New Instruments

NEW SELF-RETAINING SUTURELESS CELLULOSE FLANGED DISPOSABLE CONTACT VIEWING SYSTEM FOR VITREORETINAL SURGERY

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Instrument Design

The Super View HTC Hassan Tornambe Disposable Contact Lens (Insight Instruments, Stuart, FL) is a disposable flat contact lens with a cellulose flange and four cellulose footplates. The circular lens is manufactured from high-index optical grade thermoplastic material, with a lens diameter of 13 mm and edge thickness of 4.8 mm (Figure 1A). The anterior surface is flat, whereas the concave posterior surface has an 8 mm radius of curvature with rounded edges for atraumatic corneal contact. The field of view is approximately 36° depending on the pupil diameter and intraocular optical aberrations. The key novel feature of the new lens is the fixed circumferential absorbent synthetic foam flange (Figure 1B). It has 4 tapered legs that are symmetrically arranged, with a dry outside diameter of 18 mm. The overall weight of the viewing system is 0.5 g. Because the flange and footplates are made from deformable foam, they contact the peripheral cornea, corneoscleral limbus, and sclera at the exact angle that exists at the junction of the lens and these anatomical structures. As a result, the lens sits flush with the ocular surface without any underlying space.

The viewing system is compatible with any gauge instrumentation. Pars plana vitrectomy ports (cannulated or not) are placed in the usual fashion (Figure 2A). A small amount of viscoelastic material is placed on the concave surface (Figure 2B), and the lens is placed on the cornea, its position maintained by the viscoelastic material's surface tension and negative suction (Figure 2C). The ocular surface hydrates the footplates (Figure 2D), and capillary action provides further adhesion of the foam ring and footplates to the ocular surface, and ultimate stabilization of the viewing system (Figure 2E), to allow macular surgery with more stable centration of the lens (Figure 2F). The flexible cellulose foam material conforms to a wide range of curvatures (Figure 3), which is particularly beneficial for use with ectatic ocular surfaces, and ultimately allows maximum contact to the globe for consistent stabilization when used in most cases. The footplates are thus able to maintain positioning through their adhesion to the conjunctiva and sclera independently rather than through their apposition to the cannulas.

Discussion

Macular contact viewing systems allow the vitreoretinal surgeon to safely and efficiently perform macular surgery. They enjoy a number of distinct advantages when compared with noncontact viewing systems: neutralization of corneal refractive errors, superior axial and lateral resolution, and freedom from inversion mirrors that can degrade image quality. However, their use is frequently beset with difficulties the surgeon may have in maintaining a stable lens position on the ocular surface. During the initial era of vitrectomy surgery, Machemer[1] described having an assistant holding a Goldmann fundus contact lens at the rim with a hemostat to provide the surgeon with a view of the posterior pole. Subsequent surgical contact lens designs have fallen into two categories: handheld systems and nonhandheld systems. Handheld systems benefit from auxiliary features such as continuous irrigation and suction. However, skilled assistants are required to carefully operate the lens to maintain stable visualization, and this may not be practical outside large residencies and fellowships. Nonhandheld contact lens systems do not require skilled assistants, but their stability on the cornea is sometimes poor and frequent repositioning is usually necessary. Because vitrectomy is usually a bimanual operation, this translates to removing an instrument from a vitrectomy port

