A Need for the Mechanical Microkeratome in Refractive Surgery

This time-proven technology has evolved its safety, predictability, and simplicity in creating lamellar flaps for LASIK.

BY SUPHI TANERI, MD

It may seem old-fashioned to defend the use of mechanical microkeratomes in the presence of fancy high-technology lasers. But aborting the use of mechanical microkeratomes may be premature at present. Let us look at cataract surgery: We have been using ultrasound to remove the crystalline lens with good results for 3 decades now, and laser-phaco has never been a serious competitive technology.

Today's mechanical microkeratomes are a time-proven technology dating back to José I. Barraquer's manual microkeratome for keratomileusis in 1958. Over 4 generations, the safety, predictability in flap creation, and simplicity of use has only improved.

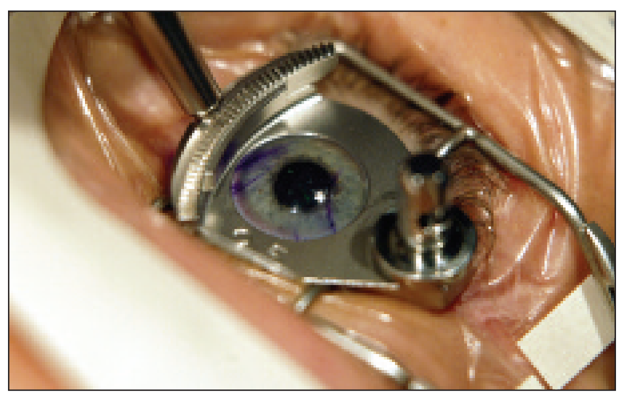

Figure 1. The Hansatome microkeratome.

CURRENT MICROKERATOME FEATURES

I have successful experience using the Hansatome microkeratome with zero compression heads,[1] the XP microkeratome, (Figure 1) (both manufactured by Bausch & Lomb, Rochester, New York), and the Carriazo-Pendular (Schwind Eye-tech-solutions, Kleinostheim, Germany). Recent improvements—across multiple brands of mechanical microkeratomes—include computerized safety checks and electronic sound confirmations that inform the surgeon when to proceed with the next step in flap creation. With modern microkeratomes, surgeons may now customize LASIK flaps for each individual eye with the use of variable head and ring sizes, automated suction control, and variable hinge position. These advances make the formerly most breathtaking part of LASIK simpler and safer.

Without doubt, the use of femtosecond lasers in therapeutic corneal surgeries (eg, full-thickness or lamellar transplantation) has spurred a huge advancement in safety and predictability to be expected in the near future. Is the use of femtosecond lasers in refractive surgery also that much desirable, however?

Recently, creating lamellar flaps with a femtosecond laser is gaining popularity. Patients are attracted by the beauty of all-laser LASIK, becaues this technology implies a better visual acuity outcome, fewer complications, and considerable improvements on the accuracy and reproducibility of flap thickness. Strictly speaking, the description "all-laser LASIK" is false advertising: After placing laser spots on the cornea with a femtosecond laser, a blunt spatula mechanically dissects the bridging tissue between the microbubbles to separate the flap from the stromal bed, resulting in a less-than-perfect surface.

Controversy regarding the preferred technology continues, as head-to-head studies comparing mechanical microkeratomes with the femtosecond laser have conflicting results.[2-6] The majority of studies have shown no significant difference between visual acuity and induced higher-order aberration results in the two types of microkeratomes.[5,7] Flap thickness is almost intuitively claimed to be more predictable with femtosecond lasers, however, the standard deviation of flap thickness with mechanical microkeratomes is greater than with femtosecond lasers. The main reason for flap thickness variability with femtosecond lasers is that there are still some mechanical interfaces needed that link the patient's eye to the femtosecond laser. These disposable docking cones or plates have considerable manufacturing tolerances, thus limiting the predictability of flap thickness.

Today, the complication rate is extremely low with both technologies. Buttonholes have become rare with mechanical microkeratomes, and lower energy settings have overcome transient light sensitivity syndrome with the femtosecond laser. On the other hand, some complications are encountered with either approach, as they both result in a lamellar flap. This flap may become distorted after surgery, epithelium may grow down the interface, and infections and diffuse lamellar keratitis are possible.

Some questions remain partially unanswered: What is the effect of femtosecond laser energy on the endothelium, the lens, or the macula? There are still two widely accepted advantages of the mechanical microkeratomes:

1. Flap creation is quicker, both in patient workflow (for the surgeon) and interrupted blood flow to the optic nerve due to shorter suction time.

2. The initial investment, upgrades, maintenance, and running costs are much higher with femtosecond lasers. One may argue that femtosecond lasers could attract more patients. Once this laser has lost its novelty, however, potential patients may be discouraged by the additional expenses that they pay for out-of-pocket. Depending on the volume of a practice, this may be a considerable amount. The alternative is to cut down your profit margin per procedure. Obviously, once you buy a femtosecond laser—from a financial standpoint—you have to use it on as many patients as possible to make it affordable.

THIN-FLAP LASIK VS EPI-LASIK

Another issue is the current trend of thin-flap LASIK. Some reports[8,9] describe the use of femtosecond lasers to create thinner flaps than the mechanical microkeratome makes to avoid potential complications associated with a stromal lamellar cut (eg, dry eye and keratectasia). With current femtosecond lasers, a planned flap thickness of less than 80 µm is not advisable, however. The reason is that gas bubbles in the stroma, created by the femtosecond laser, may diffuse through Bowman's membrane under the epithelium and obstruct further laser application if the overlying stroma is too thin.

I think, when in doubt that a LASIK flap may cause problems, the best advice is to avoid it completely and perform a surface ablation (ie, PRK, LASEK, or Epi-LASIK).[10,11] Surface procedures create the smoothest possible stromal surface, leave as many corneal nerves unaltered as possible, and weaken corneal tectonic stability by the least possible amount. In Epi-LASIK, the epithelium is mechanically separated from the stroma by a blunt blade. Although the potential superiority of Epi-LASIK compared with PRK and LASEK still has to be proven, many manufacturers are working on Epi-LASIK heads that may be coupled with their existing mechanical microkeratomes. At present, we are testing the Epi-LASIK head for the Zyoptix XP microkeratome (Bausch & Lomb) in a premarketing study. As we increase our precision with customized ablation by using sophisticated patterns and eye trackers, the impact of induced aberrations becomes a more important influence to consider.

Mechanical microkeratomes are a time-proven technology. They have evolved in their safety, predictability, and simplicity in creating lamellar flaps for the LASIK procedure. They also offer the possibility to create epithelial flaps for surface ablation procedures through Epi-LASIK heads. Femtosecond lasers expand our options in corneal transplantation surgery, but in the presence of modern mechanical microkeratomes there is no need for them in refractive surgery. ■

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