



Extended Wear Hydrophilic Lenses: An Insight into Clinical In-Office Patient Management

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The use of soft contact lenses for extended wear can provide a beneficial and convenient therapy for patients where spectacles and/or daily wear contact lenses are contraindicated.

Extended wear refers to day and night wear of contact lenses which are removed at regular intervals for cleaning and disinfecting. The ultimate goal of extended wear is clear, comfortable vision without harmful ocular side effects.

The purpose of this paper is to provide an insight for in-office patient management.

One of the greatest contributors to overall success is proper patient selection. Those suggested as possible extended wear candidates include those persons unable to remove and care for their daily lenses, and examples include:

1. elderly patients
2. physically handicapped
3. children/adults with unilateral or bilateral aphakia
4. high ametropes (children/adults)
5. keratoconus in early stages
6. institutionalized patients
7. emergency related occupations such as nurses, physicians, police, firemen and ambulance drivers.⁷

Other considerations include:

1. ocular and general health
2. previous contact lens experience
3. lens fitting difficulties
4. patient compliance
5. risk/benefit ratio

The following conditions should disqualify a patient:

1. history of allergies or infections, especially in conjunction with high incidence of cellular infiltrates on conjunctival samples.

2. high index of conjunctival fornix bacteria (greater than 15 colonies per eye) on conjunctival swab.
3. active ocular pathology and/or taking ocular medications.
4. GPC greater than grade I.
5. corneal endothelial abnormalities.
6. corneal hypoaesthesia.
7. reduced tear flow or tear break up time (BUT). normal SCHIRMER TEAR TEST 17 mm/30-200 SEC normal BUT greater than 10 sec.
8. oedema during daily wear with lenses designed for extended wear.
9. poor motivation.^{7,17}

Zantos et al. suggest patients likely to have a problem with oedema have endothelial cells 20 times larger than normal: (5 microns thick x 20 microns wide seen with 40x magnification), and that these patients exhibiting 'endothelial bedewing' (small mobile deposits on back surface of the endothelium), are more likely to have extended wear problems.²³

Patients should be discontinued from extended wear if any of the following occur:

1. failure to comply with practitioner instructions or adhere to a schedule of follow-up examinations;
2. through the first week, there is persistence during the day of excessive debris trapped under the contact lens.
3. persistent epithelial staining associated with improper corneal coverage by the contact lens;
4. repeated occurrence of adverse eye reactions such as corneal abrasions, and anterior stromal infiltrates.

It is possible these patients may be converted to daily wear soft contact lenses.²³

Positive contributors to successful patient compliance include proper counselling and careful monitoring. Proper handling, cleaning, disinfecting, storage and when and/or how to insert/remove a lens are aspects of counselling. Basic monitoring should include follow-up examinations of 1) visual acuity, 2) overrefraction, 3) slit lamp biomicroscopy, and at least every quarterly progress examination, 1)

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a postrefraction with best visual acuity, and 2) keratometry with lenses on and off.

An already stabilized daily wear patient is a good candidate for extended wear. Delivery of the lens(es) should take place morning or afternoon. At this time allow the lens to stabilize on the eye for at least an hour. If the lens centers well, and moves well (crisp movement of at least 1 mm) and provides good clear comfortable vision, the patient can sleep with them overnight and should be examined the following morning. Follow-up examinations vary, and one suggestion is:

1. the first morning after;
2. after 3 days wear;
3. one week, two weeks, one month, three months, and every six months, thereafter.

Each practitioner develops his/her own fitting philosophy. Certain guidelines help establish greater potential for success. There is no hard and fast rule as to how steep or flat to fit a lens in relation to the cornea because a multitude of factors are involved. For example, the tightness of the upper lid, the configuration of the corneal limbus, tear production, and so on. Dr. John De Carle considers an ideal Permalens^R fit, a lens centering well and exhibiting perhaps a millimeter movement but not more, on straight ahead gaze. On upward gaze, vertical downward movement should be similar. If the lens slides to the lower lid, another lens should be tried.^{8,9}

Along with providing a good tear pump, lens movement allows epithelial debris to escape. De Carle believes epithelial debris can still manage to escape even if the lens is fitted a little steeply. If the practitioner desires to stay away from fluorescein in evaluating lens fit, lens fit can easily be detected with a keratometer. As the patient blinks the keratometer mires will move slightly. They become flatter immediately after a blink and then steeper again. Through experience evaluation becomes easier. An alternative is fluorosoft^R (HMW fluorescein) and slit lamp.^{8,9}

Bausch and Lomb O₃/O₄ lenses have a 1 mm wide edge bevel, which can be used to judge movement.