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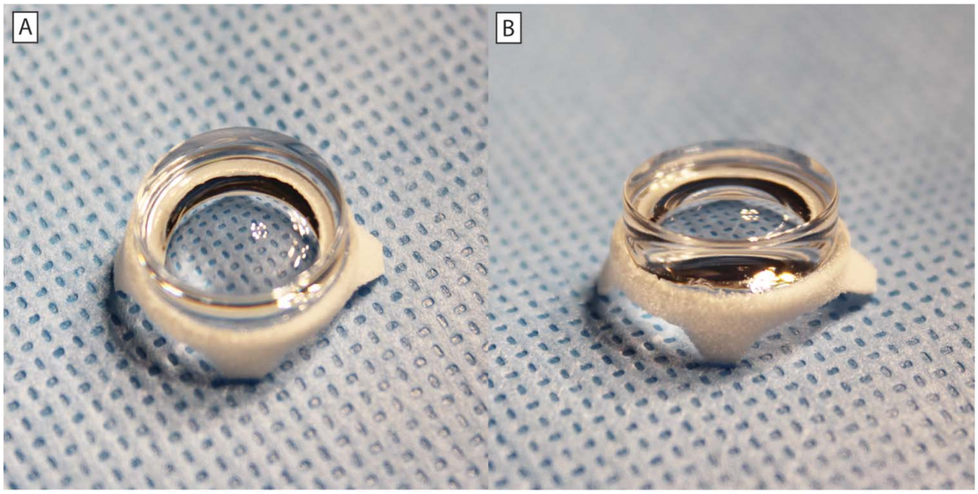

Fig. 1. The Hassan Tornambe contact lens (Insight instruments). **A.** The lens is a disposable planoconcave lens. **B.** An absorbent flange and 4 footplates provide enhanced lens stability.

to use the hand to make the adjustment, unless skilled assistance is available. Frequent repositioning may compromise the safety of the surgery, and can introduce air bubbles and debris into the coupling agent, which may degrade visualization.

Many investigators have sought to address the issue of macular contact lens stability by various means. One of the earliest and most widespread strategies has been to suture the lens onto the ocular surface.[2] A separate ring is often sutured onto the sclera, and the contact lens is placed within the ring. Sutured lenses are stable, but every suture increases the risk of perforation and associated complications, and operative time is lengthened for suture placement, lens ring placement, and lens ring removal. More recent efforts have focused on stabilizing the contact lens without the use of sutures. Securing the contact viewing system to the lid speculum by various means can provide stability and lens centration but may hinder the movement of the globe and require the surgeon to perform cumbersome maneuvers when switching between macular surgery and more peripheral vitreoretinal surgery that requires wide-angle viewing.[3]

