

Diagnosis & Imaging

Single-use contact lenses aid imaging, diagnosis

Multiple mirror, fundus, and retina lenses provide quality images

By Louise Culham, PhD, MPhil, MCOptom, and Paul Karpecki, OD, FFAO

Several expensive, complex pieces of equipment are available to eyecare professional for imaging and diagnosis, but are we making the most of our time-honored, low-cost tools? Contact lenses for imaging, diagnosis, and treatment have been around for decades, the first example of which was described by Goldmann in the 1950s.¹ And while some ODs have embraced these imaging devices, in particular the four-mirror gonioscopy lens, other contact lenses could be of great assistance in optometric practice.

Many optometrists regularly make use of non-contact lenses at the slit lamp (such as 90 D or 78 D) or with a head-mounted binocular indirect ophthalmoscope (such as 20 D). Lenses that contact the patient's eye are less frequently used, possibly because of the need for anesthetic, and in some cases, contact fluid.

These lenses have notable advantages that enhance visualization and provide better diagnostic precision. Image quality is better with use of such lenses because the contact endpoint neutralizes the power of the cornea and offsets irregularities such as astigma-



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tism. There are fewer air/optical surface interfaces and consequently losses because aberrations and reflectance are minimized, which improves image contrast. A more extensive view of the fundus is achievable—in particular there is better access to peripheral regions of the fundus and the ability to image the anterior chamber angle. Higher magnification and superior depth discrimination are possible. Inspection through the depths of the vitreous may be accomplished by positioning the focus of the slit lamp in front of the retina. And there is the further benefit of improved eye stabilization during the exam.

Another reason that eyecare professionals may be reluctant to use contact lenses is the vast array of choice; selecting the optimal lens

for a specific task is difficult, often exacerbated by complex and apparently conflicting specifications. Below we will discuss the basic lens choices and make recommendations for those wishing to make a start in this discipline.

Choosing a contact lens

In choosing a contact lens, the three key aspects to consider are the region of the globe to be studied, the required magnification, and the field of view. Table 1 presents the major lens types that an optometrist may wish to consider.

For imaging, the first decision to make is whether the emphasis is on the anterior chamber angle, the central retina or the peripheral retina. Figure 1 shows the sections of the eye to target.

There are two main “general purpose” lenses: the four-mirror lens (Figure 2) and the three-mirror lens (Figure 3). Either of these would be an ideal first lens, with the

TAKE-HOME MESSAGE Contact lenses for imaging, diagnosis and treatment have been around for decades. Now single-use contact lenses are available. Three- or four-mirror lenses provide high image quality, high magnification, good depth discrimination and a wide field of view. Single-use lenses also eliminate worries about device disinfection and disease transmission, while cost is not prohibitive.

choice between the two dependent on the individual practitioner's interests and access to alternative imaging equipment.

The four-mirror lens allows for a speedy evaluation of all four quadrants of the anterior chamber. Both static and dynamic gonioscopy can be performed.² In addition, the central optic provides a 30-degree view of the posterior pole, allowing for examination of the macula and optic nerve. By focusing in front of the retina it is also possible to

Single-use lenses are surprisingly cost efficient

scan the vitreous, although the field of view is limited. Hence, this lens covers areas 1-3 in Figure 1. It has the added benefit of not requiring contact fluid because the contact endpoint is small and has a similar curve to the cornea; the patient's tears are therefore sufficient as the coupling solution.

The three-mirror lens is the alternative device to consider if just a single contact lens is to be selected for a practice. It is a great lens to visualize all main regions of the eye because it has four viewing optics—three mirrors plus a central optic. This allows for imaging of the anterior chamber, the poste-

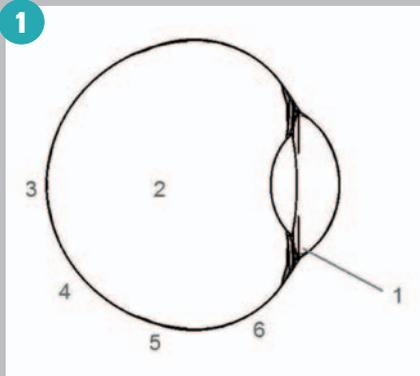


Figure 1. Regions of the eye.

rior pole (central 30 degrees), the vitreous, the mid periphery including the arcades, and the far periphery (labeled 1-5 in Figure 1). In order to see around the whole globe, rotation of the lens is necessary. Some lens designs do not require contact fluid; however, better imaging is achieved if fluid is used because the contact endpoint is larger than a four-mirror and typically the curve does not match the corneal curvature. Not only is this an ideal first (or second after the four-mirror) lens to have in practice, but the techniques learned are applicable to all other types of lenses. With all contact lenses, a firm but light touch will ensure good contact without putting undue pressure on the cornea. The patient may not

1). The Retina 90 lens gives a wider field of view out to the arcades but is still concentrated on the central posterior pole (regions 2, 3, and part of 4 in Figure 1). This provides detailed examination of the optic nerve and macula while also allowing inspection of a broader area.