Another area of concern is cleaning and disinfecting lenses. Lens deposits and tearing are common with extended wear lenses. The commonly used high water content lenses have a high affinity for mucoprotein lipid deposition. This may be related to the larger pore diameter of high water content material, to the hydration shifts these lenses are subjected to, or an inability to adequately clean these lenses.^{1,11,14,20,21}

Deposits (organic or inorganic) forming on the lens surface have been reported to occur in 5 to 33% of extended wear patients. The use of low-viscosity or hypo-osmotic artificial tears may modify the

incidence and degree of lens deposits by helping the tears flush debris. Debris on the front surface in the form of oily patches can sometimes be removed with "in-vivo" application of lens lubricant or "in-vitro" use of daily cleaner solution.²⁵

McEachern et al. believe "removal should be based upon needs and symptoms, not on time."¹⁶ Provided a quiet eye is evident and the patient symptomless, an extended wear lens can be left on for up to a maximum of 3 months.^{8,9} Lenses are usually replaced because they are lost, torn or impossible to clean.

The longer the lenses remain on the eye, the greater the chance for deposits, therefore if cleaning is done on a weekly basis enzyme tablets may prove helpful to remove protein. For advanced cases of protein build-up (beyond 2 weeks), enzyme tablets may be ineffective; LIPOFRIN, a stronger cleaner is very effective and causes minimal irritation. De Carle has had great success with Lipofrin^R and suggests 9% hydrogen peroxide as an alternative, although hydrogen peroxide has the potential to just bleach protein and not remove it.^{8,9}

Repeated removal of lenses only increases the likelihood of disturbing a quiet system and increases the risk of lens tearing, loss, or introduction of foreign matter, as well as many other adverse variables.

The choice of cleaning system depends upon practitioner experience. Thermal, or chemical, but not both can be used. One must remember heat has a tendency to increase protein deposits, and chemical systems can create adverse ocular reactions and increase inorganic (calcium) deposits.^{8,9}

Several lenses currently available for use as extended wear include:

- | | |
|--------------------------------------|-----------------------------------|
| 1. Permalens | 5. TC75 |
| 2. Hydrocurve-II ⁵⁵ | 6. Silsoft |
| 3. Hydrocurve-II ⁵⁵ TORIC | 7. CSI |
| 4. CW79 | 8. O ₃ /O ₄ |

Three of the more commonly used lenses are examined in Table 1.

TABLE 1

	% WA- TER	* DK	** DK/L	*** EOP	C.T. (mm)
Permalens	71	42×10^{-11}	depends on C.T.	depends on DK/L	0.10-0.43
H-II ⁵⁵	55	12×10^{-11}	22.7×10^{-9}	depends on DK/L	0.06-0.07
O ₃ /O ₄	38.6	8.5×10^{-11}	24×10^{-9}	10	0.036

*DK = oxygen permeability

**DK/L = oxygen transmissibility (cm/sec) x (ml O₂/ml x Hg)

***EOP = equivalent oxygen pressure^{5,23,25}

Corneal Integrity and Complications

The cornea swells when deprived of atmospheric oxygen. Polse et al. have found from studies to maintain normal corneal function a minimum oxygen tension beneath a hydrophilic lens must be 10 mm/Hg.^{1,11,14,20,21} Other studies indicate the critical level of atmospheric was 1.5 to 2.5 per cent (oxygen pressure 11.4 to 19.0 mm Hg).¹⁰

Under open-eye conditions hydrophilic lenses reduce oxygen available to the cornea and the condition is compounded under closed-eye conditions; under extended wear it is not uncommon to develop 9 to 11 per cent oedema. Hypoxia contributes 6 to 8 per cent and decreased tear toxicity the remainder. When the cornea swells 6 to 8 per cent, deep vertical striae can be detected before other clinical evidence of corneal oedema.^{2,3,12,15,18,19} Vertical striae (associated with Descemet's membrane and the endothelium) are often present in the morning, soon after eye opening, and absent in the afternoon.²⁵ The striae may persist without other associated clinical signs or symptoms. A hydrophilic lens must have an oxygen transmissibility (DK/L) of 15×10^{-9} to provide the above minimal values. Given accurate parameters calculation can be made to meet the requirements.^{2,3,12,15,18,19}

The normal oedema cycle for the cornea is 3-4% overnight, reducing to 0% one hour after awakening. Extended wear produces overnight oedema levels on the average as high as 12 per cent, and daytime oedema of 4 per cent. Ideally, a lens that produces 8% overnight oedema would allow the cornea to recover to normal limits.^{2,3,12,15,18,19}

Holden et al. found that after one week's wear, the cornea stabilized to diurnal variations in oedema.²⁴

A decrease in oxygen supply to the cornea resulting in an increase in corneal thickness can produce the "over wear syndrome". Several things to consider are:

1. severely infected eyes.
2. severe pain.
3. decreased vision.
4. increased corneal stroma thickness.
5. eyelid oedema.
6. anterior chamber inflammation.¹³

Several noteworthy disturbances to corneal integrity include:

- *1. corneal oedema.
2. pannus.
- *3. epithelial microvesicles.
4. corneal ulceration.
5. 'red-eye' (non-ulcerative keratitis).