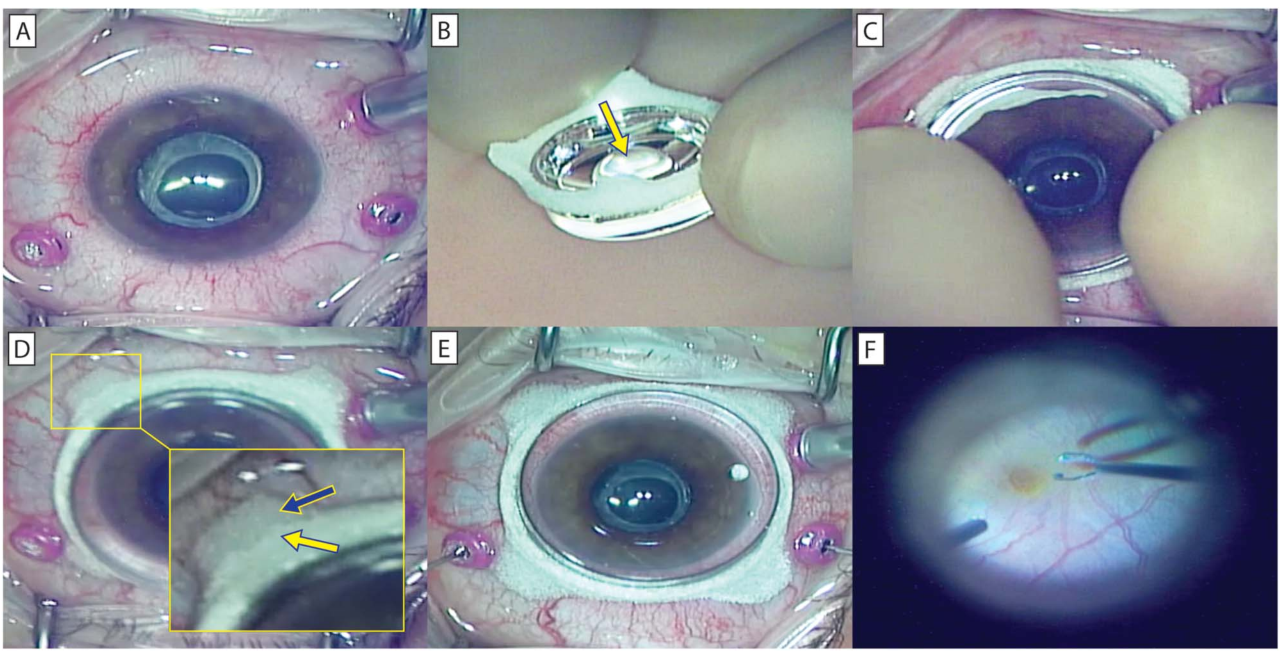

Fig. 2. Intraoperative views. **A.** Cannulas are inserted in the usual fashion. In this case, a 27-gauge vitrectomy system is used. **B.** A small amount of viscoelastic material is placed on the concave surface. **C.** The lens is engaged on the cornea. **D.** The flange and footplates absorb ocular surface fluid. The inset is a magnified view of a footplate in the process of being hydrated: an advancing demarcation line between hydrated (blue arrow) and still dry (yellow arrow) sponge material is observed. **E.** The lens is stabilized and macular surgery is commenced. **F.** Intraoperative view through the Hassan Tornambe lens. Indocyanine-green assisted peeling of the internal limiting membrane is being performed for a macular hole. The lens did not require any adjustments during this case.