For a very wide field of view that includes

the peripheral retina, various lenses such as the Retina 170 and Retina 180 are available (areas 2-6). They offer a good overall examination, which is ideal for patients with diabetes and other potential peripheral retinal problems. With a little manipulation of the device, it is easy to observe out to the

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3 points in choosing a lens

- 1 Region of the globe to be studied
- 2 Required magnification
- 3 Field of view

complain, but with too much pressure, the cornea can be affected and wrinkling of Descemet's membrane can occur.

Pupil dilation is usually required when using a three-mirror lens. The "direct" viewing nature of its design means that the pupil of the eye is the limiting aperture. Central viewing may be reasonable without dilation, but imaging the peripheral retina would be challenging. If the practitioner needs to view the retina without dilation, or the patient does not dilate well, then an "indirect" contact lens design would be better because the pupil is not the limiting aperture. This is due to the fact that for indirect lenses, the narrowest part of the ray bundle is at the nodal point of the eye, making it more efficient for light in (illumination) and light out (image formation). The retina lenses described next are indirect lenses, and while they perform optimally with a dilated pupil, in situations in which non-dilated eye examination is necessary, they provide the best images.

If the practitioner wishes to proceed further with contact lenses, the next to acquire would be a lens for viewing the retina. The Fundus lens provides a good image of the posterior pole, particularly the macula and optic nerve head out to about 36 degrees and the vitreous (regions 2 and 3 in Figure



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Lenses for imaging

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ora serrata. Obtaining a good look at mid and peripheral retina can reassure the optometrist that problems in these zones will likely be detected. The main difference between the Retina 170 and Retina 180, other than the difference in magnification (0.52x versus 0.8x; see Table 1), is the physical size of the lens—the Retina 170 is smaller and therefore better suited for smaller or deep set palpebral apertures.

For those wishing to specialize in conditions of the anterior segment, a single-mirror gonio lens would be ideal—necessary if argon laser trabeculoplasty or selective laser trabeculoplasty is to be undertaken. Compared to the four-mirror lens, the single-mirror lens has a wider continuous view (almost 180 degrees) but will require more rotation to access all quadrants. It is the better of the two options for ophthalmic photography and is has slightly greater magnification (see Table 1).

Single-use vs. reusable lenses

Single-use or disposable lenses are a rela-



Figure 2. The four-mirror lens.

tively new concept, and they offer many benefits. The most obvious benefit is that the sterile, single use format (Figure 4) removes all responsibility (from the doctor, clinic and/or hospital) for cleaning and disinfection of the lens, and all concerns about disease transmission are eliminated. Some clinics choose to have a box of lenses on hand for use only with challenging patients.

Patients with a history of hepatitis, herpes, HIV, or readily contagious infection, such as a red eye or a recent history of EKC-causing adenovirus, are good candidates for single-use lenses. Studies have shown that the adenovirus can remain alive on inanimate objects such as lenses or tonometers for up to one month.^{3,4} Furthermore the Centers for Disease Control (CDC) guidelines for disinfection and sterilization in healthcare facilities have recognized that 3% hydrogen peroxide and 70% isopropyl alcohol may not be effective against adenovirus.⁵ Disinfectants such as bleach in addition to the above are recommended; however, lenses may not be able to withstand bleach without affecting the lens quality. For those practitioners concerned with meeting Joint Commission standards,⁶ disposable lenses will assist with minimum effort and expense.

Single-use lenses are surprisingly cost efficient. Proper cleaning and disinfection of traditional reusable lenses, together with the upfront purchase costs, is expensive. Cleaning between each patient is an obscure cost that few practitioners or practice managers had previously considered

