Contact Lens Wear On the Job

Recommendations have changed regarding how appropriate contact lenses are in different work environments.

Contact lenses and certain environments or situations may produce adverse ocular effects, it is tempting to assume that contact lens wearers are at greater risk in a hazardous environment and ban contact lenses automatically.

Recommendations and regulations governing the use of contact lenses in the workplace are increasingly based on scientific research and clinical experience. Here, well look at some current recommendations.

Perceived Hazards

Various perceived hazards appear to have been the basis for the formulation of the regulations and guidelines banning contact lenses from the workplace.

One widely circulated example: the presumed fusing of a contact lens onto the cornea of a worker by an arc flash, even though he also wore industrial safety glasses.[1] He had no immediate complaints following the incident and did not remove his contact lenses for at least 17 to 18 hours afterwards.

The Corneal damage that this worker suffered was more characteristic of ultraviolet radiation exposure; for this to occur, the worker could not have been wearing UV-absorbing safety lenses. An infrared corneal burn produces symptoms and signs immediately.

Chemicals may be trapped behind gas permeable contact lenses, or they may be absorbed, concentrated and released by soft contact lenses onto an already compromised cornea. Contact lenses cause worse-than-normal burns from chemicals by holding the agent against the eye.

Some believe that the presence of a lens in the eye may prevent adequate irrigation following a chemical injury. The basis for this appears to be another reported case in which a process engineer was conducting an experiment in an eye-hazardous area while wearing both contact lenses and safety goggles.[1] A 50% caustic chemical splashed into his eyes and face. According to the report, the emergency bath flushed the chemical from his face and eyes, but some of the chemical pooled beneath the contact lens, causing severe burns of the eye before the contact lenses could be removed.

The possibility of such an occurrence while wearing safety goggles is highly questionable. Still, unsubstantiated cases such as this form the basis for claims that contact lenses have no place in any chemical laboratory. Perhaps the greatest concern has been that contact lenses might absorb and retain gases, vapors, fumes and smoke. But, many well-controlled studies have demonstrated that this does not occur.[3]

National Guidelines

Since 1978, the National Institute for Occupational Safety and Health (NIOSH) has recommended that workers not wear contact lenses while working with chemicals that present an eye irritation or injury hazard. This policy was recommended by the 1978 Standards Completion Program and was based on the best professional opinion of the committee membership based on literature data.[4] The policy was also consistent at that time with general industry practice, Occupational Safety and Health Administration (OSHA) regulations, and recommendations of non-clinical professional groups such as the American Chemical Society.

OSHA previously prohibited the wearing of contact lenses with any respirator, but these regulations were challenged by users of self-contained breathing apparatus (SCBA). A study of firefighters found that safety-related problems caused by spectacles were proportionately higher than those caused by contact lenses, that the contact lens-related problems were not hazardous, and that the use of contact lenses with respirators should not be prohibited. *(See New Guidelines for Eye Safety in the Workplace.)*

These OSHA regulations contradict the 1962 recommendations of Irvin Silberstein, O.D. Dr. Silberstein evaluated employees who were successfully wearing rigid contact lenses in the San Francisco Federal Naval Shipyard. He concluded that contact lens wearers can be safely employed in various industrial positions if they are adequately trained in the use of their lenses and observe normal industrial eye-safety practices.[5]

Forty years ago, contact lens specialist Louis Girard, M.D., stated that one of the most common misconceptions we hear patients express is that if a patient is injured while wearing contact lenses, the lens will contribute to the extent of the injury.[6] Surveys of O.D.s and ophthalmologists by the National Eye Research Foundation, the American National Standards Institute (ANSI) and the College and University Safety Council of Ontario have provided no evidence to support these claims. There are few documented cases in which a contact lens increased the severity of an injury but hundreds of instances in which a contact lens provided protection.

Your Role

To determine whether contact lenses are advisable in a specific environment, consider the effect of the various risk factors both on the eye and in the individual who is not wearing contact lenses. Once you determine this, you can evaluate the risk using the known physical parameters and physiological effects of the contact lens. There may or may not be laboratory studies, epidemiological data or well documented case reports to support or refute your theoretical conclusions. An extensively referenced review of contact lens use in a large range of environments is available. [3]

Some particular factors to consider: any toxic physical or chemical agent, any mechanical hazards, raw materials and byproducts, potential for exposure, protective equipment (provided/available/ worn) and other protective measures. Also, consider hygiene facilities, health personnel on staff and factors that affect compliance.

