The effects of blue light on the retina and the use of protective filtering glasses

Council on Dental Materials, Instruments, and Equipment

Dentist office personnel should use protective filtering devices, either eyeglasses or eye shields, while curing visible light-activated resins. Ophthalmic research into the appearance of blue light lesions has not ruled out the possibility that short wavelength light (light with wavelengths of less than 500 nm) may contribute to the premature aging of the retina and to senile macular degeneration (the decreasing ability of the macular region of the retina to provide visual acuity). Near ultraviolet and blue lights also may cause the formation of cataract. Macular degeneration is a major cause of visual loss in older people in the United States. Also, reports indicate that light-induced retinal damage can be hastened by increased exposure to visible light with wavelengths of less than 500 nm. This effect is photochemical rather than thermal or structural. The macular degeneration is among the most active research areas in ophthalmology. Most of the data on light-induced retinal damage have been derived from studies of animals and have not been confirmed in studies of humans. Although no direct cause-and-effect relationship has been documented for dental visible light-curing unit use, the council recommends the use of appropriate, protective, filtering eyeglasses.

The ocular media (composed of the cornea, aqueous media, crystalline lens, and vitreous humor) passes light between 400 and 1,400 nm to the retina (the range of the visual spectrum is approximately 400 to 700 nm). As the lens ages, it acts as a natural absorber of wavelengths of between 320 and 400 nm. In addition, the lens provides partial protection to the retina from blue light. This protection increases with age, as the lens becomes more yellow. When the lens is removed after cataract surgery, this natural filter is removed, causing exposure of ultraviolet and near blue lights to the retina. The fovea, or the macular region of the retina, provides the eye with the most sensitive visual acuity. It is composed almost entirely of the color-sensitive cone cells of the retina. It is this vital zone that may be subjected to premature aging by increased exposure to ultraviolet and blue lights. For example, when the transmission region of the eye-glasses at levels of less than 500 nm would depend on a specific curing unit and the specific set of protective eyeglasses. It is possible that combinations may exist that result in little or no irradiance at levels of less than 500 nm reaching the eyes of the user; for example, when the transmission region of the eye-glasses at levels of less than 500 nm corresponds to the no emission intensity in that region from the curing units. Furthermore, even if some irradiance of less than 500 nm is transmitted through the eyeglasses, the irradiance might have been reduced to a safe level by the eye.

The following products have been removed from the list of classified dental materials, instruments, and equipment.

Crown and bridge and temporary crown and bridge resins

Acceptable

SR-Isoosit-PE, Degussa

Nitrous-oxide/oxygen scavenging equipment

Acceptable

Brown Mask, Summit Services
Brown Scavenger, MDT Corp

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ASSOCIATION REPORTS

Dental chairs

Acceptable

Elegan, JSA, JSR, SPD-5, VSA & VSR, Syntex Dental Products

Dental porcelain and ceramics

Provisionally Acceptable

Dicor, Dentsply International

Dental X-ray equipment

Acceptable

Healthco Lumix III, Healthco Co

Endosseous implants

Provisionally Acceptable

Biotics, Bofors Nobelpharma

Nitrous oxide/oxygen scavenging equipment

Acceptable

Porter/Brown Clean-Air Scavenging Equipment, Porter Instrument Co

Powered oral hygiene devices

Provisionally Acceptable

Interplak, Dental Research Corp

Recognition program for products not currently covered by a formal acceptance program or certification program

Additions

Carislex 100, National Patent Dental Products, Inc
Centrays, Coopercare, Inc
Cenwiss, Coopercare, Inc
Ideal Sutures, Interstate Drug Exchange, Inc
Lactona Toothbrushes & Stimulator, Lactona Corp
Super-Dent Sutures, Rugby Laboratories

The council's laboratory recently measured the transmission characteristics of 20 commercially available protective eyeglasses. The transmission curves are shown in Figures 1 and 2. As noted in the illustrations, considerable differences exist among the glasses and, thus, the protection that they offer. Users of visible light-curing units should be aware that protective eyeglasses should be selected carefully for adequate protection of the eyes. As emission spectra of various curing units differ (Fig 3), the possible protection offered by eyeglasses that transmit some irradiances at levels of less than 500 nm would depend on a specific curing unit and the specific set of protective eyeglasses. It is possible that combinations may exist that result in little or no irradiance at levels of less than 500 nm reaching the eyes of the user; for example, when the transmission region of the eyeglasses at levels of less than 500 nm corresponds to the no emission intensity in that region from the curing units. Furthermore, even if some irradiance of less than 500 nm is transmitted through the eyeglasses, the irradiance might have been reduced to a safe level by the eye.
The transmission characteristics reported are for plano lenses without prescription modifications. These characteristics may be affected by variations in thicknesses of the lenses and may depend on whether the filtering effect is in surface coatings or inherently in the materials of the lens bodies. In addition, the possibility of changes in transmission characteristics with time or after exposure to light has not been evaluated.

