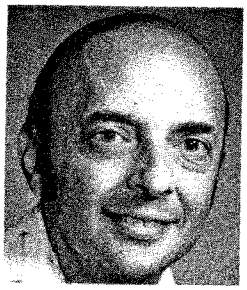
Today's Hydrogel Extended Wear Lenses



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Over the past four years the use of extended wear hydrogel lenses has increased dramatically. Hydrogel extended wear lenses account for about 12% of new fittings or refittings in Australia and one-third of new fittings or refittings in the United States. Both the Fifth International Contact Lens Congress held August 19 to 24, 1984, in Australia and the Eleventh National Research Symposium on Contact Lenses held August 11 and 12, 1984, in the United States produced important information on this and other topics.

A panel discussion at the Australian meeting indicated that about 50% (±10%) of patients continue to wear extended wear hydrogels one year after being fitted. Most discontinuance is attributed to the maintenance cost for frequent lens replacements and professional service and to physiological complications. Nevertheless, many patients can use extended wear with some success if the lenses are fitted properly, cared for and replaced correctly, and their use is within the inherent capabilities of the materials and the individual response of each patient's eyes.

To be physiologically compatible with the eye, extended wear lenses must provide sufficient oxygen, allow for clean and wet lenses and eyes, and provide an appropriate chemical environment. If these conditions are not met, undesirable changes of all layers of the cornea, as well as changes to the bulbar or palpebral conjunctival tissue and blood vessels, can occur.

Although contributions to our understanding of the physiological complications have come from many sources, a major body of work has been done by the Cornea and Contact Lens Research Unit (CCLRU) at the University of New South Wales, Sydney, Australia. Much of the data in this article were presented by individuals presently or formerly associated with the CCLRU.

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OVERVIEW

The overall oxygen transmissivity of presently available extended wear hydrogel contact lenses is probably about 50% of the level necessary for

sleep conditions; and for average minus-powered lenses, the supply of oxygen is clinically comparable for the various brands. As opposed to the 3% or 4% overnight swelling from sleeping without contact lenses, hydrogel extended wear lenses cause an average overnight swelling of 12%, with a range of about plus or minus 5% for individual eyes.

After overnight swelling, the atmospheric oxygen available upon awakening allows deswelling. However, with present hydrogel lenses, most corneas do not deswell completely; the average deswelling is 7% to 8%. Corneal swelling during sleep and incomplete deswelling while awake may contribute to a depressed corneal metabolism, reduced ability to repair tissues or fight off infections, microcystic formations, endothelial polymegathism, and neovascularization.

Because hydrogel lenses attract precorneal fluid components such as mucoproteins, lipids, calcium, and desquamated cells, the lenses build up deposits if they are not frequently removed for cleaning (Figure 1). Also, since the pump to interchange precorneal fluid between the lens and the eye is poorer with hydrogel lenses, debris can stagnate between the lens and the cornea. Debris on the front of the lens or behind it can precipitate giant papillary conjunctivitis, corneal infiltrates, and infections. Because hydrogel lenses are absorptive, chemicals from the environment or from eye drops can become concentrated enough to produce chemical trauma to the tissues, especially when the buildup of mucoproteins on the lens creates increased binding sites.

There are three broad categories of physiological complications from hydrogel extended wear: 1) Common and moderately serious responses; 2) Rarer but very serious responses; and 3) Common responses with unknown consequences.

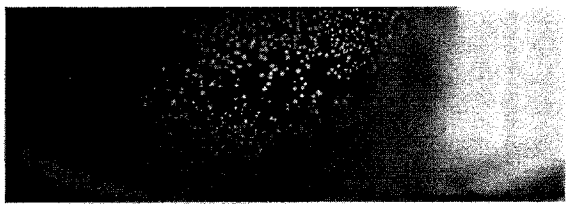

Figure 1 Deposits on a hydrogel extended wear lens

Extended wear usually produces an overnight swelling of 12% and . . . daytime deswelling should be complete or nearly so.