TABLE 1 Contact lenses for diagnostic imaging

Sensor Medical Technology Contact Lenses	Main Purpose	Regions of the Eye (See Figure 2)	Typical procedures Note: quoted angles, fields of view and magnification relate to Sensor Medical lenses only	Image Magnification	Additional comments	Comparable lenses from Volk and Ocular Instruments ("Ocular")
SMT 4 Mirror Lens	Diagnosis of glaucoma	1, 2, 3	Static gonioscopy via four 64° mirrors. Dynamic gonioscopy Examination of posterior pole (central 30°) via central aperture	0.8x	Little rotation of lens required since 4 mirrors cover majority of 360° of anterior chamber angle	Volk 4 mirror Ocular 4 mirror
SMT 3 Mirror Lens	General purpose lens allows view of all key regions of the globe	1, 2, 3, 4, 5	Examination of posterior pole (central 30°) via central aperture Examination of mid periphery including arcades (via 73° mirror) Examination of far periphery (via 67° mirror) Examination of anterior chamber angle (via 59° mirror)	0.93x	Field of view of each area wide, but rotation of lens required to see whole globe	Volk 3 mirror Ocular 3 mirror
SMT Single Mirror Lens	Diagnosis and treatment of glaucoma	1	Viewing the anterior chamber angle (via 62° mirror) Photography of angle Argon laser trabeculoplasty Selective laser trabeculoplasty	1.0x	Large mirror and increased magnification compared to 4 mirror lens Provides best view of the angle.	Volk SLT Gonio Ocular SLT Gonio
SMT Fundus Lens	View fundus	2, 3	Examination of posterior pole (central 36°)	0.93x		Volk Fundus lens Ocular Fundus lens
SMT Retina 90 Lens	View macula	2, 3, 4	Examination of posterior pole (central 120° dynamic)	1.0x	Best lens available for areas 2,3 and 4	Volk Area Centralis Ocular Mainster Standard
SMT Retina 170 Lens	View fundus	2, 3, 4, 5, 6	Examination of fundus: (wide field, central area out to the ora serrata; 175° dynamic)	0.52x	Retina 170 smaller in size than Retina 180; for practitioner preference.	Volk SuperQuad 160 Ocular PRP 165
SMT Retina 180 Lens	View fundus	2, 3, 4, 5, 6	Examination of fundus (wide field, central area out to the ora serrata, 180° dynamic)	0.8x	Widest field and highest magnification available. Resolution optimized for areas 4, 5 and 6	Volk SuperQuad 160 Ocular PRP 165

because until now there has been no alternative. The cost of chemical purchase and storage, utility use, and staff time add up. In order to avoid the upfront investment in traditional lenses, some practices start with disposable lenses only.

Another aspect to consider in a busy practice is convenience and patient flow, particularly in satellite clinics or practices with multiple lanes. There is no worry about losing a lens or having it stolen, dropping a lens, and no need to walk to a different room to find a lens.

Many private clinics choose single-use lenses as a practice builder. The doctor can explain to patients that single use, sterile lenses offer first-rate imaging and the ultimate protection against disease transmission. This may differentiate

the clinic from others in the area, it will reassure the patient that they are receiving the best care, and will demonstrate that the clinic is embracing the newest cutting edge technology.

One of the concerns raised about single-use lenses is quality. With modern manufacturing techniques, the quality and consistency is excellent, even with the high-volume production that allows the cost to be low. There is the added benefit of a new, pristine lens for every patient with no dust, scratches, or fingerprints, and no deterioration from multiple cleanings.

In summary, we are fortunate as eyecare professionals that, in contrast to other medical disciplines, we can

view internal structures of the eye using relatively simple, low cost, non-invasive instrumentation. Contact lenses have stood the test of time and have served the eyecare professions well. While they are unlikely to be the only device in the optometrist's toolkit, they may be a very useful addition to the practitioners' repertoire.●

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REFERENCES

1. Goldmann H. slit lamp examination of the vitreous and the fundus. *Br J Ophthalmol*. 1949 Apr;33(4):242-7.
2. Gonioscopy.org. Available at: www.gonioscopy.org. Accessed 11/23/15.
3. Cheung D, Bremner J, Chan JT. Epidemic kerato-conjunctivitis--do outbreaks have to be epidemic? *Eye (Lond)*. 2003 Apr;17(3):356-63.
4. Butt AL, Chodosh J. Adenoviral keratoconjunctivitis in a tertiary care eye clinic. *Cornea*. 2006 Feb;25(2):199-202.
5. Pihos, AM. Epidemic keratoconjunctivitis: A review of current concepts in management. *J Optom*. 2013 Apr; 6(2): 69-74.

6. Pyrek K. Recent Joint Commission Alert is another Wake-UP Call for Awareness of Improper HLD or Sterilization of Equipment and Devices. *Infection Control Today*. Available at: <http://digital.infectioncontroltoday.com/i/344852-aug-2014/24>. Accessed 11/23/15.

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Figure 3. The three-mirror lens.



Figure 4. Single-use lens in sterile pouch.

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