Chemical Hazards

Airborne matter. Noxious gases, vapors, fumes, aerosols and smoke can seep behind inappropriate protective devices and directly affect the eye.[7] The ocular response varies with the concentration and the physical and chemical properties of the agent. Highly toxic substances stimulate blepharospasm and lacrimation, both of which limit access to the eye and dilute the concentration of the chemical.

Insidious long-term exposure may produce a chronic conjunctivitis, possibly with a mild superficial keratitis. It is unlikely that individuals subjected to such environments would wear contact lenses comfortably or would even have had them prescribed.

Several chemicals, including those that are inert toward ocular tissues, may act as lacrimogens while producing few or no detectable changes in the cornea or conjunctiva. Other vapors may produce a delayed response that manifests several hours after a symptomless exposure; the clinical signs include loss of epithelial cells, edema and epithelial vacuoles. The ocular nasolacrimal route is insignificant relative to the respiratory route when considering systemic absorption of airborne toxins.

The corneal response to volatile substances is unlikely to be significantly affected by gas permeable contact lens wear, because these substances would be eliminated rapidly by tear flow. Water-soluble gases, fumes and substances capable of binding to or being absorbed into soft lens materials, however, would likely produce prolonged exposure, resulting in a more severe or chronic response.

Chemical splash. The accidental splashing of toxic chemicals into the eye is one of the most frequent causes of serious eye injury in the workplace and in other environments. But, more severe injury results from immersion or from spills of large volumes of liquid.

Most common organic solvents react physically only with external ocular tissues. While this may result in a loss of the corneal epithelium with accompanying severe discomfort, the stroma is unaffected other than by transient edema until re-epithelialization is complete. Concentrated acids and alkalis, with their extremes of pH, result in a rapid destructive response in the extraocular tissues and adnexa when splashed into the eye; if the eye is not immediately irrigated, severe and permanent damage will result. Acids tend to be self-limiting, while alkalis may rapidly disrupt, soften and penetrate the cornea to involve the intraocular elements, including the lens, retina and uvea.

Detergents and surfactants may produce a similar response with far fewer symptoms. Also, prolonged exposure to hypertonic solutions or some volatile solvents may produce corneal epithelial desiccation.

Laboratory studies have shown that chemicals were not trapped behind contact lenses. Rather, the blepharospasm induced by the chemical irritation acted to tighten the lens against the cornea, creating a barrier effect. Numerous case reports confirm that an eye splashed with chemicals is protected by a contact lens.[3] These findings do not suggest that contact lenses may be used as a substitute for protective eyewear, but they do emphasize that, in most chemical environments, a contact lens wearer with appropriate protection is at less risk than a non-contact lens-wearer.

Mechanical Hazards

***Foreign bodies*.** A superficial corneal foreign body is one of the most common minor ocular injuries. The symptoms of pain, foreign-body sensation and lacrimation are readily alleviated by simple removal of the offending particle. If a foreign body of suitable size, shape and velocity impinges on the eye, it may penetrate into the cornea or sclera, or actually perforate the globe.

The protection of the cornea by a contact lens would depend on the thickness and rigidity of the lens. While foreign bodies may be trapped beneath rigid lenses, this does not happen with soft lenses unless the speck is inserted with the lens. Laboratory and case studies confirm that contact lenses, especially rigid lenses, protect the cornea to some extent.[7, 8] Soft contact lenses evidently can be worn safely in environments that may appear hazardous on cursory inspection and may still contraindicate the use of gas permeable lenses.

Abrasions and laceration. These injuries are usually caused by accidents or assaults involving sharp objects such as knives, scissors, chisels, glass or flying metal. The presence of a gas permeable lens would likely provide some protection depending upon the direction of the offending impact, but a soft lens would offer little resistance to a sharp object.

Concussions and contusions. Contusions are caused by the direct impact of blows from blunt objects to external ocular tissues. Kicks, punches and impact to the eye by bats, sticks, racquets, balls and other projectiles can result in ecchymosis, subconjunctival hemorrhage, corneal abrasion, epithelial and stromal edema, hyphema, angle recession, dislocated lens, rupture of various intraocular tissues and retinal detachment. Rupture of the entire globe is rare.

Concussions occur due to shock waves transmitted through the ocular or orbital tissues to a structure distant from the point of impact (the contra-coup effect). For example, a blow to the apex of the cornea may cause a posterior subcapsular cataract and may also damage the macular region. Explosions, such as those that may occur in the mining industry or from bombs, shells or grenades, produce shock waves with velocities that may rupture the globe.

