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Grant Humphreys

Pacific University
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Abstract
Most of the industrial corporations that have the need for workers to wear full-face respiratory devices in a radioactive or hazardous materials environment have gone along with the fail-safe policy of the National Society for the Prevention of Blindness and OSHA. That policy is that contact lenses are not to be worn in these environments in a respiratory device. Much research has been done in this area and many authors have stood on the side lines evaluating the data and drawing their conclusions, either pro or con. This article will review some past arguments and present some first hand knowledge and arguments for the use of contact lenses in a full-face respirator in a radioactively contaminated environment.

Degree Type
Thesis

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SHOULD CONTACT LENSES BE WORN IN A FULL-FACE RESPIRATOR?

by

Grant Humphreys

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
February, 1990

Advisor: Jurgen Meyer-Arendt, MD
ABSTRACT

Most of the industrial corporations that have the need for workers to wear full-face respiratory devices in a radioactive or hazardous materials environment have gone along with the fail-safe policy of the National Society for the Prevention of Blindness and OSHA. That policy is that contact lenses are not to be worn in these environments in a respiratory device. Much research has been done in this area and many authors have stood on the side lines evaluating the data and drawing their conclusions, either pro or con. This article will review some past arguments and present some first hand knowledge and arguments for the use of contact lenses in a full-face respirator in a radioactively contaminated environment.

Key words: Full-face respirator, contact lenses, radioactive environment, industrial safety
The author, Grant Humphreys, was discharged from the US Navy in 1982 where he was the work center supervisor in charge of the radiological controls associated with nuclear propulsion. He has since done contract work in radiation protection at various nuclear power stations around the continental US. He expects to graduate as a Doctor of Optometry from Pacific University in Forest Grove, Oregon in May, 1990.
INTRODUCTION/HISTORY

Since 1947, with the advent of optical plastics in the manufacture of contact lenses, their use has begun to grow. Today, well over 15 million people in the United States wear contacts and a million more are fitted annually. As the popularity of contact lenses has grown, so has concern over the safety of their use in industry. Accidents have occurred in which contact lenses are involved. The longevity of the misinformation about the role contacts have played in these accidents is remarkable. Two "Scare-stories" that are still commonly heard in industry, regardless of the mounds of articles refuting them, are that contact lenses compromise the protective function of safety equipment (eg. absorptive filters, respiratory protection) and that contacts have a concentrating effect on heat (infrared radiation). All the companies in which these alleged incidents involving contact lenses occurred have flatly denied that they happened. Also, the American Academy of Ophthalmology, the American Optometric Association, the Canadian Ophthalmology Society, the U.S. Occupational Safety and Health Administration, and the National Society to Prevent Blindness all issued statements indicating that the stories are false.

Throughout the 1970's a number of studies were done to try to ascertain the role that contact lenses have played in eye injuries to workers on the job. One survey of all the state departments of workers' compensation showed that, of the 36 states responding, only one incident was reported, but no details were provided. A study analyzing reports from contact-lens prescribers on cases of ocular trauma concluded that in cases of physical trauma, contacts actually provided protection to wearers. Another study concluded that contact-lens wearers who also wore additional eye
protection sustained a lower injury rate than other wearers of safety
glasses. Using animals as subjects, investigators
did studies to determine if chemicals posed a particular threat to
contact-lens wearers. Their results indicated that hard contacts didn't
trap chemicals, and that both hard and soft lenses may even have
prevented chemicals from damaging the cornea.

Admittedly, not all research expounds on the safety of contact lens
use. No reputable research paper can deny that some risk is inherent in
the use of contact lenses and all should stress the importance of a
precautionary attitude and a proper cleaning/handling regimen.