COMMON AND MODERATELY SERIOUS RESPONSES*

EDEMA

Non-contact lens wearers experience a normal overnight edema of 4%, compared to 12% for patients wearing contemporary hydrogel extended wear lenses. This is only partially reversible under open eye conditions, with average daytime deswelling of 8%. Thus clinical edema signs should be monitored for long-term residual edema. In a study of Bausch & Lomb 03/04 extended wear lenses, edema from overnight swelling averaged 11% the first night, 11% after 3 weeks, and 10% after 3 years in extended wear, thus confirming the previously reported absence of adaptation. Also, the accompanying deswelling capacity did not vary over this same time period.

It was concluded that acceptable extended wear would produce an overnight swelling of 12% and that daytime deswelling should be complete or nearly so. It was suggested that the daily cleaning of striae is a satisfactory criterion for managing edema. If striae fail to clear, patients should be refitted with daily wear lenses, rather than other extended wear hydrogel lens types, which all have similar average oxygen transmissivity.

RED EYE

During sleep, normal physiological debris accumulates under extended wear lenses when lens movement is inadequate to clear it during waking hours. This trapping of debris can be seen at the moment of eye opening in virtually any patient wearing any of the hydrogel extended wear lenses. This debris is small (usually less than 0.10 mm), pale gray in color, and consists of mucous and epithelial cells.

When they are excessive, the patches of trapped debris become larger and persist throughout the day during the open-eye situation. This may lead to an inflammatory reaction and the so-called "red eye response."

Although trapped posterior lens debris is normal at the time of eye opening, it *must* be cleared from behind the lens during the day. "Red eye responses" are, therefore, usually associated

*Based upon a presentation by Steve G. Zantos, PhD, on such responses, including edema, "red eye," corneal infiltrates, and epithelial microcysts.

Corneal infiltrates are a very common adverse response to extended wear.

with inadequate lens movement. The degree of movement should be as great as possible without creating discomfort or vision problems, at the least enough to be easily discernible at *low* magnification with slit lamp biomicroscopy. In addition to adequate lens movement, in-eye saline rinses can be used at night before retiring and upon awakening.

CORNEAL INFILTRATES

Corneal infiltrates are a very common adverse response to extended wear. An accumulation of inflammatory cells, these infiltrates have a dull grainy appearance and occur in peripheral areas of the anterior stroma, indicating white blood cell penetration of the cornea (Figure 2). Infiltrates are often located adjacent to the accompanying localized redness, but staining is not a good indicator. The typical signs and symptoms are summarized in Table I.

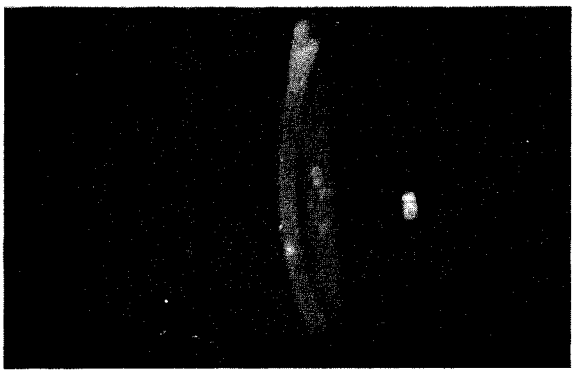

Figure 2 Corneal infiltrate from hydrogel extended wear

According to Zantos, this type of corneal infiltrate is managed by avoiding lens wear for at least a week, by which time the infiltrates usually disappear. Medication is not normally required during this period, and the patient should resume daily wear before extended wear. However, patients who experience two of these episodes within a year should be converted to a daily wear schedule.