A haptic (scleral) contact lens would likely provide considerable protection from contusions and concussions, while a thin, soft lens with a high water content would offer little protection. There are numerous cases in the literature describing the protection from blunt trauma provided by contact lenses.[9]

Temperature Extremes

Hyperthermia. High environmental temperatures such as those encountered in smelting industries have both systemic and local effects that tend to be reversible. Severe disfiguring and debilitating burns result from direct contact with flashes, plasma, flames, hot bodies or liquids. The response of the cornea and conjunctiva to exposure to or direct application of heat varies with temperature and duration.

No type of contact lens would have any effect on the severity of high temperature burns. Haptic or soft lenses may offer slight protection to the critical limbal region in moderate burns.

Hypothermia. Exposure to low environmental temperatures may be experienced at extreme northern or southern latitudes, at high altitudes or in occupations associated with refrigeration. The presence of highly vascular adnexa and uvea have a warming effect that protects the cornea from freezing in most situations. Studies have shown that eyes wearing contact lenses in extreme cold suffered no acute deleterious effects, indicating that contact lenses may be acceptable and even offer protection from wind-driven ice and snow in cold environments.[10]

Radiation

Ionizing. Soft X-rays and alpha-particles have low penetrance and damage the superficial corneal and conjunctival epithelia through associated hypoesthesia, hyperemia and edema. This is similar to the eyes response to ultraviolet C (100 to 280nm) but with a longer latent period. Any contact lens would provide some protection against such irradiation and also against low energy beta-radiation. Higher energy beta-radiation may damage corneal epithelium and endothelium, resulting in corneal edema. Therapeutic Y- and X-rays used in and around the eye require appropriate protection for the lens and retina; only lead contact lenses offer this protection.

***Infrared* (IR)**. Infrared radiation occupies that band of the electromagnetic spectrum between 780nm (the upper limit of the visible spectrum) and 1mm. The ocular effects of IR irradiation occur due its absorptioneither directly heating a structure or indirectly heating it from adjacent structures or fluids.

When exposed to hazardous levels of IR, there is an aversion reflex due to the sensation of heat, which occurs whether or not contact lenses are worn. In some instances, soft contact lenses dry and become more adherent to the cornea. Instillation of a few drops of wetting solution will accelerate rehydration. This must occur before any attempt is made to remove the lenses.

Ultraviolet (UV). The need to protect ocular tissues from excessive exposure to UV using appropriate ophthalmic and industrial absorptive glass and plastic materials is generally accepted and well understood.9 Most early contact lens materials provided little protection from UV. Current UV-absorbing contact lenses that cover the limbal region give protection against UV at least equivalent to wrap-around sunglasses or goggles.

Clear UV-absorbing contact lenses do not protect against glare or the blue light retinal hazard due to high radiant transmittance of the visible spectrum (light). They do reduce the veiling glare from corneal and lens fluorescence. While not a replacement for sunglasses, UV-absorbing contact lenses supplement traditional forms of UV protection. [11]

New Guidelines for Eye Safety in the Workplace

The arbitrary banning of contact lenses in the workplace has been opposed continuously since the first regulations were initiated.[7,13-15] Professional and lay groups have issued new guidelines that remove most previous restrictions for wearing contact lenses in the industrial environment. These groups include the American Optometric Association, the American College of Occupational and Environmental Medicine, the American Academy of Ophthalmology, the American Chemical Society, and Prevent Blindness America.

The Occupational Safety and Health Act of 1970 charges the National Institute for Occupational Safety and Health (NIOSH) with recommending occupational safety and health standards and describing exposures that are safe for various periods of employment. A recent NIOSH bulletin evaluated what is known about contact lens wear while working with chemicals and provides guidelines for their use in a chemical environment.[15]

NIOSH recommends that workers be permitted to wear contact lenses when handling hazardous chemicals provided that the safety guidelines are followed and that contact lenses are not banned by regulation or contraindicated by medical or industrial hygiene recommendations. However, contact lenses are not eye protective devices, and wearing them does not reduce the requirement for eye and face protection.

NIOSH offers the following guidelines for contact lens use in a chemical environment:

1. Conduct an eye injury hazard evaluation in the workplace. This should include an assessment of chemical exposures, contact lens wear and appropriate eye and face protection for contact lens wearers. The eye injury hazard evaluation should be conducted by a qualified person, such as a certified industrial hygienist, a certified safety professional, or a toxicologist.

The chemical exposure assessment for all workers should include, at a minimum, an evaluation of the properties of the chemicals in useincluding concentration, permissible exposure limits, known eye irritant/injury properties, form of chemical (powder, liquid or vapor) and possible routes of exposure. The assessment for contact lens wearers should include a review of the available information about lens absorption and adsorption for the class of chemicals in use and an account of the injury experience for the employer or industry, if known.

