I was able to inject the Akreos MI60 hydrophilic acrylic IOL (Bausch & Lomb, Rochester, New York) reliably through 1.8-mm incisions with minimal wound stretch (0.1 mm; Figure 1). Hoya's microincision hydrophobic acrylic IOL (Tokyo; not yet fully launched) can be injected through a 2.2-mm incision with an all-through-the-wound technique; wound stretch is limited (Figure 2). I have also implanted the AcrySof IQ (Alcon Laboratories, Inc., Fort Worth, Texas) through a 1.8-mm incision but at the cost of significant wound stretch (Figure 3). In a poster I presented at the European Society of Cataract and

TABLE 1. WOUND STRETCH WITH IMPLANTATION OF THE ACRYSOF IQ*

Initial size	1.8 mm	2.0 mm	2.2 mm	2.4 mm
Final size	2.06 mm	2.14 mm	2.28 mm	2.44 mm
Wound stretch	0.26 mm	0.14 mm	0.08 mm	0.04 mm

** All IOLs were implanted with the D Cartridge (Alcon Laboratories, Inc.)*

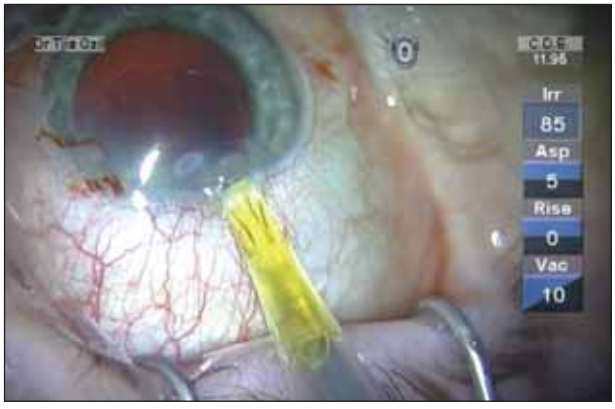

Figure 4. The acceptable incision size for the AcrySof IQ is 2.2 mm.

Refractive Surgeons (ESCRS) meeting,[1] I showed that the acceptable incision size for the AcrySof IQ, with minimal wound stretch (0.1 mm), is 2.2 mm (Figure 4 and Table 1).

Every IOL, with its specific design and material properties, has its own minimum required incision size through which it can be reliably injected without clinically significant wound stretch. One should not attempt to inject an IOL through smaller incisions when wound distortion cannot be excluded. Hydrophilic acrylic material is generally more easily compressed compared with hydrophobic acrylic material.

INDUCED ASTIGMATISM

Although safety, and therefore wound integrity after IOL injection, is my highest priority, induced astigmatism has become increasingly important. Final refractive outcomes are of the greatest importance with presbyopia-correcting and/or toric IOLs. The ultimate goal is to pre-

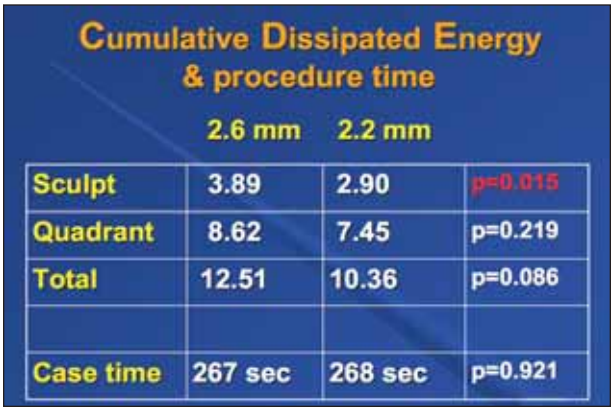

Figure 5. The 2.2-mm group did not require more ultrasound energy or procedure time compared with the 2.6-mm group.

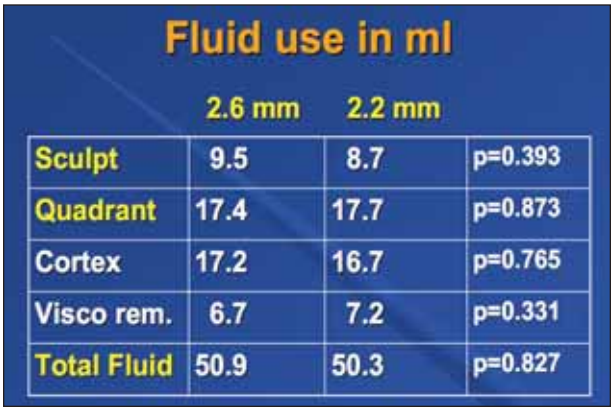

Figure 6. The 2.2-mm group did not require more fluid use.

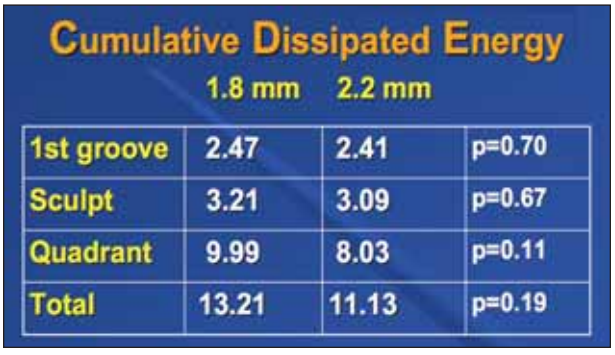

Figure 7. Ultrasound energy was not significantly different between the 1.8- and 2.2-mm groups.