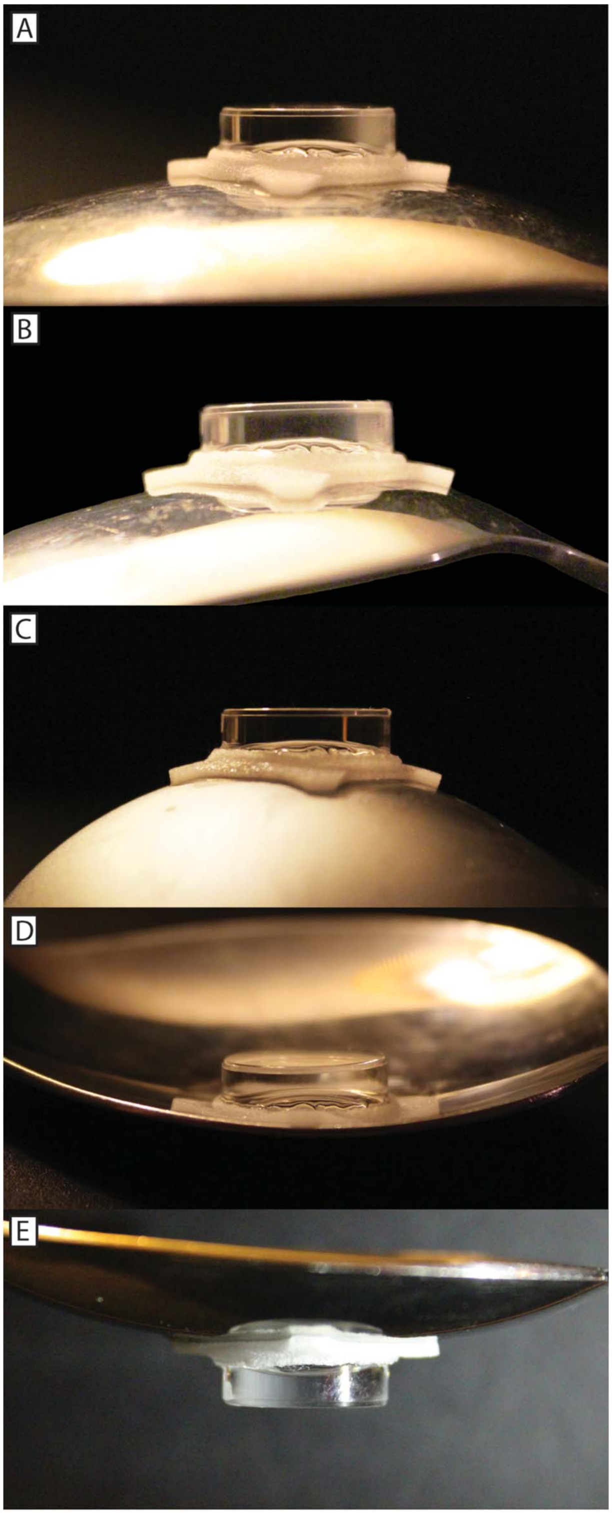

Fig. 3. Ex vivo demonstration of the ability of the absorbent sponge flange and legs to be able to conform to a variety of surface curvatures. The lens is seen conforming to and stabilizing on increasingly steeper convex surface curvatures of spoons (**A**–**C**). The lens' flexibility, stability, and adhesive properties even allow prolonged self-retention on concave surfaces (**D**) and upside down (**E**).

Other methods have focused on modifying the means by which the lens supports itself on, or adheres to, the ocular surface. Manufactured lenses with solid silicone or acrylic footplates that are integrated as part of the lens itself and extend from the lens edge have been shown to improve mechanical stability.[4] However, the stability is limited by the success of adhesion to the ocular surface, which may be compromised if the contact angle of the lens (which is fixed) does not exactly match what is needed for each ocular surface. It has also been shown that good stability can be achieved by simply wrapping a strip of cellulose drainage sponge around the lens ring and then securing the temporal tails to the surgical drape.[5] The stability of the latter method is derived, in part, from the fluidic adhesion of the hydrated sponge—a rudimentary, but highly perceptive, strategy.

Our new disposable, presterilized, and preassembled lens design combines the virtues of several of these aforementioned retention systems for optimal lens stability that requires neither sutures nor skilled assistance. The flange increases the surface area of contact between the lens system and ocular surface, whereas the footplates are oriented to maximize instrument maneuverability. The absorbent foam flange and footplates use capillary action and surface tension to actively stabilize the lens, in addition to the negative suction created by the viscoelastic material under the lens. Because the flange and footplates are made of absorbent foam, they conform to the shape of the cornea, corneoscleral limbus, and sclera at essentially all clinically seen contact angles, depending on the shape of each individual globe. This feature is unlike that seen with existing self-retaining nonhandheld surgical contact lenses, which have flanges that are an integral material part of the lens itself, attached to the optic at a fixed contact angle.[6,7] A lens with a fixed contact angle is unlikely to completely adhere to the globe in all eyes as there is notable variability in the anatomic relationships at the corneoscleral junction in eyes that undergo vitreoretinal surgery. This explains the less than optimal stability of fixed contact angle lenses that is seen when compared with the new lens we are describing.

The improvement in stability seen with this lens and its absorbent ring and flanges has been clinically significant. In our experience with prototypes, it is rare that the lens requires any repositioning. It remains centered even when unexpected issues such as trocar displacement and subsequent conjunctival ballooning alter the anatomy of the corneoscleral junction. The viewing system has been seen to offer a stable view in eyes with a wide variety of ocular surfaces, including keratoconic corneas and keratoprostheses.

In summary, our new disposable, prefabricated, presterilized, and preassembled lens design is easy to use and uses multiple means, including its near universal and adaptable contact angle, to maintain centration to greatly improve the safety and efficiency of macular surgery.

Key words: contact lens, macular surgery, ophthalmic instrumentation, pars plana vitrectomy, retina, viewing system.

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