2. Provide suitable eye and face protection for all workers exposed to eye injury hazards, regardless of contact lens wear. Contact lens wear does not appear to require enhanced eye and face protection.

For chemical vapor, liquid, or caustic dust hazards, the minimum protection consists of well-fitting nonvented or indirectly vented goggles or full-facepiece respirators. Close-fitting safety glasses with side protection provide limited chemical protection but do not prevent chemicals from bypassing the protection. Workers should wear face shields over other eye protection when needed for additional face protection, but they should not wear face shields instead of goggles or safety glasses regardless of contact lens wear.

3. Establish a written policy documenting general safety requirements for wearing contact lenses, including required eye and face protection and any contact lens wear restrictions by work location or task. Besides the general training required by the OSHA personal protective equipment standard, provide training in employer policies on contact lens use, chemical exposures that may affect contact lens wearers, and first aid for contact lens wearers exposed to chemicals.

4. Comply with current OSHA regulations on contact lens wear and eye and face protection.

5. Notify workers and visitors about any defined areas where contact lens wear is restricted.

6. Identify to supervisors all contact lens wearers working in chemical environments to ensure that the proper hazard assessment is completed and the proper eye protection and first aid equipment are available.

7. Train medical and first aid personnel in the removal of contact lenses and have the appropriate equipment *available.*

8. In the event of a chemical exposure, begin eye irrigation immediately and remove contact lenses as soon as practical. Do not delay irrigation while waiting for contact lens removal.

9. Instruct workers who wear contact lenses to remove the lenses at the first signs of eye redness or irritation. Contact lenses should be removed only in a clean environment after the workers have thoroughly washed their hands. Evaluate continued lens wear with the worker and the prescribing optometrist or ophthalmologist. Encourage workers to routinely inspect their contact lenses for damage and/or replace them regularly.

10. Evaluate restrictions on contact lens wear on a case-by-case basis. Take into account the visual requirements of individual workers wearing contact lenses as recommended by an eye care provider.

Note that these recommendations are for work with chemical hazards. They do not address hazards from mechanical, physical or biological agents. However, the same general principles could be applied to workers potentially exposed to these hazards.

Additional Risks

Barometric pressure. Extremes of barometric pressure occur at high altitudes and under water. Bubble formation occurs in haptic lenses at altitudes greater than 5,400m (more than 17,000 feet).

Corneal thickening response with soft lenses increases with altitude. Bubbles may also form under gas permeable and soft lenses during decompression from hyperbaric exposure. Even so, contact lenses have been safely used for various high altitude and underwater activities. One precaution: A potential microbial hazard from Pseudomonas aeruginosa has been reported in pressure chambers.

Vibration stress. This may be encountered while operating machinery, such as pneumatic drills or chain saws, or while travelling in or on modes of transportation ranging from low-capacity motorcycles to aerospace vehicles. Visual acuity is impaired at vibration between 6 and 8Hz. This effect occurs with spectacles, contact lenses and the naked eye. Soft lenses are not dislodged regardless of vibration level.

Acceleration stress. We might expect high G forces to cause a contact lens to dislodge from the cornea. However, contact lenses are not displaced by more than a few millimeters under high acceleration forces. Indeed, combat pilots have worn contact lenses when exposed to forces up to +12G. Zero gravity of space flight has little negative effect on the cornea-contact lens relationship.

Ultrasound. Ultrasonic irradiation of the cornea at 3W/cm-2 produces transient corneal haze and swelling, while higher levels of irradiation result in corneal leucomata formation and chorioretinal burns. An individual is unlikely to be subjected to these levels of ultrasound accidentally, since they are achieved by the application of a transducer either directly onto the cornea or via a coupling medium.

Clinical ophthalmic ultrasound in the frequency range of 8 to 10MHz produces an irradiance level of approximately 5mW/cm-2. The presence of a contact lens on the eye will affect the ultrasonogram in terms of the lens material impeding the acoustics, but no increased risk of corneal damage is created. Indeed, there have been no reports of corneal damage resulting from airborne ultrasound.

Humidity. The optimum range for comfort is 40% to 60%. Ambient temperature and humidity have not been found to be important factors for contact lens wearers, except for those wearing very thin high-water-content lenses. Wear of such lenses in very dry condition (i.e., low humidity) can result in slight corneal desiccation or aggravation of an existing dry eye conditions.

Wind. Wind can be expected to have two effects in the eye: drying and stimulation of tearing. So, whether an individual worker in these and similar occupations can safely and comfortably wear contact lenses can only be evaluated by trial.