One such study on the uptake of chemicals by soft contact lenses
has even taken upon itself to classify the corneal response as, "Soft
Contact Lens Toxic Occlusion Phenomenon, Type I and Type II." In this
study some soft contact lenses were shown to have concentrated some
unknown chemical that caused an adverse corneal response (later shown in
at least one instance to have been Benzalkonium chloride). From the
study itself, "complete corneal recovery (ie. restoration of total
corneal transparency, re-establishment of pre-event visual acuity)
requires up to four weeks. Less than full recovery has, so far, not
been seen." 10

Other studies have shown that hard contact lenses do not trap
chemicals. Few, if any, corporations currently
disallow contact lens use while on the job except in those instances
when respiratory protection is required in a radioactively
contaminated/hazardous environment. The question remains, do soft
lenses trap and/or concentrate radioactive contamination precluding
their use in a radioactively contaminated environment, with or without
respiratory protection? An attempt was made to evaluate this
question:
METHOD: While working as a radiation protection technician, whose duties include routine entry into radioactively contaminated spaces for radiation, contamination, and airborne activity measurements, the author counted two new pairs of Sola/Barnes-Hind Hydrocurve II EW soft contact lenses on a Canberra Germanium-Lithium (GeLi) multichannel analyzer using Canberra Spectran-F V2.0/ software for 3000 seconds. Using one pair as a control and wearing the other pair on a daily wear basis with an AOSept hydrogen-peroxide disinfecting regimen and LC65 cleaner the lenses were counted again after three weeks.

RESULTS: None of the four separate counts showed any detectable activity concentration at an error quotation at 1.96 sigma and an LLD confidence level at 95.0%.

NOTE: The policy at this work station was that the wearing of contact lenses is acceptable, but they were not to be worn in conjunction with respiratory protection equipment. This policy was in no way violated.

In addition, a study by Cullen, Chou, and Egan specifically addresses the two common "scare-stories". They point out the absurdity of the first assertion, that the protective function of safety equipment is compromised by the use of contact lenses, with the common-sense notion that safety equipment is worn in front of the eyes. Therefore, the radiation reaching the ocular tissues is the radiation which has passed through both the safety equipment and the contact lens and so, at all wavelengths, less radiant energy reaches the cornea when any type of contact lens is worn.

They refute the second assertion, that contact lenses have a concentrating effect on heat, showing that the refractive index of an optical medium is an inverse function of the wavelength. This wavelength dependence is the basis for the dispersion of light by a prism. They therefore reason that for long wavelengths the refractive
index will be lower and there will be a smaller change in vergence of the radiation refracted by the contact lens. A thick positive lens may slightly concentrate the incident radiation at the posterior surface of the contact lens (i.e., the cornea) but this effect is outweighed by the increased absorption of the infrared by the greater thickness of hydrated lens material. With this exception it follows that the condenser-lens effect is a violation of a fundamental principle of optics and the residual heat absorbed by the corneal epithelium is less than if no contact lens were worn.

They conclude that many of the decisions relating to occupational safety and contact lenses are based on information which has little or no scientific basis. The result is unnecessary concern and inconvenience for the individuals directly affected.

No one questions this conclusion as it is common policy for safety organizations to establish a fail-safe policy on a new issue until research can establish a more tenable decision. An example of this is a 1978 National Institute of Occupational Safety and Health "NIOSH/OSHA Pocket Guide to Chemical Hazards", which recommends that contact lenses not be worn when working with any of their list of several hundred chemicals. NIOSH admitted they then made a policy decision to take a conservative, overly cautious approach on the contact-lens issue. They did this because they knew very little about the effect of chemicals on lens wearers and couldn't accurately pinpoint the more dangerous chemicals on their list.

CURRENT POLICY

With these, and countless other studies in mind, the NSPB in 1981 issued their current policy on contact-lens use in industry: "Contact lenses may be worn in many occupations. Contact lenses provide adequate means of visual
rehabilitation for those employees who have had a cataract removed from one or both eyes, for those who are highly nearsighted, or those who have irregular astigmatism, corneal scars, or keratoconus. However, when the work environment entails exposure to chemical fumes, vapor or splashes, intense heat, or a highly particulate atmosphere, contact-lens wearing should be restricted. Certain federal or state regulations may also limit their use." (Wearing of contact lenses in contaminated environments with a respirator shall not be allowed. Federal Register, Volume 36, Number 105, Part II #1910, 134(e)(5)(ii).) "Contact lenses of themselves do not provide eye protection in the industrial sense. For occupational use, contact lenses should be worn only in conjunction with appropriate eye protection. (To be of industrial quality, safety eyewear devices must meet or exceed all the requirements of the American National Standard Practice for Occupational and Educational Eye and Face Protection 287.1-1979, or later revision thereof, as published by the American National Standards Institute, Inc.) The employer should ensure the identification of the contact-lens wearer for appropriate emergency care and for protection in work areas hazardous to the eyes."

