FLIGHT SAFETY FOUNDATION
HUMAN FACTORS & AVIATION MEDICINE
Vol. 37 No. 5 *For Everyone Concerned with the Safety of Flight* September/October 1990

Contact Lenses in Aviation

Loss of visual acuity can result during critical stages of flight when crew members fail to observe proper care and use practices.

by
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Pilots with certain visual imperfections can benefit from the use of contact lenses. This is not a panacea, because the aviation environment dictates special considerations to prevent an aid to safety from becoming a hazard instead.

Given the four basic correctable vision acuity problems, myopia, hyperopia, astigmatism and presbyopia, contact lenses are not recommended for two of the four, and work very well for only one of the four: myopia, or nearsightedness. Contact lenses are commercially available for all of these conditions, but have practical shortcomings that compromise their general usefulness in aviation.

The normal eyeglasses prescribed for myopia have one very significant drawback in flight. The visual image presented to the retina through these glasses is smaller than it is in real life. The stronger the correction, the smaller it gets. The image of another aircraft that shares your airspace may be easily one-third smaller as seen through these lenses. Also, the further down your nose these glasses slide, the smaller is the object. The myopic pilot wearing his corrective lenses obviously still sees 20/20, but his 20/20 is no match for that of a normal or corrected hyperopic (far-sighted) eye.

The near-sighted person correctly believes that the image seen seems to have sharper contrast. He likes the way the world appears because everything is so distinct. But it is smaller, sometimes significantly so. This presents a unique hazard when airborne traffic projects its smallest possible image: coming at you or heading directly away from you. The proof of this will be readily seen by looking at a myopic pilot wearing his glasses. His eyes look smaller when he wears his glasses. Remove them and his “normal-sized” eye is apparent. He also sees the rest of us as smaller when he looks out at us through his glasses.

The Case for Contact Lenses

It should come as no surprise, then, that a corrective lens system that does not interfere with or alter image sizes would be a step in the right direction. Contact lenses correct the visual deficit without adverse impact on the image size, thus being a definite plus from the perspective of the safety professional. The use of glasses for myopia clearly underwrites an increased risk of late response to a potential mid-air collision. Contact lenses are the good news.

The bad news is that some people never fully accommodate to the nuisance that contact lenses can create.

Contact lenses are foreign bodies that the eye would like to reject, a limitation that may be overcome by gradually staged advances in wearing time so that the eye is fooled into accepting the presence of what it thinks is a boulder-sized rock. The initial response of tearing, pain and lid spasm will go away if your are cautious in building acceptance. The amount of time required varies both with the person and with the kind of contact lenses used. Some people will never be able to wear them all day. Others adjust rapidly and fully. You discover how adaptive you are by trying them. In two weeks, you will know if you can be a contact lens wearer.

Contact lenses require a shallow bed of tears on which to ride. Without this tiny protective layer, the contact lens will abrade the cornea of the eyeball. This event is succinctly described as "memorable" by those who have found out the hard way why contact lenses should be removed at bedtime. Pilots, following an evening of partying, have been known to "forget" to remove them, and have endured three to seven days of pain while the membrane attempts to repair itself. None of my patients has suffered any long-term residual effects from such an oversight, but permanent damage to the cornea is a real possibility. Even in the course of normal usage, contact lenses will signal their presence by sufficiently altering the surface of the cornea that it will retain flourescine stain, a feature that allows a physician to identify who the recalcitrant contact lens wearers are.

The shallow bed of tears that supports the contact lens allows a physiological response by the cornea that is unintended. The cornea literally absorbs the tears, and it swells as a result. While the contact is in place, this presents no problem. However, when the limits of wear endurance are reached, the pilot must remove his contacts and resume wearing his regular glasses, now with a swollen cornea; this transitory anatomic distortion will interfere with his visual acuity.

A Word of Caution

For a period that is frequently measured in hours, while waiting for the corneal edema to subside, eyeglasses fail to give the 20/20 that they did in the examiner's office. It could result in a blurry 20/50, or worse. This means that a pilot who has not built tolerance for a full day of contact lens wearing (which includes unexpected delays and changes in plans), has no business wearing them in the cockpit at all. The expectation that regular glasses will restore visual acuity when the time comes to take the contacts out is both unrealistic and dangerous. What the pilot will really need is a competent co-pilot who can take over flight duties for him.

The biggest inconvenience about contact lenses is the struggle to keep them clean. Deposition of mucus manufactured by the conjunctiva on behalf of its besieged neighbor, the cornea, will accumulate on the surfaces of the contact lens rendering it opaque unless some conscientious intervention is undertaken. Cleaning solutions are made by numerous manufacturers, and the fact that there are so many brands attests to the potential imperfect performance of any one of these products. Running out of cleaning solution, whether because of poor planning or because you suddenly found yourself allergic to the one in your shaving kit is not an uncommon experience. I once had the opportunity to examine a flier who was "inattentive" to the need for the basic contact lens housekeeping demands. When I realized that the view through my ophthalmoscope could not penetrate through the mucus blanket built up on the contact lenses, I facetiously asked "If I can't see in, how can you see out?" Sheepishly, the real problem of soaking and scrubbing was admitted.

A Question of Alignment

Contact lenses are supposed to be positioned squarely over the pupil of the eye. Slippage of the device can distort vision, especially when the lens has migrated into the corner of the eye, well away from the pupil. The wearer will discover that the accumulated tolerance for this intrusive foreign body is limited only to its normal position. Dislodgement will produce the familiar symptoms of a rock in the eye. The larger the diameter of the lens, the less likely is slippage, even pulling Gs during acrobatics. Some branches of the military service allow pilots to wear these large contact lenses without regard for the intended flight profile since they will predictably hold their position.