Computers. The computer user who wears contact lenses has fewer surface reflections and perhaps fewer aberrations than spectacle lens wearers. These advantages are offset by several potential disadvantages. Myopic wearers require a presbyopic addition earlier. Low levels of astigmatism may contribute to video display terminal (VDT) user discomfort. Also, computer tasks requiring concentration may reduce the blink rate, which in turn reduces lens movement and increases drying effects.

Commercial office buildings. In offices in which poor air quality contributes to so-called sick building syndrome, we can anticipate that factors such as temperature, relative humidity, air movement, CO2 levels, and airborne pollutants could adversely affect contact lens wear in a variety of ways.

Military. Some occupations do not allow an individual to adhere to wearing schedules or lens care protocols. There may also be a lack of hygiene facilities and an increased level of chemical, mechanical, physical, microbial and biological hazards. This became apparent to the U.S. military during various deployments since the 1990s.[12]

Recent events and reports have revealed non-compliance with USCENTCOM FHP (United States Central Command Force Health Protection) policy. According to USCENTCOM, due to the risks associated the lack of adequate hygiene, dust and dirt, of the deployed environment, lens wearers have experienced documented eye infection, damage, and loss of combat capability. In the one 10-day period, the 86th Combat Support Hospital in Baghdad saw four soldiers with contact lens-related corneal ulcers and/or injury, and several contact lenses were removed from bloody eyes injured by IEDs (improvised explosive devices). Had service members been wearing their glasses (presumably with polycarbonate lenses) instead of contact lenses, they may have prevented eye damage due to metallic fragments from the IEDs.

Numerous reports and studies indicate that contact lenses may be worn safely under a variety of environmental situations, including those that might appear on the surface to be hazardous. Some types of contact lenses may offer added protection to spectacle lens and non-spectacle lens wearers, as in the case of chemical splash, dust, flying particles or non-ionizing radiation. Thus, a universal ban of contact lenses in the workplace or other environments is

References:

1. Novak JF, Saul RW. Contact lenses in industry. J Occup Med 1971 Apr;13(4):175-8.
2. Cullen AP, Chou BR, Egan DJ. Industrial non-ionizing radiation and contact lenses. Can J Public Health 1982 Jul-Aug;73(4):251-4.
3. Cullen AP. The environment and contact lens wear. In: Bennett ES, Weissman BA, eds. Clinical Contact Lens Practice. 2nd ed. Baltimore: Lippincott, Williams & Wilkins, 2004:881-915.
4. NIOSH. Pocket Guide to Chemical Hazards. NIOSH Publication No. 78-210, Cincinnati, 1978.
5. Silberstein IW. Contact lenses in industry. Am J Optom Arch Am Acad Optom. 1962 Mar;39:111-29.
6. Girard LJ. Indications and contraindications for the use of corneal contact lenses. In: Corneal Contact Lenses. St. Louis: C.V. Mosby Company, 1964;118.
7. Segal EB. Contact lenses and chemicals. Chemical Health & Safety 1997; 4(3): 33-7.
8. NIOSH. Contact Lens Use in a Chemical Environment. Current Intelligence Bulletin 59. NIOSH Publication No. 2005-139, Cincinnati, 2005.
9. Tang K, Shah A, McMahon TT, Weissman B. Gas-permeable contact lenses can protect against ocular trauma: two cases. Eye Contact Lens 2005 Sep;31(5):244-5.
10. Socks JF. Contact lenses in extreme cold environments: response of rabbit corneas. Am J Optom Physiol Opt. 1982 Apr;59(4):297-300.
11. Bergmanson JP, Soderberg PG. The significance of ultraviolet radiation for eye diseases. A review with comments on the efficacy of UV-blocking contact lenses. Ophthalmic Physiol Opt 1995 Mar;15(2):83-91.
12. Bancroft D, Lattimore M. Initial 67th Combat Support Hospital Optometry Services in Taszar, Hungary, during Operation Joint Endeavor. Mil Med 2001 Jan;166(1):71-4.
13. Dixon WS. Contact lenses: do they belong in the workplace? Occup Health Saf 1978 May-Jun;47(3):37-9.
14. Cullen AP, Contact Lenses in the Work Environment. In: Pitts DG, Weissman BA. Environmental Vision. Boston: Butterworth-Heinemann, 1992; 315-331.
15. Stones I, Spencer G. Contact lenses in the workplace: The pros and cons. Canadian Centre for Occupational Health and Safety, P85-1E, Hamilton, Ontario, 1985.