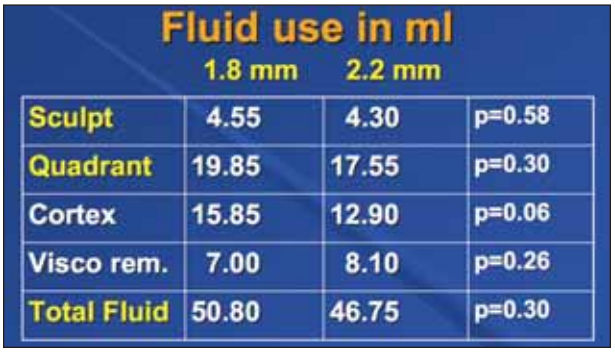

Figure 8. The 1.8- and 2.2-mm groups had similar fluid use.

dict the induced astigmatism with absolute certainty and without any variance. Ideally, the 5-mm central optical zone of the cornea should not be influenced by the incision(s). This can probably be achieved with a true 2-mm postinjection incision size with the proper location (not too central).

It is obvious that smaller incisions induce less astigmatism than larger incisions. It is also true that sclerocorneal incisions affect the corneal shape less than clear corneal incisions. With current IOL injection technologies for 2.2-mm and smaller incisions, we are quite close to this ideal astigmatism-neutral procedure. However, there is still an opportunity for improvement, with undoubtedly further progress in the coming years.

SUB–2-MM INCISIONS

Once wound strength and minimizing induced astigmatism are mastered, surgeons may then consider the latest trend in cataract surgery, sub–2-mm incisions. Biaxial phaco is a viable technique using incisions as small as 1 mm. Several manufacturers have launched 1.6- to 1.8-mm microcoaxial phacoemulsification systems with success.

Not many cataract surgeons have adopted phaco incisions 1.8 mm or smaller for their standard procedure; however, more surgeons are transitioning to 2.2- to 2.4-mm microcoaxial phaco or planning to do so. Phaco equipment manufacturers have made enormous progress in ultrasound technology and fluid dynamics

TAKE-HOME MESSAGE

- Phaco technology for sub–2-mm cataract surgery is no longer the limiting factor for more widespread use.
- Wound integrity should have the highest priority when choosing the incision size for a specific IOL and injection system.
- Appropriate hydrophilic acrylic IOLs are now on the market for sub–2-mm cataract surgery.
- Innovative injection systems are still desirable for most IOL designs to reduce induced astigmatism for refractive cataract surgery.

properties. The emulsification technology of today is no longer the limiting factor for sub–2-mm phaco surgery. IOL injection technology, however, still needs further improvement to allow routine phaco surgery through sub–2-mm surgery.

In 2008, I presented a study comparing 2.6- and 2.2-mm coaxial torsional phaco.[2] The 2.2-mm group did not require more ultrasound energy, fluid use, or procedure time compared with the 2.6-mm group (Figures 5 and 6). In September, I presented the results of a comparative study between 1.8-mm and 2.2-mm microcoaxial torsional phaco,[3] for which I performed 30 cases in each group (matched for age and nucleus density). For all surgeries, I used a 45° Kelman miniflared tip (Alcon Laboratories, Inc.), with a bottle height of 75 cm and 300 mm Hg vacuum limit for quadrant removal. For the 2.2-mm group, an Ultrasleeve (Alcon Laboratories, Inc.) was used with an aspiration flow setting of 25 mL/min. In the 1.8-mm group, I used a Nanosleeve (Alcon Laboratories, Inc.; not commercially available) and 20 mL/min. Ultrasound energy and fluid use were not significantly different between the 1.8- and 2.2-mm groups (Figures 7 and 8). The procedure time was 38 seconds longer for the 1.8-mm group, which was caused by initial IOL injection failures in five cases, which required reloading and repeated injection.

CONCLUSION

No matter what your technique, one thing should remain clear: Choose an incision size that guarantees your patients maximal visual results. With this in mind, make wound integrity and minimizing induced astigmatism your highest priorities for your specific IOL and injection system. In my personal experience, 1.8-mm microcoaxial torsional phaco is viable for routine cataract study. The current Monarch IOL injection system (Alcon Laboratories, Inc.) is not compatible with an incision size of 1.8 mm. ■

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1. Tjia KF. Final incision size assessment of microincisions after AcrySof single piece IOL injections. Poster presented at the: XXVII Congress of the ESCRS; September 12-16, 2009; Barcelona, Spain.
2. Tjia KF. Fluid use and ultrasound energy comparison between coaxial and microcoaxial torsional ultrasound. Poster presented at the: XXVI Congress of the ESCRS; September 13-17, 2008; Berlin, Germany.
3. Tjia KF. A comparison between 1.8 mm and 2.2 mm micro-coaxial torsional phaco. Paper presented at the: XXVII Congress of the ESCRS; September 15, 2009; Barcelona, Spain.