*usually do not result in an interruption of extended wear.

1. Corneal Oedema

Despite similarities in lens design, lens characteristics and patient refractive error a wide variation in corneal response may be found. Lens thickness, DK/L, water content, and so forth, can also influence corneal response. Particular attention should be paid to the posterior cornea development of vertical striae.^{24,25}

2. Pannus

A marked loss of epithelial and anterior stromal transparency in the form of a 1 to 2 mm-wide annulus at the limbus after several weeks of extended wear may be apparent. The likely aetiology of this condition may be prolonged hypoxia of the peripheral cornea due to excessive lens thickness at the periphery of the contact lenses. Mechanical irritation of the conjunctiva and limbus by the lens may also be a cause.^{24,25}

3. Epithelial Microvesicles

Small (15 to 50 microns) irregular-shaped vesicles may occur in the corneal epithelium after four or more weeks of continuous wear. These vesicles begin near the basement layer of the epithelium, and move forward with time, eventually breaking the surface. Contact lens pressure areas on the cornea are considered the cause. These areas will stain with fluorescein.^{24,25}

4. Corneal Ulceration

Multiple small epithelial lesions of obscure aetiology may occur and coalesce into a large central ulcer. A hypopyon may develop and ring abscess form. When the cornea heals, dense scarring with marked loss of vision may be evident.^{24,25}

5. Red Eye

This reaction can occur at various stages of extended wear, with a variety of contact lens materials and designs, and a variety of patient refractive errors and age groups. The reaction occurs with loose and tight fitting lenses; however, may be more common with tight fittings due to entrapment of debris beneath the lens. The condition is usually unilateral, and symptoms are acute, the patient usually awakens during the night. Alerting symptoms include a "scratchy" sensation beneath the top lid, watering, and occasionally a sticky eye with increased sensitivity to light. With removal of the lens clinical symptoms usually disappear within the first two days. Clinical signs may persist several days longer, and include masked conjunctival and ciliary vessel engorgement and small patches of infiltrates with stromal and epithelial involvement. Fluorescein staining overlying some foci in infiltrates may be apparent. The

aetiology of this condition has been associated with bacterial contamination, viral infections, or toxic or allergic reactions to chemicals in contact lens cleaning solutions.^{24,25}

Keratometric changes, refractive error changes and a significant degree of corneal neovascularization have been associated with extended wear. Morgan reported keratometric changes from 0.5 to 2.74 diopters with long-term use of soft lenses.^{2,3,12,15,18,19} The patient who presents with significant change in manifest refraction should be examined for corneal oedema and keratometric changes. Even with no significant oedema, minus or plus changes in power can occur due to adaptation of the contact lens to the corneal surface. To avoid this problem the practitioner should order lenses of slightly less power than the manifest refraction.^{4,6}

Corneal neovascularization is more frequent (up to 7% of eyes fitted), with extended wear as compared to daily wear of both hard and soft lenses. Cessation of lens wear, changing the wearing schedule, or switching to a more hydrophilic lens usually controls the growth.^{4,6}

In summary, it is recommended that the patient be aware of certain minor symptoms which he/she may experience during the first few weeks, including dryness of the eye, hazy vision, and small amounts of secretion on the eyelids in the morning. The use of a lens lubricant or normal saline may alleviate these minor symptoms and help dislodge early morning debris.

Sometimes dislodgement or folding of the lens on the eye may occur. The patient should be reminded to report any troublesome or unusual symptoms.

A reminder that clinical signs demanding particular attention, which are usually benign and do not require cessation of the extended wear program include:

1. vertical corneal striae;
2. epithelial changes
 - punctate staining
 - microcysts
 - dimpling
3. front and back surface lens debris.

The major reasons for failure to continue extended wear appear to be motivation and lens deposits.⁵

Future considerations include disposable extended wear lenses, and ideally a lens material which resists deposits, or perhaps a lens which can be worn indefinitely. It is not impossible that research could produce disposable and/or permanent wear lenses; either concept would indicate a revolutionary approach to clinical in-office patient management.

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