Table I. Signs and Symptoms of Corneal Infiltrates

Patients Symptoms	
	Apparent upon awakening
	Localized red eye
	Scratchy eyes
	Secretion on lid
	Photophobia and lacrimation
	One eye only
Clinical Signs	
	Monocular
	Localized redness
	Lens movement lacking
	Posterior lens debris
	Infiltrates

EPITHELIAL MICROCYSTS

Epithelial microcysts are small, irregular, high index formations in the corneal epithelium. They occur in 41% of hydrogel extended wear patients, typically after about 2 months of wear. Microcysts must be differentiated from vacuoles and bullae. There are usually less than 50 microcysts per eye, and in small numbers they generally cause no problems. Microcysts may also follow abrupt cessation of hydrogel extended wear. They have a fluctuating course and resolve slowly.

No action seems necessary for less than 50 epithelial microcysts per eye. Visual acuity begins to decline above 50; such patients should return to daily wear, especially if microcysts are accompanied by significant staining. Because microcysts are probably due to hypoxia, the value of refitting with another of the available hydrogel extended wear lenses is questionable.

RARER BUT VERY SERIOUS RESPONSES

It is difficult to get an accurate estimate of the incidence of serious infection with contact lens wear. However, the number of reports appearing recently in the ophthalmic literature are of significant concern. Brien A. Holden, PhD, in his paper on serious infections from extended lens wear, made several important points, summarized in the following discussion.

He quoted the work of Chalupa and Sjostrand which indicated that very severe microbial keratitis

was much more common with hydrogel extended wear than with hydrogel or hard daily wear. Of the six cases of contact lens-related very severe microbial keratitis seen by them over a two-year period, five cases were on hydrogel extended wear, and four of these had been treated with a topical steroids before the acute incidents. Cultures on these five patients were positive for pseudomonas in three cases. This is an interesting finding as pseudomonas almost never affects healthy tissue, but requires a biologically injured tissue and/or a decreased antimicrobial defense. Of the six cases of very severe microbial keratitis, one lost both eyes, three resulted in keratoplasty, and two resulted in best-corrected vision of 20/60 and 20/100.

> ". . . red eyes" and corneal infiltrates should be treated as infectious keratitis until proven otherwise.

Another survey discussed was that of Cooper and Constable which showed similar results and a 3-times greater incidence of serious infections with extended wear compared to daily wear soft contact lenses. A significant contributing factor was believed to be patient noncompliance, resulting in contaminated solutions and storage cases. However, other significant factors have been found to contribute to serious contact lens-related infections (Table II).

Table II. Causes and Incidence of Infections Related to Contact Lens Wear

Extended wear	69%
Subsequent steroid therapy	83%
Warm climates	69%
Delay in treatment	50%

Kenneth R. Kenyon, MD, of The Harvard Medical School confirmed these observations and suggested that "red eyes" and corneal infiltrates should be treated as infectious keratitis until proven otherwise. He also noted that 75% of infectious keratitis cases resulting from lens wear are associated with pseudomonas.

Patients with contact lens-related infections must be instructed to report any of the following warning signs: unilateral redness, discharge, reduced vision, and/or photophobia. If unilateral redness occurs, patients should remove lenses and be seen by the practitioner immediately. An infection should be assumed and topical antibiotics, but not steroids, used. During illnesses such as colds or flus, which can increase the probability of serious infections in patients with extended wear hydrogel lenses, patients should switch to spectacles or daily wear. In the presence of fever, palpebral conjunctival temperature and overnight swelling may increase with extended lens wear.

COMMON RESPONSES WITH UNKNOWN CONSEQUENCES

Among the responses whose sequelae are unknown, corneal endothelium morphological changes are of special concern, because these may produce functional changes.

The main role of the corneal endothelium is to help maintain deturgescence. With normal aging, cell density decreases and size variance (polymegathism) increases. Recent research indicates that a polymegathistic cornea withstands trauma more poorly, and lens wear can increase polymegathism. In her presentation "Are Contact Lens Induced Endothelial Changes Permanent?" Deborah F. Sweeney noted the following:

1. After five years of hydrogel extended lens wear, polymegathism increases by an average of 22%, but there is no change in cell density. It is speculated that this increased polymegathism is due to some cell shrinkage.

2. After cessation of hydrogel extended lens wear, the trend toward reduction of polymegathism levels off in about a month, but usually does not reach baseline. Also, there are significant variations of recovery among patients.