The justification, by national safety organizations, for establishing a fail-safe policy on an unknown issue is just plain common sense and for corporations to establish policies contrary to the national policy would be foolhardy, especially in a nation rampant with litigation. The problem is that such national policies are slow to change and industrial policy is necessarily even slower, especially in the face of often contradictory information.

DISCUSSION

Now let us discuss something that is rarely mentioned in research papers because the researchers have no first-hand knowledge of it and it therefore does not occur to them, the physical work environment. In the
case of nuclear power generating stations, the spaces are concrete
enclosed with various sized piping systems ranging from the incredibly
dangerous at high temperature, pressure, and/or radioactivity levels to
the absolutely harmless electrical conduit or water pipes; large
machinery which may or may not be in operation, have rotating parts, and
be generating enough noise to require hearing protection equipment; and
ladders, catwalks, and platforms that may be tens to hundreds of feet
off the ground level. The worker enters this environment required to
wear protective clothing which consists of, at a minimum, coveralls,
rubber boots, rubber gloves, and a hood. Often, additional protective
clothing can be required, such as plastic coveralls and additional
gloves and boots. This extra clothing, naturally restricts a person's
movements. Now, in addition to whatever tools and equipment the worker
may be required to carry, place that worker in a full-face respirator
and place additional limitations on their vision.

The current standard for refractive correction in a respirator
include two basic designs:
1. Various temple designs constructed so as to minimize leakage past
   the respirator seal around the face.
2. A frame designed with spring-action to be held in the face piece of
   the respirator.

Both designs are grossly inadequate. Any surface that breaks the
respirator seal to the face necessarily compromises the integrity of the
respiratory protection.

The frame-held design is, on the other hand, fraught with
inadequacies. Regardless of the refractive correction, as the lenses
are moved away from the bridge of the nose to the respirator facepiece
the vertex distance is increased and the effective power of the lenses
will no longer match the refractive error of the worker unless this is
taken into account by the practitioner, I can not say how often this takes place though I can report no first-hand knowledge of it ever happening. This becomes increasingly more important as the power of the lenses increases (which necessarily implies an increase in the workers dependence on an accurate correction).

So, these lenses of smaller eye size (to fit into the mask) are moved away from the face, creating tunnel vision, the central acuity is inappropriately corrected, and the worker is placed in a potentially dangerous environment in restrictive clothing. Not an ideal situation.

Truly, any refractive correction inside a respirator is going to involve some compromise but spectacle correction can, in no way, approach the visual performance that can be achieved with contact lenses. Certainly acuity with contact lenses is just as good if not better than with spectacles. With contacts, individuals don’t experience the prismatic displacement that eye movements through spectacles create therefore there is better spatial localization. Contacts would also allow the full field of peripheral vision, limited only by the respirator itself. In addition, there is no scotoma ring or double vision that is often found with spectacles.

Often, the question of dislodging a contact lens comes up. Contact lenses are not as susceptible to being dislodged as are spectacles. Agreeably, the possibility of dislodging, or decentering, a lens, especially hard lenses is true; the chances of it happening to both lenses at once is minimal. Reports on an unspecified number of police officers who wore soft lenses for a nine-month period recorded no dislodgings.

CONCLUSION

It has been said that the lack of eye injuries involving contact-lens wearers can be attributed to the number of companies prohibiting
their use. This statement necessarily assumes the question of compliance. This is a poor assumption. The workmen’s compensation files are full of claims by workers who did not comply with simple safety precaution policies. Why would we assume 100% compliance on the issue of contact lens use when the benefit of superior visual performance in a potentially hazardous environment are readily apparent to even the most casual observer. This is not to say that there is no risk involved. There is risk in everyday life. The important thing to remember is to weigh all the risks and minimize the risk where possible. If we can take it as a given that there are people currently wearing contact lenses on the job in full face respirators, routinely and safely, then a better policy would be one that acknowledges the fact and allows for the identification of these people in case of an emergency. To make policy without taking all the ramifications into account is not justified and is short-sighted to say the least.
REFERENCES