Only gas permeable lenses are approved for use by the U.S. armed forces. These "soft" contact lenses allow the osmotic passage of oxygen through the product to the cornea. Even at the diminished oxygen tensions found at altitude, there is sufficient oxygenation beneath the contact lens to preclude local hypoxic tissue damage. This attribute is not true of the "hard" lens variety and is therefore not recommended for use in the pilot's work place.

Contact lens wearers do not enjoy low ambient humidity. They complain that it feels as though it is their tears that are supplying what little moisture is found in a pressurized cabin. Non-contact wearers are equally affected, but have fewer such symptoms. The criticality of available moisture for comfort becomes readily apparent as you watch passengers change from contact lenses to glasses.

Small amounts of associated astigmatism may be corrected by contact lenses at the same time as the myopia, but the greater the astigmatism correction, the greater the precision needed in positioning the lens — a lens that normally wants to change its position with each blink. Presbyopia, the requirement for reading glasses or bifocals, similarly demands precise positioning so that the special correction for reading is always correctly lined up with the lower pole of the lens (just as in eyeglasses). This is frequently easier said than done.

Although this author endorses the use of contact lenses by myopic pilots, there can be no such approval for their use in the industrial environment that is aviation maintenance. Chemical splashes that find their way behind a contact lens may have unexpected adverse consequences, especially if the wearer was rendered unconscious during the incident that occurred. Who in that shop knows that contact lenses were in place and must be expeditiously removed? How do you get them out, quickly and harmlessly, and then what?

The bottom line, however, is that contact lenses are an excellent solution to the problem of myopia in aviation.♦

Because We Always Did It That Way

Why do we persist in using altitude chambers when the risks are well-known?

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Traditional wisdom has it that actual hypoxia experiences in an altitude chamber provide necessary and realistic training for pilots. Students are told that this event will acquaint or reacquaint an aviator with his personal set of symptoms so that if they occur in flight, he can recognize the problem and take appropriate action. Civil and commercial pilots are encouraged to periodically update this training. Military pilots have a requirement for recurrent training every three to five years.

Problem: Hypoxia symptoms learned while playing patty-cake (or some other equally ignominious and childish task) in an altitude chamber with another adult need not be a memorable learning experience.

Problem: In-flight hypoxia symptoms occurring in the midst of all manner of airborne operations may not mimic the symptoms learned in the nicely controlled training chamber environment. Pilots who believe that they know all they need to know have been misled by the system that was supposed to protect them.

Problem: Sets of symptoms change as a pilot ages. The symptoms that he learned at his last exposure may not be the same set of symptoms that he experiences today.

Problem: Some hypoxia teaching techniques abort the sequence as soon as the first recognizable symptom is noted. The trainee should know his entire symptom spectrum.

The real problem, however, is evolved gas. Unpressurized flight above 18,000 feet invites a well-known and extensively documented risk of decompression sickness (DCS). Pre-breathing 100 percent oxygen for 30 minutes before the altitude exposure is touted as a means to lessen this risk, but as the U.S. National Aeronautics and Space Administration (NASA) proved in training shuttle astronauts who could find themselves at great risk during extra-vehicular activity in orbit, there is no guarantee against DCS unless this oxygen prebreathing session is 24 hours in duration. That is how long it takes to bleed off the dissolved nitrogen in body tissues that would otherwise come out of solution in the form of intravascular bubbles. These bubbles obstruct blood flow. For certain body tissues, such hydrostatic interruption of metabolic processes may cause severe functional compromise. Your big toe may not care, but your brain will.

For 30 years or more, the statistical risk for the occurrence of one of the five clinical presentations of DCS has been a constant — approximately one per thousand unpressurized flight exposures, usually at a chamber altitude of 25,000 feet. Certainly, the fact that the military services strive to have a hyperbaric recompression facility on the same site as the altitude chamber (ready on a moment's notice to treat the aviator who falls victim to the statistical risk) must tell the observer that this is a potentially deadly business. Fifteen percent of these DCS cases risk death or disability where timely treatment is unavailable. The other 85 percent just suffer pain.

One branch of the military trains nearly 20,000 pilots and student pilots annually in its altitude chambers. Simple math allows the reader to estimate (correctly) how many cases of DCS should have occurred each year — nearly 20. The statistics are a matter of public record and are remarkably consistent over the years.

This being the case, why does hypoxia training, that invites the risk of injury to trainees, continue? Can a pilot be made hypoxic at ground level without exposure to unpressurized flight? The answer is an unequivocal *yes*. All that is required is a mix of carbon dioxide, or nitrogen, and oxygen breathed through a mask in a classroom setting where the relative concentrations of the two gases can be varied. This can be done at ground level without risk of injury. ♦

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About the Author

Frank E. Dully Jr., M.D. is an associate professor of aviation safety at the University of Southern California's Institute Of Safety and Systems Management.

Retiring with the rank of captain from the U. S. Navy after nearly 25 years of service as a flight surgeon, he identified personality profiles and life style markers of high-risk aviators. His experiences afloat include tours of duty aboard destroyers and aircraft carriers. Dully has been the director of training and commanding officer of the Naval Aerospace Medical Institute and has been both on teaching faculty and a practicing physician at the Naval Postgraduate School's aviation safety program.

Dully has an undergraduate degree from Holy Cross, an M.D. from Georgetown University and a master's from the University of California. He is a board-certified aerospace medicine specialist and a Fellow in The American College of Physicians. He is also a three-time past president of the Society of U.S. Navy Flight Surgeons.

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