3. After five months of non-lens wear, three of five patients who were critically evaluated still had significant polymegathism as well as a stromal thinning of approximately 4%.

In Dr. Holden's presentation "Making Extended Wear Safer," he indicated that lens movement is the only factor that appears to affect the amount of polymegathism associated with hydrogel extended wear lenses. As lens movement with blinking increases to 2-3 mm, there is less polymegathism. Also, patients with a normal corneal thickness which is greater than average

before lens use tend to have more corneal swelling and polymegathism during lens wear.

He also reported that after prolonged extended wear and subsequent discontinuance, there is a 1% stromal thickening, which reverts to a 10% thinning 30 days later. This moves toward baseline after 5 months, but a residual thinning remains.

Dr. Holden's study demonstrated a 15% decrease of oxygen uptake by the corneal epithelium on the first day of removal after prolonged hydrogel extended wear. This slowly recovers to baseline after 30 days of lens wear, and is paralleled by a 10% epithelial thinning the first day after removal with recovery toward baseline in 30 days. It is thought that the decrease of oxygen uptake indicates a depression of corneal metabolism, which would reduce the defensive capabilities of the epithelium and make it more prone to infection.

The consequences of these common endothelial, stromal, and epithelial changes are not known, nor are instruments available to observe them in normal practice. Because they exist, practitioners must manage patients based not only on clinical observation and patient history, but also on the research findings regarding subclinical events.

Patients should be told that no lens guarantees 30 consecutive days and nights of wear . . .

PATIENT MANAGEMENT

Stanley J. Yamane, OD, discussed the "Management of Extended Wear Patients" and recommended the following management principles:

1. Patients' perceptions of and need for extended wear should be understood, discussed, and balanced with complete information. Patients should be told that no lens guarantees 30 consecutive days and nights of wear, but only that the FDA has approved lenses for *up* to 30-day wear. The individuals should wear them only as long as is healthy for their particular eyes. The "extended wear" needs of many patients may be as modest as taking naps with their lenses in, or wearing them continuously on weekends only.

2. Not all patients who want extended wear should receive them. Only those whose needs will be fulfilled, whose initial wearing shows favorable physiologic response, whose desire is great enough to accept the long-term costs, and whose maturity allows them to comply with instructions should be fitted.

3. Instructions to patients should be comprehensive and reinforced by oral and audiovisual education in the office, as well as written forms to take home.

   If they have not worn contact lenses before, patients should be given a daily-wear regimen for the first week to reinforce their ability to handle and care for their lenses.

4. Patients must assume responsibility for monitoring their own extended wear use, that is, to check daily as to whether their eyes "feel, look and see good." Upon awakening, they should blink 6 to 8 times to determine if their eyes and lenses feel good. They should observe their eyes in a mirror to tell them if their eyes look good, with no excessive redness or secretions. Finally, they should cover each eye alternately and check the sight of the open eye with a distant target to verify that they see well. If they fail any part of these tests, lenses should be removed and the practitioner should be seen.

5. Practitioners have the responsibility to monitor patients by seeing them the first morning after extended wear, and 3 days, 1 week, and monthly for 6 months, then at least once every 3 months. We should also be readily available and provide economical fee structures that allow patients to use the required professional care, lens replacements, and solutions over an extended time.

. . . many experts believe that cosmetic extended wear should last a maximum of 6 days and nights, or ideally only 2 to 3 days and nights.

CONCLUSION

Extended wear seems to be here to stay. But its present state of development requires a dedicated, conservative approach. Many patients want the apparent convenience and natural feeling implied by extended wear, but it should be provided only to appropriate patients, within the limits of their individual eyes to react favorably. Based on

present knowledge, many experts believe that cosmetic extended wear should last a maximum of 6 consecutive days and nights, or ideally only 2 to 3 days and nights. The main concepts today are maintenance of ocular health, monitoring by both patients and practitioners, and convenience. New developments may expand the extended wear horizons of the future.

SUGGESTED READING

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