Summary

The council recommends the use of appropriate, protective, filtering eyeglasses. The eyeglasses should transmit less than 1% below 500 nm if the glasses are not matched with the curing unit. Appropriate eyeglasses may be matched with the curing unit used.

9. Ellingson, O.; Landry, R.; and Bostrom, R. An
more than 150 dental research scientists met in San Antonio, TX, Nov 17-21, 1985, to determine whether scientific consensus exists on methods used to assess the cariogenic potential of foods.

Recognizing that although much progress has been made in the reduction of dental caries in children, ADA President Abraham Kobren, DDS, MS, highlighted the significant caries problem that still exists in adolescent adults. He challenged the conference attendees to a better understanding of the relationship that exists between food and dental caries to continue the progress toward eliminating dental decay as a national health problem.

Dominick DePaola, DDS, PhD, chairman of the program committee, viewed the conference objectives as being twofold: to determine whether scientific consensus exists on methods used to assess the cariogenic potential of foods, and, in areas where consensus does not exist, to identify the research areas that need to be stressed to advance the field.

The first part of the meeting was an open program with authors invited to present their papers on the four methods used in targeting the conference: human plaque acidity models; animal caries models; de- and remineralization models; and an integration model—that is, the use of some combination of the preceding three methods. These resource papers and the subsequent open discussion provided the framework for four working groups to meet in closed sessions to prepare position papers for plenary open discussions to be held on the last day of the conference.

In an introductory paper on the complexities of dental caries, Brian A. Bart, BDS, MPH, PhD, and Amid I. Ismail, BDS, MPH, reviewed the diet, nutrition, and food cariogenicity relationships. They concluded, “The more we look at the whole question of food cariogenicity, the more it shapes itself in terms of total dietary pattern rather than individual foods, and the dietary pattern is just part of the multifactorial etiology of caries.”

After the introductory remarks, several reference papers were presented on the various testing models. The human plaque acidity model for evaluation of foods is based on the production of acid by plaque bacteria when it comes into contact with a fermentable substance. Acid production, as estimated by a fall in pH, is monitored by one of three methods: plaque sampling, touch electrodes, or interproximal telemetry. In Switzerland, any food not resulting in a plaque “critical” pH level of 5.7 or lower is considered safe for teeth. Experimentation to date has shown that no product judged dentally safe for teeth by that criterion has been found to promote dental decay.

In the animal caries model, a test food is offered to animals, usually rats, for a period. Then, a caries score is determined for comparison with scores from reference test foods of known cariogenicity. The use of the de- and remineralization models involves the placement of slabs of enamel into a food-saliva mixture to determine whether destruction of the enamel surface will occur. Although the methods in the first two processes (plaque pH and animal testing) were agreed to by the working groups, the exact nature of the de- and remineralization tests requires further definition and research.

Need for indirect methods

The integration of methods working group considered that although the true cariogenicity of a food can be established only by experimentally determining in humans the extent to which tooth decay is associated with a given food, such experiments are unfeasible and, therefore, indirect methods are needed.

The plaque pH and animal caries methods were reviewed as valid approaches to estimate the cariogenic potential of food. Foods could be judged as having no cariogenic potential if when tested twice by the plaque pH method, they provided decreases in pH statistically equivalent to or less than those generated by sorbitol.

When a food was found to produce some decrease in pH, however, it could be evaluated further in the animal caries model. When testing showed low caries activity as compared with a range of reference foods, the food could be considered to have low cariogenic potential.

Not all foods are adaptable to the preceding methods. For example, rats cannot be taught to chew gum. In such instances, the development of other methods must be awaited. The working groups recommended areas in which future research should be done:

—The de- and remineralization models in time could emerge as valid and simple tests but further refinement and testing in both in vivo and in vitro systems are necessary.

—Research should be continued to refine the plaque pH measurement methods so that they can be used more effectively to assess foods of low cariogenic potential.

—Better methods should be developed to test foods that are difficult to assess for cariogenic potential using existing methods.

—To assist research and development on non- and low-cariogenic foods, greater emphasis should be placed on finding simple yet reliable methods for screening foods with respect to cariogenic characteristics.

The proceedings of the conference will be published in the Journal of Dental Research. Financial support for the conference was provided by food ingredient suppliers including Roquette, Imperial Chemical Industries, Monsanto, Stauffer, Xyrofin, Purina, and the Nutrasweet Group of G. D. Searle. Sponsoring food manufacturers included Nabisco, Continental Baking, Gerber, Procter & Gamble, Kraft, Warner Lambert, Hershey, and Mead Johnson. Also providing support were International Life Sciences Institute, Block Drug, the Chocolate Manufacturers Association, Sugar Association, and National Confectioners Association, and the National Institute of Dental Research.

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